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REGIONAL ENVIRONMENTAL AND SOCIAL ASSESSMENT FOR NATIONAL SPECIAL ECONOMIC ZONE

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ACRONYMS AND ABBREVIATIONS

AAQ	Ambient Air Quality
AIDS	Acquired Immunodeficiency Syndrome
ANL	Ambient Noise Level
ATMs	Automated teller machines
BADC	Bangladesh Agricultural Development Corporation
BARC	Bangladesh Agricultural Research Council
BBS	Bangladesh Bureau of Statistics
BDHS	Bangladesh Demographic and Health Survey
BDT	Bangladesh Taka
BEPZA	Bangladesh Export Processing Zone Authority
BEZA	Bangladesh Economic Zones Authority
BFD	Bangladesh Forest Department
BITAC	Bangladesh Industrial Technical Assistance Center
BIWTA	Bangladesh Inland Water Transport Authority
BMD	Bangladesh Meteorological Department
BNBC	Bangladesh National Building Code
BOD	Biochemical Oxygen Demand
BPDB	Bangladesh Power Development Board
BR	Bangladesh Railway
BREB	Bangladesh Rural Electrification Board
BRTA	Bangladesh Road Transport Authority
NSEZ	National Special Economic Zone
BSRM	Bangladesh Steel Re-Rolling Mills Ltd.
BTCL	Bangladesh Telecommunications Company Limited
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
CBO	Community Based Organization
CDM	Clean Development Mechanism
CEMS	Continuous Emission Monitoring System
CETP	Common Effluent Treatment Plant

CGS	City Gate Station
CHTs	Chittagong Hill Tracts
CIA	Cumulative Impact Assessment
CNG	Compressed Natural Gas
CoC	Code of Conduct
COD	Chemical Oxygen Demand
CPP	Cyclone Preparedness Programme
CPR	Community Property Resource
CR	Critically Endangered
CRVA	Climate Risk and Vulnerability Assessment
CSL	Clear Standing Length
CSO	Civil Society Organization
CTC	Centralized Traffic Control
CUFL	Chittagong Urea Fertilizer Limited
dB(A)	Decibels
DC	Deputy Commissioner
DEM	Digital Elevation Model
DFO	Divisional Forest Officer
DG	Director General
DIFE	Department of Inspection for Factories and Establishments
DO	Dissolved Oxygen
DOE	Department of Environment
DPHE	Department of Public Health Engineering
DRMP	Disaster Risk Management Plan
DRSs	District Regulator Stations
DYD	Department of Youth Development
EC4J	Export Competitiveness for Jobs
ECA	Ecologically Critical Areas
ECC	Environmental Clearance Certificate
ECR	Environmental Conservation Rules
EHS	Environment, Health, and Safety
EHSG	Environment, Health, and Safety Guidelines
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EN	Endangered

EPA	Environmental Protection Agency
EPZ	Export Processing Zone
ES	Environmental and Social
ESA	Environmental and Social Assessment
ESF	Environmental and Social Framework
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMP	Environment and Social Management Plan
ESMS	Environmental and Social Management System
ESS	Environmental and Social Standards
EZ	Economic Zone
FAO	Food and Agriculture Organization
FFWC	Flood Forecasting and Warning Center
FGDs	Focus Group Discussions
FP	Family Planning
GBV	Gender Based Violence
GHG	Greenhouse Gases
GIIP	Good International Industry Practice
GIS	Geographic Information System
GM	Grievance Mechanism
GOB	Government of Bangladesh
GPS	Global Positioning System
GRA	General Relief Activities
GSB	Geological Survey of Bangladesh
GTCL	Gas Transmission Company Limited
GWQ	Groundwater Quality
HCR	Headcount Rate
HH	Household
HIES	Household Income and Expenditure Survey
HIV	Human Immunodeficiency Virus
HQ	Headquarter
HR	Human Resource
IBA	Important Bird and Biodiversity Area
IEE	Initial Environmental Examination
IFC	International Finance Corporation

ILO	International Labor Organization
IMDMC	Inter-Ministerial Disaster Management Committee
IOR	Indian Ocean Region
IP	Internet Protocol
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
IWM	Institute of Water Modelling
KAFCO	Karnaphuli Fertilizer Company Limited
KGDCL	Karnaphuli Gas Distribution Company Limited
KII	Key Informant Interviews
kV	Kilovolt
LC	Least Concern
LILO	Line In Line Out
LMP	Labor Management Procedure
LPG	Liquefied Petroleum Gas
LRP	Livelihood Restoration Plan
MCA	Multiple Correspondence Analysis
MCH	Maternal and Child Health
MEZ	Mirsharai Economic Zone
Mg	Magnesium
MLD	Millions of Liters Per Day
MMCFD	Million Cubic Feet Per Day
MMSCFD	Million Standard Cubic Feet per Day
MOEFCC	Ministry of Environment, Forest, and Climate Change
MOFL	Ministry of Fisheries and Livestock
MOL	Ministry of Land
MOLE	Ministry of Labor and Employment
MOU	Memorandum of Understanding
MOWR	Ministry of Water Resources
MPAs	Marine Protected Areas
MSL	Mean Sea Level
MSW	Municipal Solid Waste
MUDP	Mirsharai Upazila Development Plan
MVA	Mega-volt-amperes
MW	Megawatt

NAAQ	National Ambient Air Quality
NDMC	National Disaster Management Council
NGOs	Non-Governmental Organizations
NICDC	National Industrial Corridor Development Corporation
NNW	North-North-West
NOC	No Objection Certificate
NT	Near Threatened
NTU	Nephelometric Turbidity Unit
NWMP	National Water Management Plan
O&M	Operations and Maintenance
ODS	Ozone Depleting Substances
OFC	Optical Fiber Cables
OHS	Occupational Health and Safety
OPGW	Optical Ground Wire
OSS	One Stop Service
PD	Power Division
PGCB	Power Grid Company of Bangladesh
PM	Particulate Matter
PPEs	Personal Protection Equipment
PPP	Public Private Partnership
PRIDE	Private Investment and Digital Entrepreneurship Project
PTWC	Pacific Tsunami Warning Center
PTZ	Pan Tilt Zoom
PWD	Public Works Department
RAP	Resettlement Action Plan
RD	Rural Dispensary
RESA	Regional Environmental and Social Assessment
RF	Reserved Forest
ROW	Right of Way
RPF	Resettlement Policy Framework
SEA	Strategic Environmental Assessment
SEA	Sexual Exploitation and Abuse
SEP	Stakeholder Engagement Plan
SPS	Sikalbaha Power Station
SQ	Soil Quality

SRDI	Soil Resources Development Institute
SRTM	Shuttle Radar Topography Mission
SSE	South-South-East
SSPs	Share Socio-economic Pathways
STDs	Sexually transmitted diseases
STP	Sewage Treatment Plant
SWM	Solid Waste Management
SWQ	Surface Water Quality
TBS	Town Board Station
TDS	Total Dissolved Solids
TIN	Taxpayer Identification Numbers
TMP	Traffic Management Plan
TOR	Terms of Reference
TSS	Total Suspended Solids
TUP	Targeting Ultra Poor
UDD	Urban Development Directorate
UEO	Upazila Education Office
UH&FWC	Union Health & Family Welfare Centre
UHC	Upazila Health Complex
UNDP	United Nations Development Programme
UNO	Upazila Nirbahi Officer
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VAW	Violence Against Women
VES	Visual Encounter Survey
VESC	Valued Environmental and Social Components
VGD	Vulnerable Group Development
VGF	Vulnerable Group Feeding
VU	Vulnerable
WARPO	Water Resources Planning Organization
WB	World Bank
WBG	World Bank Group
WHO	World Health Organization
WTP	Water Treatment Plant
ZDP	Zero Discharge Plan

Final Report

Regional Environmental and Social Assessment for National Special Economic Zone

EXECUTIVE SUMMARY

1 INTRODUCTION

The Bangladesh Government's long-term development plans under "Vision 2031" and "Vision 2041" are to grow the country into a middle-income country by 2031, as well as a developed and prosperous country by 2041, respectively. To achieve the goal of the plan needs to create jobs and employment opportunities through a competitive business environment, increased human capital and skilled labor force, efficient infrastructure, and a policy environment that attracts private investments. In this regard, the Government of Bangladesh (GOB) has launched an initiative to provide industrial land and infrastructure to increase private investments with the support of the Bangladesh Economic Zones Authority (BEZA). National Special Economic Zone (NSEZ) is one of the major development projects of the GOB planned in Feni and Chattogram Districts.

The main objective of the RESA is to examine the associated environmental and social risks and impacts due to the development and operation of the NSEZ in the region. It will pay particular attention to potential cumulative risks and impacts of multiple activities in a region, but may not include the site-specific analysis of a specific project.

This RESA was carried out in line with the relevant national legislation, policy, and guidelines as well as World Bank Environmental and Social Standards (ESS1-10) under Environmental and Social Framework 2018, relevant WBG EHS guidelines, & other Good International Industry Practices (GIIP).

2 DESCRIPTION OF THE NSEZ AND ITS AREA OF INFLUENCE

The NSEZ has been proposed to be located in Mirsharai Upazila (Saherkhali and Ichakhali Union) and Sitakunda Upazila (Muradpur and Saidpur Union) in Chattogram and Sonagazi Upazila (Sonagazi and Char Chandia Union) in Feni district.

NSEZ has a total land area of 33,805 acres (mostly reclaimed land) with a 25 km coastline along the Sandwip Channel in the Bay of Bengal. The NSEZ site has been divided into 12 separate precincts, which have their own land uses. All the land within NSEZ has not yet been acquired, and some lands have been allocated to investors, it is more complicated to accurately phase the site according to best practices. The Master Plan of the NSEZ has divided the total area into three phases. The execution period is divided into three phases, i.e., a) Phase-I: years 0-5, b) Phase-II: years 6-10, and c) Phase-III: years 11-20. Various types of infrastructure/utilities will be developed following international standards within NSEZ to provide world-class networks, structures, and services, which will make NSEZ a competitive, sustainable, and resilient zone (Table-1).

Table E-1: Key Types of Infrastructure Services and Assets Planned for NSEZ

Key Infrastructure, Services, and Functions	Types of Infrastructure/Utility Assets
Flood Protection and Management	Coastal embankments, river dykes, canals, sluice gates, pumps, stormwater drainage, etc.
Water Storage/Recreation	NSEZ Sarobar (Lake)
Transport	Roads, Bridges, Jetties, inland container depot, Rail, Light Rapid Transit, etc.
Buildings	Industrial sheds,, Administration Buildings, Residential/Commercial/Retail/Educational/Medical/Hotels/Club and Community Services Buildings, Fire Services, etc.
Telecommunication	Towers, Cables, Fiber Optics, Backbone, Switches, etc.

Key Infrastructure, Services, and Functions	Types of Infrastructure/Utility Assets
Water Supply and Sanitation	Water Supply System (Potable/Grey), Sewage Treatment Plants (STP), Water Treatment Plants (WTP), Water Reservoirs, Deep Tubewells (DTW), Desalination Plants, etc.
Energy	Power Plants, Sub-Stations, Power Supply Network, provision of use of Solar Energy (including Floating Solar), Renewable, Gas Supply Network, District Regulating Station (DRS), City Gas Station (CGS), etc.
Waste Water Management	Sewage Treatment Plants (STPs) and Common Effluent Treatment Plants (CETPs),
Solid Waste Management	Municipal and Industrial Solid Waste (ISW), Biomedical Waste, and Bio-Gas Plant Facilities

Source: BEZA

3 ES BASELINE OF THE REGION

The study area of the RESA for the NSEZ has been selected based on the location of the EZ and related facilities, their footprint, nature, and spatial distribution of potential environmental and social risks and impacts. The study area includes the project footprint area and area of influence (AOI). The AOI is comprised of areas of direct and indirect impacts as follows:

- **Direct area of influence:** considers the physical footprint (inside of the master plan boundary having an area of 33,805 acres) of the development activities, such as the site layout, work staging areas, and areas affected during development and operation works (e.g., traffic patterns).
- **Indirect area of influence:** includes an area (10 - 15 km radius of the master plan boundary/ 547,091 acres considering the project footprint) that may experience project-related changes, combining with activities, not under the direct control of the development activities (e.g., labor influx, induced development, access to employment, etc.).

Physical Environment

According to the climatic sub-regions of Bangladesh, the study area is located in the South-East Region. The hill over 300m in height have north-eastern zone climate. The rest of the area has a small range of temperatures, and rarely goes over a mean of 32.0°C and below a mean of 13.0°C. Rainfall is heavy, usually over 2,540 mm. In winter, dewfall is heavy. The region is generally flat and low-lying towards the Sandwip Channel. From the spatial analysis, the topographic elevation ranges between - 11.07mMSL to 23.7mMSL. In the study area, the major share of the land is under the water bodies, which is about 188,929.07 acres, covering 37.21% of the total land cover. Agricultural land consists of 140,105.62 acres and accounts for only 27.59% of the total area. The mudflat and settlement with homestead vegetation area cover 15.04% and 13.89%.

Feni and Little Feni are the two major rivers that flow down to the Bay of Bengal on the northwest of the proposed NSEZ area. The major Khals which flow through the NSEZ site are Ichakhali, Bamon Sundar, Saherkhali, and Domkhali Khal. Others are Daborkhali, Khutakhali, Hoania, and Donakhali Khals. Most of the Khals receive water from hills to the east of the Dhaka-Chattogram Highway. Hydrogeological investigation shows that the topsoil in the study area is composed mainly of silty clay. The depth of the deep aquifer varies between ~50m to ~150m and is increasing towards the southeast. Traffic survey on the Borotakia to NSEZ and NSEZ to Borotakia road indicates a high volume of daily vehicular movement, with a total of 3,997 PCUs traveling from Borotakia to NSEZ and 3,848 PCUs in the reverse direction. It was observed that Baby Taxi/CNG/Auto are predominant on the road.

Ambient Air Quality: primary ambient air quality was monitored at ten different locations covering the whole study area. PM_{2.5} and PM₁₀ are observed to vary from 10.84 - 46.38 µg/m³ and 19.49 - 79.51

$\mu\text{g}/\text{m}^3$, respectively, which comply with the Bangladesh air quality standard set by DOE. SO_2 , NO_2 , CO , and O_3 also comply with the Bangladesh air quality standard set by DOE.

Ambient Noise Level: primary ambient noise monitoring has been conducted at ten different locations covering the whole study area. Daytime and nighttime noise levels were found to vary from 48.0 - 69.6 dB(A) and 39.4 - 58.4 dB(A), respectively. All the observed values except ANL-2 and ANL-3 were within the national as well as IFC standards set for the respective zones during the day and nighttime.

Surface Water Quality: ten surface water samples were collected from the Feni River and Sandwip Channel (marine water), and five from different khals, including Ichakhali, Daborkhali, Bamansundar, Hoania, Saherkhali, and Domkhali. The analysis results indicate that all the parameters were within the permissible limit of the ECR, 2023 standard, except the Chemical Oxygen Demand and Phosphate.

Groundwater Quality: five groundwater samples were collected and analyzed, and the analysis results indicate that all the parameters were within the permissible limit of the ECR, 2023 standard, and the WHO Guidelines value, except the Boron, Iron, Magnesium, Sodium, and Total Dissolved Solids.

Biological Environment

A comprehensive inventory of plant species was conducted within the study area, resulting in the identification of a total of 56 distinct species. It was revealed that 43 of them belonged to the category of homestead species, 10 species were classified as fallow land species, and 3 species of mangroves.

A total of 18 species of mammals, 185 bird species, 28 species of reptiles, and 9 species of amphibians were found within the study area. In addition, a total of 30 species of coastal fisheries and 16 species of culture fish and crustacean species were recorded in the study area. A detailed list of all flora and fauna species has been provided in Appendix B (Volume III).

As part of RESA, a comprehensive Critical Habitat Assessment (CHA) was conducted following the ESS6 of the WB ESF and its Guidance Note (2018). From the assessment, it was revealed that the proposed NSEZ site and study area are not a Critical Habitat for any of the identified species. While the CHA confirms the area is not a designated Critical Habitat, some of the recorded species are classified as Endangered, Vulnerable, or Near Threatened, and therefore may still be sensitive to development-related disturbances. It is important to note that activities undertaken as part of NSEZ development may impact these species, particularly through habitat alteration, noise, pollution, or increased human activity.

NSEZ site as well as the study area doesn't hold any protected area, marine protected area, marine reserve, ecologically sensitive area, and hilsha sanctuary. However, a hilsha spawning ground boundary point is located within the study area, namely Mayani Point, Mirsharai, Chattogram. In addition, in the study area, two Important Bird and Biodiversity Areas have been found, namely the Ganges-Brahmaputra-Meghna delta and Muhuri Dam.

Socio-Economic Environment

The salient features of the demography and socio-economic profile are as follows:

- Mirsharai Upazila has a population of 472,777 followed by Sitakunda Upazila 4,57,368 while Sonagazi shares the lowest population size of 67,320. The population comprises 48% males and 52% females. Majority (~40%) of the population was aged between 20-49 years.
- Agriculture, comprising crop cultivation, fisheries, direct farming, sharecropping, agricultural laborers, and so on, is the most common source of employment in the study region.
- About 88% of households have grid electricity connections. The union-wise variation shows most households have access, except in Muradpur.
- About 19.40% use wood, 35% use wood/cow dung mix, 42% use wood/cow dung/LPG mix, and 2.5% use LPG. Others use a mix of electricity, cylinders, and other sources.
- About 59.45% use tube-well water, 28.36% use both tube-well and deep tube-well, and 12.19% access deep tube-wells.

- Nearly 90% use electricity for lighting and fanning, 10.45% use solar panels, and less than 1% use kerosene lamps.
- 31% have water-sealed sanitary latrines, and 69% have non-water-sealed sanitary latrines, indicating widespread access to sanitation facilities.
- No archaeological, heritage, and cultural structures are located within or around the NSEZ.
- One tourist spot is located inside the proposed NSEZ master plan boundary.

4 STAKEHOLDER MAPPING AND PUBLIC CONSULTATION

During the RESA, the key stakeholders were categorized into three categories, i.e., Project Affected Parties, Other Interested Parties, and Disadvantaged/Vulnerable Individuals or Groups who were consulted. Validation workshops were conducted at different levels, including the Union, Upazila, District, Regional and National levels, to disseminate project-related information, disclose the outcome of the draft RESA and environmental concerns, and seek information on appropriate mitigation for negative impacts. The key concerns and recommendations from the stakeholder consultation process are given below:

- Compensation and rehabilitation must be ensured prior to the start of construction work as per applicable national legislation for any further development in the region.
- Fisherman and livestock-dependent communities' livelihoods will be impacted. Therefore, the rehabilitation of fishermen and livestock-dependent communities should be ensured on a priority basis.
- Groundwater crisis already exists in the NSEZ region. NSEZ should focus on surface water resources to avoid conflicts between different water users. Rainwater harvesting in each industry should be mandatory.
- Wildlife residing in the NSEZ area including spotted deer, rhesus monkeys, etc., is suggested to be rehabilitated in alternative forest areas.
- Generation and management of solid waste in NSEZ will be a critical task. Currently, there is no mentionable waste management system in the region. Even the local municipal authority has a lack of ability to handle waste in the region.
- Plastic pollution in the marine environment is an issue, and it should be ensured that solid waste/plastic waste is not disposed of in the aquatic environment.
- Liquid waste can pollute water resources if adequate mitigation measures are not considered. ETPs should be established, and the operation and functionality of the ETPs.
- Social infrastructure, i.e., educational institutes, medical facilities, roads, housing and infrastructure, drainage and culverts, waste management facilities, graveyards, playgrounds, community centers, recreational facilities, fire stations, townships, etc., need to be established and improved.
- The rainwater naturally drains out through the khals. Stakeholders suggested considering drainage facilities parallel to the road network and keeping existing khals functional at any cost.
- There are many tourist spots and natural resources surrounding the NSEZ. There is great scope for developing and promoting these potential tourist places.
- Job placement should be prioritized with skill-developing training. Industry should prefer local employees during recruitment.

5 POTENTIAL ES RISKS AND IMPACTS

5.1 Potential Positive Impacts

The nation and region will have the following benefits from the development and operation of the NSEZ:

- Approximately 1.4 million direct job opportunities by 2040
- An increase in land and property values in the region
- Skill development and training for the local people
- Transfer of relevant technical skills and tools
- Boost national foreign exchange reserves and bring in foreign currency

- Increase the revenue and profitability of the business sector
- Development of local infrastructure, notably the transport infrastructure.
- Better social amenities, including education facilities, health facilities, recreational facilities, and markets, among others
- Improved security in the region
- An increased number of tourists visiting the area
- Benefit to local retail businesses
- Increased market for local agricultural products
- Improved public transportation system in the region
- Improved quality of life in the region
- Income to material/equipment suppliers and contractors will be increased.

5.2 Potential Negative Impacts during the Development Phase

A summary of potentially significant negative E&S impacts anticipated during the development of the NSEZ has been given below:

- *Air Quality:* particulate matter (PM_{2.5}, PM₁₀) will be the major pollution that will be generated from site development activities. In addition, emissions will occur due to the operation of diesel fuel generators and exhaust emissions from transport vehicles.
- *Noise Level:* major sources of noise will be dredging activities, vehicular traffic, and operation of heavy construction equipment like dozers, scrapers, concrete mixers, cranes, generators, pumps, etc. The increased noise level will impact on aquatic environment, workers' health and safety, and residents close to access roads are at higher risk of noise nuisance.
- *Surface Water:* may be impacted due to non-point discharges of solids from soil loss and sewage generated by the construction workforce stationed at the site. During dredging, oxygen-demanding compounds, nutrients, and sediments from the seabed will enter the marine water column. Since concentrations of oxygen-demanding compounds are normally much higher in pore water than in the water column, this will cause a depletion in oxygen concentration. Nutrients may stimulate primary production when light and temperatures are sufficient, and may cause eutrophication problems when released in favorable conditions.
- *Groundwater:* tubewells have been established and about 10 MLD of water is produced to supply different construction sites. According to the stakeholder consultations, there is a water crisis in the region. Hydro-Geological Survey under the MUDP 2018 recommends that the aquifer condition in the EZ area is not suitable for the heavy groundwater withdrawal required for the project. Heavy pumping from that aquifer would cause the compression of the aquitard and result in land subsidence. Besides, there is a high risk of later intrusion of seawater/salinity into groundwater.
- *Topography:* will be changed due to activities such as dredging, land development, super dyke, roads, stormwater drainage, pipelines, industries, etc. Soil quality may be impacted if any contaminated sediment is used for land development.
- *Land Use:* land use of an area of 33,805 acres will be changed to an industrial area.
- *Khals and Drainage:* excavation, earthwork, and levelling activities in the ES site and development activities surrounding the area by the local community change the natural topography of the land, which disrupts the natural drainage. This may lead to waterlogging in the upper catchment areas of the khals during heavy rainfall, with the situation worsening during high tide periods. In addition, the flood control infrastructures, if not well maintained, will be subject to negative impacts such as local flooding. Furthermore, these khals were traditionally used by local fishermen for sea access. However, the development of NSEZ has disrupted this access for the fishermen.
- *Impacts of Dredging:* An approximate total amount of 450.89 million m³ of soil will be required for EZ site land development. During dredging, turbidity can rise sharply to 500-700 NTU or more near the dredging equipment. High turbidity will affect phytoplankton and algae, reducing

primary productivity and oxygen availability. Dredging noise and water disturbance can disturb fish and dolphins, altering migration and spawning behavior. Dredging will change in seabed elevation and currents, which may lead to erosion or accretion in nearby coasts. The long-term dredging activities have the potential to significantly disturb benthic habitats, marine mammals, and valuable fish resources. In particular, if dredging operations in the Sandwip Channel are not scheduled to avoid critical breeding and spawning seasons, they may adversely impact sensitive species such as Hilsha (*Tenualosa ilisha*). If the dredged sediments contain elevated levels of salinity, heavy metals, or organic pollutants, there is a risk of leaching into the surrounding soil and shallow groundwater. Contamination from the dredged materials can harm dolphins, fish, invertebrates, and other marine life.

- Flora and Fauna:** The development of the EZ will inevitably impact local vegetation, including planted mangroves and common tree species, thereby reducing the area's natural greenery. According to the master plan, about 31.65% (10,699.21 acres) of the EZ site currently comprises mangroves/forest/vegetation. These mangroves are planted by Bangladesh Forest Department. However, BEZA allocated a total of 40.37% (13,646.28 acres) of land as mangroves, green areas, vegetation, and open spaces—a significant increase compared to the existing coverage. This demonstrates BEZA's strong sustainability commitment, as more mangroves/forest/vegetation will be safeguarded than currently exist. While some partial clearance of vegetation will be necessary, BEZA is prioritizing ecological balance by expanding green and open spaces. This approach aims to minimize long-term ecosystem disruption and protect biodiversity, including vulnerable species such as the Irrawaddy Dolphin, Indo-Pacific Humpback Dolphin, and the nationally significant Hilsha fish populations. Development activities, including Jetty construction and dredging in the Sandwip Channel, are also expected to impact the Irrawaddy Dolphin (*Orcaella brevirostris*), which is classified as Endangered, and the Indo-Pacific Humpback Dolphin (*Sousa chinensis*), listed as Vulnerable globally on the IUCN Red List of Threatened Species. The project activities are also expected to impact Hilsha (*Tenualosa ilisha*) populations and their breeding and spawning grounds.
- Land Acquisition and Resettlement:** approximately 76 households, primarily consisting of poor fishermen, have already been displaced due to land acquisition for access road construction, highlighting the economic displacement faced by residents, including buffalo owners and gazers. Railway and road development are anticipated to further affect numerous residential and commercial structures.
- Social infrastructure:** the development of NSEZ will place significant pressure on existing social infrastructures, including healthcare, education, housing, sanitation, waste management, transport, and community services, which are currently limited and inadequate in Mirsharai, Sitakunda, and Sonagazi. The influx of workers and families will overwhelm schools, health facilities, and roads, while unplanned housing may cause waterlogging, congestion, and health risks. To address these challenges, a phased Infrastructure Readiness Plan (2025–2040) has been prepared in collaboration with relevant ministries and agencies, focusing on enhancing the capacity and build new hospitals, schools, vocational institutes, worker townships, upgraded roads, and sanitation systems.
- Fisherman and Fishery Activity:** expected to significantly impact the livelihoods of fishing and land-dependent communities in Mirsharai, Sitakunda, and Sonagazi Upazilas, where fishing is a key economic activity. Development and dredging activities have already reduced fish catch rates in the Sandwip Channel, with fishermen reporting damage to nets due to increased marine traffic and relocations of essential fish landing stations, leading to accessibility issues. Traditional fishermen, reliant on shallow waters, may lose access to fishing areas and cyclone shelters, resulting in loss of income and long-term socioeconomic challenges.
- Livestock Population and Dependent Community:** the reduction of grazing land led many buffalo owners to sell their animals or shift to other areas for grazing. The livestock population, particularly buffalo and sheep, has dropped from 20,000 to around 8,000 due to these restrictions. This decline affects livelihoods tied to livestock, including buffalo owners, herders,

and dairy businesses, posing a long-term socioeconomic challenge. If grazing restrictions from NSEZ development continue, buffalo and sheep numbers will likely decline further, undermining livestock-based livelihoods, eroding traditional herding skills, reducing local dairy and meat supply, and driving affected communities toward unstable work, migration, and increased pressure on alternative grazing lands.

- **Labor Influx:** The NSEZ is expected to create 1.4 million jobs by 2040, bringing a large influx of workers, families, followers, service providers etc. During the development phase of NSEZ it poses risks of housing shortages, informal settlements, pressure on education, health, water, sanitation, and waste systems, and heightened risks of disease, social tension, child labor, labor exploitation, gender-based violence and sexual exploitation and harassment. Environmental stress from resource overuse, pollution, and traffic congestion will add further challenges.
- **GBV and SEA/SH:** the development of the NSEZ involves a large-scale workforce, projected to reach 1.4 million by 2040, creating heightened risks of GBV and SEA/SH. The predominantly male workforce, combined with an influx of migrant labor, may increase vulnerabilities for women, adolescent girls, and other marginalized groups in host communities. Factors such as limited awareness, unequal power dynamics, and insufficient protective measures can exacerbate these risks.

5.3 Potential Negative Impacts during the Operation Phase

A summary of potentially significant negative E&S impacts anticipated from the operation of the NSEZ has been given below:

- **Air Quality:** PM_{2.5}, PM₁₀, SO_x, NO_x, CO_x, CH₄, VOCs, NH₃, and heavy metals, i.e., Cr, Ni, Pb, and Hg, will be increased in the region from the operation of industry, vehicles, vessels, jetty operation, etc. Transportation will be one of the major sources of GHGs. Solid waste management and wastewater treatment facilities will emit CO₂, CH₄, and N₂O.
- **Noise Level:** ambient noise level will be increased in the region from activities including traffic movement and industry, and facilities operation, jetty operation, ship movement, etc.
- **Surface Water:** major threats to surface water quality will be pollution from sewage, effluents from the operation of industries, accidental leaks or spills of hydrocarbons, etc. Brine effluent from the desalination plant will be injected into the water discharge pipe and ejected into the Sandwip Channel. Discharging brine effluent from the desalination plant may lead to elevated levels of salinity in the direct vicinity of the discharge. Effluent may also contain biocides, chlorine, and lower levels of dissolved oxygen, which will influence water chemistry and quality. Using MIKE-21 FM and ECO Lab FM Modules, a water quality model has been developed to evaluate the dispersion of key water quality parameters under three distinct scenarios, namely normal operation of the CETPs and STPs, failure of these treatment systems, and the combined impact of climate change along with treatment system failure. Under normal operating conditions, the model results show that most parameters remain within the permissible limits defined by the ECR, 2023. However, parameters such as COD, Ammonia, and Phosphate exceed acceptable limits in several internal khals, though these exceedances are not observed on the Sandwip Channel. In contrast, during the failure of CETP and STP systems, significant degradation in water quality is observed, with elevated concentrations of COD, Ammonia, Phosphate, BOD, Lead, and Mercury, particularly during low tide conditions, and pollutants dispersing up to several kilometers from their sources. The worst-case scenario, incorporating climate change effects alongside treatment system failure, further intensifies the dispersion and concentration of pollutants across the internal khals and the Sandwip Channel. While some parameters like pH and Nitrate remain within regulatory limits, others, such as Ammonia,

Chromium, Lead, Mercury, Phosphate, and Total Coliform, show extensive spatial spread, indicating heightened environmental vulnerability under compounded stress conditions.

- *Groundwater:* accidental spillage or leaks of chemicals, and leachate from the landfill site could percolate into the subsurface and potentially contaminate the groundwater.
- *Population Influx and Infrastructures:* By 2040, the NSEZ is projected to experience around 1.4 million workers and their dependents, resulting in a significant population influx that will transform land use and substantially increase demand for housing, water supply, sanitation, healthcare, education, transportation, waste management, and other social infrastructure. This rapid growth raises concerns about unplanned development and the emergence of informal settlements or slums in the surrounding areas. While the influx offers considerable employment opportunities, it also brings risks of social tensions, including gender-based violence, labor exploitation, and crime. Current social infrastructure and public services around the NSEZ are insufficient to meet existing needs and will be further strained by this population growth. Healthcare facilities lack adequate emergency services, beds, and trained personnel to manage an expected rise in injuries, illnesses, and complex health conditions. Education institutions face limitations in capacity and technical training programs, particularly impacting the preparation of local labor especially women for employment in advanced industries. Additionally, underdeveloped road and transport networks are likely to experience increased congestion and wear due to heightened construction and freight traffic. Housing shortages are already causing unplanned, inadequately serviced settlements, which may exacerbate flooding, congestion, sanitation issues, and public health risks. The substantial population increase is also expected to exert pressure on environmental resources, potentially leading to pollution, deforestation, traffic congestion, and resource depletion. These challenges may undermine social cohesion and degrade living conditions if service provision and infrastructure development do not keep pace with demographic growth, highlighting the critical need for careful consideration of social infrastructure capacity and urban planning in the NSEZ's surrounding areas.
- *Solid Waste:* it is estimated that a total of 777,084 tons/year of solid waste will be generated including 245,644 tons/year of industrial solid waste and 53,144 tons/year of municipal solid waste will be generated by the year of 2040. Waste originating from the marine jetty may include inert solid waste from administrative offices, as well as hazardous or potentially hazardous waste associated with vehicle and equipment maintenance operations.
- *Liquid Waste:* it is estimated that approximately 118.32 MLD of sewage wastewater and 386.1 MLD of industrial wastewater will be generated by the year 2040. Untreated wastewater, if discharged into nearby surface waters, may affect the surface water and/or if disposed of on land without treatment, may pollute the ground and surface water.
- *Traffic:* the maximum one-way passenger traffic by 2040 towards the Dhaka-Chattogram Road and Sonagazi will be around 9,000 PCU/hour and 3,200 PCU/hour, respectively. Therefore, traffic congestion may happen particularly at entry and exit points of the EZ, as well as along primary access corridors, which will increase travel times, emissions, and logistics costs. A rise in traffic will lead to air pollution, GHG emissions, and noise pollution, affecting nearby settlements. In addition, increased traffic will heighten safety risks and disrupt community mobility, especially for pedestrians and non-motorized users.
- *Flora and Fauna:* industrial emissions may cause soil acidification and nutrient imbalance, harming native flora. Increased human activity could introduce invasive species. Habitat degradation, pollution, and noise may disrupt the feeding, breeding, and migration patterns of terrestrial wildlife, leading to biodiversity loss. For aquatic fauna, industrial runoff and emissions can degrade water quality, harming fish, crustaceans, and other marine species. During the operational phase, increased vessel traffic and other activities are expected to impact the conservation-significant and globally threatened Irrawaddy Dolphin (*Orcaella brevirostris*) and the Indo-Pacific Humpback Dolphin (*Sousa chinensis*). Project activities are also expected to affect Hilsha (*Tenualosa ilisha*) populations, including their breeding and spawning grounds.

- **Community Health Safety and Security:** The operation of the NSEZ, including access roads, and railway connection will significantly affect nearby communities. Air dispersion modelling shows that emissions of PM_{2.5}, PM₁₀, NO_x, and SO₂ from traffic and industry can extend up to 2-3 km downwind, with the highest impacts within 200-300m of the road and rail corridors. Settlements such as Barotakia, Shitalpur, Muradpur, and surrounding unions fall within this zone, where residents, schools, and health centers face increased risks of respiratory and cardiovascular illnesses. Noise modelling indicates truck and rail operations may reach 70-75 dB(A) within 200 m, exceeding WHO limits and affecting sleep, learning, and community well-being. Road accident risks are greatest near intersections of feeder roads and railway crossings where communities access markets and schools. In addition, inadequate sanitation in labor camps within 1-2 km of settlements, combined with a projected 1.4 million worker influx, increases the likelihood of diarrheal outbreaks, vector-borne diseases, and communicable disease transmission in roadside markets and transport hubs.
- **Occupational Health and Safety:** potential hazards include machinery accidents, high temperatures, chemical exposure, and confined spaces, with risks of injuries, chronic illnesses, or fatalities. Specific industries such as steel, power, and petrochemicals carry additional risks of fires, explosions, and toxic leaks. Workers may also face psycho-social challenges, including stress and mental health issues, while poor sanitation may increase susceptibility to diseases.
- **Child and Forced Labor:** potential risks of child and forced labor, especially among unskilled and semi-skilled workers, due to prevailing socio-economic challenges in Bangladesh.
- **Social Infrastructure:** the operation of the NSEZ will trigger a large demographic shift, straining already limited social infrastructures in Mirsharai and Sonagazi. Inadequate housing is likely to fuel informal settlements, land-use conflicts, and social inequality. Education systems will be overwhelmed by rising demand, while healthcare facilities already deficient will struggle with increased disease risks and population pressure. Weak transport networks and sanitation systems will collapse without major upgrades, leading to congestion, pollution, and public health hazards. Local markets, religious institutions, and community spaces will face overcrowding and disorder, while the absence of robust governance and regulatory capacity may exacerbate social tensions and competition for resources. Without inclusive planning and universal design, marginalized groups, including women, children, and persons with disabilities, risk exclusion. Proactive, integrated planning and the establishment of a local urban authority are critical to ensure equitable, resilient, and sustainable infrastructure development.
- **Fisherman and Fishery Activity:** presence of larger vessels can obstruct the visibility of artisanal fishermen, create safety hazards with large bow waves, and impede the safe crossing of established shipping channels. Additionally, operational activities may modify coastlines, reduce access to fishing areas, and enforce exclusion zones, limiting fishermen's access to resources. Increased risks to fishing equipment from larger vessels may also arise without knowledge of local fishing practices.

6 CUMULATIVE IMPACT ASSESSMENT

The Private Sector Development Support Project facilitated the development of a master plan for establishing the NSEZ across the Mirsharai, Sitakunda, and Sonagazi Upazilas. The NSEZ site covers a total of 33,805 acres. The Master Plan has been divided into three phases: Phase I, Phase II, and Phase III: Years 11-20. The NSEZ site has been divided into 12 separate precincts; this includes residential and support amenities, city center/ business hub, health and education center, mixed-use/ residential, administrative/ institutional center, light/medium industrial area, port and logistics hub, forest/transitional area, heavy industrial area, open space, leisure/ entertainment area, cultural center.

Project under Consideration (PUC): will develop infrastructures in NSEZ, which include transport networks, power networks, gas pipelines, water supply, waste management facilities, telecommunication networks, etc.

Past and Present Project: In the Phase I activity, BEZA constructed a super dyke of approximately 25 km long along the coastline. Approximately 2,500 ha of land were already developed. Under Phase I activity, around 15 light/medium industries have started the construction activity or are in the commissioning stage. Apart from this, site access roads, a temporary jetty, one power plant, and sub-station have been constructed.

Reasonably Foreseeable Future Actions (RFFAS): Expansion of internal roads, construction of external roads, railway transport, jetties, water treatment plant, surface water supply pipeline, desalination plant, electricity distribution line, gas pipeline, township, telecommunication network, stormwater networks. The side development, construction, and operation of Phase II and Phase III industries.

External Stressors: External stressors or drivers that have the potential to have an impact on selected VCs are industrialization and natural hazards (flood, cyclone, coastal flood, etc.).

The overall approach for the CIA study was developed in reference to the guidance issued by the International Finance Corporation (IFC) in the form of the Good Practice Handbook for Cumulative Impact Assessment and Management. The key VCs selected for this CIA are land use, topography & drainage, air quality, groundwater resource, marine water quality, mangrove and mud-flood habitat, aquatic and migratory bird species, protected marine fauna, livelihood (land-based & fisherman), and social well-being.

Key and relevant stakeholders were identified as a part of the CIA study process, and consultations were undertaken with them to gather information on the selection of VCs, understanding past, present activities and RFFAS, obtaining input on potential cumulative impacts identified by the study team, and what stakeholders thought would be appropriate mitigation measures.

A summary of the cumulative impacts and recommended mitigation measures is provided below.

- *Land use change:* The loss of agricultural land and wetland in the spatial boundary is more than the national land conversation rate of agricultural land for industry and urbanization. The contributions to land use change from past and present activities are already moderate. The cumulative considering past, present, and RFFAS is assessed to be high. To mitigate the impacts, ensure phase-wise development. Develop a land use plan for the region, considering future industry development and induced development.
- *Topography and Drainage:* The past & present projects (Phase I) have impacted the topography and drainage of the spatial boundary due to embankment and land development. The RFFAS (land development and linear projects) potential to have an impact on topography and drainage. The anticipated topographical change may cause the local drainage system and waterlogging of the region. The cumulative impact on topography and drainage is assessed to be medium. To mitigate the impact, a regional-level drainage study needs to be conducted by BEZA in collaboration with BWDB to understand the impact of drainage and prepare a regional drainage management plan.
- *Air quality:* The contributions to PM and NO_x in the airshed from past and present activities are medium. The monitored PM and NO_x concentrations in the spatial boundary are within the threshold limit. The cumulative contribution of PM in the airshed from past, present, and future industrial activities and development stressors is expected to lead to exceedance of the PM threshold level. The cumulative contribution of NO_x in the airshed from past, present, and future industrial activities and development stressors is not expected to exceed the NO_x threshold level. Impact on air quality in terms of concentration of PM and NO_x is assessed to be high and medium, respectively. To mitigate the impacts, a regional air quality monitoring program needs to be established, and based on the review of regional monitoring data, the DOE will need to consider appropriate steps to regulate industries by linking it with the issue of Environmental Clearance or decisions about new industries in the region.
- *Groundwater Resources:* During the construction stage of various project components under PUC past and present projects have been sourced the required water from groundwater. The

site development, construction of Phase II activities, required water will be sourced from the groundwater. As per the master plan, the required water for the NSEZ will be sourced from the Feni reservoir (medium term) and the Meghna River (long term). It is envisaged that during the operation phase of the Phase activity, surface water will be supplied to the NSEZ area. The future industrialization process is likely to increase the influx of migrant workers in this region. Water demand for domestic needs in the area will increase and will be sourced from groundwater. The cumulative impact on groundwater resources on the groundwater depletion rate is assessed to be high. To mitigate this, regular monitoring of groundwater tables should be ensured by DPHE, and permission should be taken from WARPO for the abstraction of groundwater.

- **Surface water quality:** The contribution of organic load (BOD), TDS, and TSS in the surface water channels and Sandwip channel from the past activities (industrial and external factors) is not significant. The concentration of BOD, TDS, & TSS in the river water is within the threshold limit for Class D waters (i.e., propagation of wildlife and fisheries). The increase in BOD in the river has a potential negative impact on DO. However, the organic load in the river water was good, and the concentration of DO was good. The cumulative impact on DO & BOD and TDS & TSS is assessed to be medium. To mitigate this, a program for regional water quality monitoring, including provision of infrastructure and manpower requirements, should be prepared and implemented.
- **Mangrove and Mud-flood habitat:** Habitats within the EZ are comprised primarily of mudflats with planted mangrove patches. Construction of super-dyke and land development in the Mirsharai area of NSEZ and modification of the drainage channel have already impacted the mangrove and mud-flood habitat. The past, present, and future development activities (stages II and III) will cumulatively impact planted mangrove and mud-flood habitats. The cumulative impact on mangrove and mud-flood habitats is assessed to be high. To mitigate this, phase-wise land development should be ensured. In addition, plantation plans should be ensured.
- **Aquatic and migratory bird species:** The aquatic habitat and mudflats of the study area are regarded as an important area for migratory birds due to their location along the migratory routes of many bird species. The habitat degradation, noise, artificial illumination, surface water quality, and influx of workforce in the NSEZ with aquatic and migratory bird species prevailing within the impact zone have a potential impact on the diversity of these species, which is assessed to be medium.
- **Livelihood (land-based and fishermen):** The land use change, loss of grazing land, loss fish habitat and nursing ground, access restriction, river water pollution and movement of vessels in the Sandwip Channel have a potential impact on land-based livelihood (agriculture, and dairy) fisherman livelihood, (fish catch and damage to fish gear and boats). The potential cumulative impact on livelihood (land-based and fishermen) is assessed to be high. To mitigate the impact, job and economic opportunities for the local people, especially project-affected families, and unemployed youths should be ensured. In addition, regional-level fishery study focuses on fish species, endangered fish species, trends in fish yield and species composition, fishermen's livelihood, and fish conservation. Additionally, phase-wise development so that grazing can be done in undisturbed areas.
- **Social well-being:** Low-cost housing growth is likely to increase in the nearby Union Parishads to accommodate the labour influx. Inadequate sanitation facilities are another feature of low-cost housing. The situation that has not yet resulted in slumification can lead to unplanned slum growth, with further advancements in industrialization, if planned actions are not taken. The existing projects are entirely dependent on groundwater resources for the supply of construction and operational-phase water. The master plan also indicated that groundwater dependency would increase over the plan period and leading to a negative impact on the availability of drinking water for the local people. As all the Union Parishads have rural settings, health care and educational facilities are not adequate. The influx of labor and access to existing services

and facilities have the potential to have a negative impact on the social well-being of the local people. The cumulative impact on social well-being is assessed to be medium. To mitigate this, participatory planning and improvement of social infrastructures should be ensured.

7 ALTERNATIVE ANALYSIS

In the analysis of alternatives, options were explored including no-go alternatives, location alternatives, sources of construction materials, access roads, sources of construction materials, water supply, gas supply, electricity supply, solid waste management, liquid waste management, phasing of development, and dredging and landfilling alternatives. A summary of the alternative analysis has been given below:

- *No-go alternatives:* the no-go alternative offers clear environmental and social benefits in terms of preserving the coastal and marine ecosystem, avoiding air, noise, and water pollution, and maintaining traditional livelihoods. However, it misses the opportunity for critical economic transformation, loss/slowdown of trade and cooperation with foreign countries, job creation, loss of infrastructure upgradation in the region, loss of revenue, climate resilience through the super dyke, environmental improvements that come from controlled and treated development (e.g., CETPs, green belt, drainage, etc.). While the No-Go Alternative has short-term ecological advantages, the Proposed Master Plan provides a balanced and sustainable development path when environmental mitigation is effectively implemented. Therefore, the no-go alternative is not recommended, and the Proposed Master Plan is preferable for long-term economic and environmental resilience.
- *Location alternatives:* Basically, in Bangladesh, there is a scarcity of suitable alternative land for establishing such a large industrial city covering approximately 33,805 acres of land. The selected site is mostly reclaimed land from the sea and a very small amount of private land. One of the positive sides of this EZ is the availability of vast government barren land, and people's displacement is less. Environmentally sensitive areas/protected areas, as well as archaeological sites, cultural heritage sites, ancient monument sites, etc., are avoided. Thus, the location alternative is not considered in the alternative analysis.
- *Access roads:* Master Plan suggested constructing new roads, including Muhuri Project Road (Zorarganj - Muhuri Project), Bamonsundar Road, NSEZ Saroni Saroni North, NSEZ Saroni Main, NSEZ Saroni South, and Mohanagar-Barodarogarhat Road. The development of access roads is preferable, considering the positive impacts of improved road connectivity to the EZ area are significant for economic growth and accessibility. However, negative impacts, especially environmental degradation, social displacement, and construction-phase issues, must be mitigated through proper route planning, environmental management, and stakeholder engagement.
- *Sources of construction materials:* Sources of construction materials for the development of the EZ can be divided into categories such as national (Bangladesh) and international (other countries). Local sourcing offers significant advantages in terms of economic development, environmental benefits, and supply chain reliability. After assessing the two sourcing alternatives across key impact areas, local sourcing emerges as the preferred option for most materials due to its strong positive impact on the national economy, environmental sustainability (lower transport emissions), support for domestic industries and employment, reliable supply chain and lead times, and contribution to government revenues through taxation.
- *Water supply:* Groundwater, surface water (Feni reservoir and Meghna River), rainwater harvesting, CETPs recycle water, and a desalination plant are the main water resources in the EZ area. As such, NSEZ has considered a hybrid of four water sources in meeting the EZ water demand. Thus, a further water supply alternative was not considered in the alternative analysis.
- *Gas supply:* the required gas can be sourced in two ways, such as trucking through tankers and pipelines. Trucking through tankers offers a short-term, flexible option with lower upfront costs and no land acquisition needs, but comes with significant environmental, safety, traffic, and reliability risks, especially for large-scale industrial use. However, pipeline supply, although more expensive initially and socially sensitive due to land needs, offers superior reliability,

environmental performance, safety, and scalability for long-term industrial development. After assessing the two gas supply alternatives across key impact areas, pipeline supply emerges as the preferred alternative for ensuring consistent, safe, and scalable gas delivery to EZ.

- *Electricity supply:* According to the master plan, the EZ has adopted a hybrid electricity strategy, e.g., combining national grid power, emergency backup generators, generation from fuel-based power plants, and renewable energy development (solar) to ensure energy security, environmental compliance, and long-term affordability for EZ. Therefore, the electricity supply alternative was not considered in the alternative analysis.
- *Solid waste management:* Various methods of solid waste management are available, including landfilling, incineration, recycling, composting, waste-to-energy, and mechanical and biological treatment. All these methods have both positive and negative environmental and social impacts. Based on the solid waste types expected from EZ, an integrated solid waste management approach is the most preferable. For sustainability, a hybrid approach is often best: composting + recycling + controlled WTE or biogas for non-recyclable waste.
- *Liquid waste management:* According to the master plan, domestic wastewater will be treated in two STPs, industrial wastewater will be treated in four CETPs, and efforts shall be made to recycle about 70% of the wastewater after treatment to meet various industrial uses. The treated effluent from the STPs and CETPs will be reused in the EZ. In case of discharging the surplus of the treated effluent to the Sandwip Channel, the effluent quality shall comply with the national standards as mentioned in ECR 2023 and regular monitoring will be done to ensure the appropriate function of the wastewater treatment systems. Considering the above issues, other liquid waste management options were not considered in the alternative analysis.
- *Phasing of development:* According to BEZA, considering the land availability uncertainly, the EZ area has been divided into three phases, and the master plan of the EZ has set phasing rules mentioning that new phases should not begin until 70% of the first or previous phase of a project is sold out/leased. Since development follows this phased and demand-driven approach, a separate alternative analysis for phasing was deemed unnecessary.
- *Dredging and landfill alternatives:* there are two primary types of dredging equipment and methods presently being used for dredging, i.e., mechanical and hydraulic dredgers. Mechanical dredging has some environmental benefits compared to hydraulic dredging, such as localized turbidity, less plume generation, energy efficiency, less mechanical noise, etc. However, considering the high efficiency for large-scale dredging and reclamation projects, time efficiency, the hydraulic dredging is preferable. The primary objective of the dredging activities is to utilize the dredged sediment for various development components within the EZ. Thus, other dredge sediment disposal alternative was not considered in the alternative analysis.

8 DISASTER RISK ASSESSMENT AND DISASTER RISK MANAGEMENT PLAN

A detailed inventory of different disasters in the NSEZ region has been prepared through an extensive literature review and consultation with the relevant stakeholders and local community. From the analysis, it has been observed that the NSEZ site is highly vulnerable to cyclones and tidal surges, earthquakes, tsunamis, flood/flash floods, and medium vulnerable to lightning and tornadoes. According to the Master plan, measures for earthquakes have been proposed considering BNBC 2015. However, the previous BNBC has been updated therefore the new BNBC needs to be adopted for the infrastructure development in the EZ. In addition, to protect the EZ from cyclones, tidal surges, flooding, and erosion, a super dyke has been designed and constructed at the Mirsharai end with crest elevations at MSL+9m to protect the site against a 100-year return period coastal flood. It is recommended to develop a greenbelt outside of the super dyke to protect the dyke from erosion from wave action, tidal surges, and impacts from tsunami-induced waves. A Disaster Risk Management Plan has been prepared to establish and maintain procedures to address or prevent such situations in the EZ region, as well as to test the effectiveness/review/revise such procedures periodically. The details of DRMP have been given in Appendix J (Volume III).

9 ES RISK MANAGEMENT

Due to the nature of some of the proposed activities during development and operation of the NSEZ in the region and their potential environmental and social impacts, the different activities/projects will fall into different project categories (red, orange, yellow, green) according to Environment Conservation Rules 2023, which will require initial ES screening, EMP/ESMP, IEE, and in some cases detail EIA/ESIA. Therefore, the ES management plan is prepared based on the following principles that can lead to the development and implementation of the activities/projects in the region.

- BEZA HQ at the national level and the Head of NSEZ at the site level are responsible for compliance with national policies, regulations, and guidelines.
- NSEZ management in coordination with the other institutions including RHD, LGED, BWDB, BIWTA, PGCB, BR, KHDCL, etc. as well as investors/industries in the NSEZ is responsible for obtaining environmental clearance from DOE and local government agencies as required.
- IEE, EIA/ESIA, and EMP/ESMP need to be prepared for activities upon screening. In case, the requirements of DOE's EIA guidelines differ from those of WB ESF, the more stringent standards and requirements will apply.
- Activities with significant environmental impacts, including those that significantly increase greenhouse gas emissions and impact on natural habitats and biodiversity will not be eligible for implementation in the region.
- Planning and design of any additional activities should ensure minimal assessment of cumulative impacts.
- Environmentally sensitive areas, cultural heritage sites, and restricted or disputed lands (if identified during project implementation) should be handled with appropriate mitigation or compensation measures during implementation following the chance find procedure.
- Participation of stakeholders (especially local communities) should be ensured by the HSE team of NSEZ in the planning, implementation, and monitoring of project activities.
- BEZA HQ as well as NSEZ management will ensure an appropriate institutional setup for implementing E&S management plans and inter-agency coordination. They will also ensure that bidding/agreement/contract documents for construction contractors and PPP operators have specific clauses to ensure implementation of E&S management plans, as required.
- Contractors to be engaged in construction/renovation/expansion/repair and maintenance/operation workers under the NSEZ should be conversant with OHS standards, labor laws, SEA/SH issues, incidence response, and reporting mechanisms.
- NSEZ management will inform project stakeholders about project interventions and their potential impacts on the surrounding ES elements.

Based on the detailed impact identification and assessment, ES risk management for air quality, noise level, surface water quality, groundwater quality, topography and soil quality, sediment quality, solid waste, liquid water, drainage, traffic, flora, fauna, land acquisition and resettlement, community health and safety, occupational health and safety, labor influx, child and forced labor, GBV and SEA/SH, social cohesion and conflict, living and livelihoods, and disaster. Details have been given in Chapter 8.

10 INSTITUTIONAL ARRANGEMENTS, CAPACITY ASSESSMENT, & STRENGTHENING

BEZA has established an Environment and Development Unit under the planning and development wing based at its HQ in Dhaka. Currently, the unit consists of three officers including one Director, one Deputy Director, and one Assistant Director. Regarding NSEZ, one environment specialist, one social specialist, and one occupational health & safety specialist/consultant are working under the Project Implementation Unit of NSEZ at the head office on a contractual basis. In addition, three environmental and social councilors are working in NSEZ on a project-based contract under the Private Investment and Digital Entrepreneurship Project of BEZA.

Based on the review of the current institutional arrangements and capacity assessment, one HSE Manager/ESG Manager, two environment safeguard specialists, four social safeguard specialists, two occupational health and safety specialists, two lab technicians and six environment and social counselors are recommended to be recruited for NSEZ to ensure the overall environmental, social, and health and safety risk management for the first phase development. They will be responsible for coordination with other ministries/departments/agencies including but not limited to DOE, FD, DOF, local administration, municipal authorities, NGOs, etc., to implement environmental, social, gender, land acquisition, compensation, resettlement, grievance management, stakeholder engagement plans, etc. In addition, a full-fledged environmental laboratory equipped with ambient air, ambient noise, surface water, groundwater, wastewater, soil quality, and sediment quality monitoring systems should be established to ensure proper environmental management in the NSEZ and the surrounding region. Details of the institutional arrangement for E&S management in the whole region covering all the relevant entities have been provided in Chapter 10 of this report.

The introduction of Environment, Social, and Governance (ESG) Digital Tools in the monitoring system has been recommended, which will enable BEZA management to accurately, efficiently, and transparently track and report on environmental, social, and governance performance in different economic zones as well as NSEZ. Digitalization can significantly improve operational efficiency, leading to a reduced environmental footprint.

11 CONCLUSION AND RECOMMENDATIONS

The NSEZ proposed by the BEZA has strategic value on many fronts. As Bangladesh believes that the establishment of industrial zones throughout the country will contribute to the development of the national economy, it could also be said that NSEZ is strategic in the economic sense. The EZ will contribute to the socio-economic development of the people living in the region as well as the economic development of the country. There is no denying that, once EZ is implemented, it will substantially enhance international trade. It also has the huge potential of attracting investors from inside and outside the country by establishing a favorable investment environment. At the microeconomic level, the NSEZ will promote entrepreneurship and create job opportunities.

The following is a highlight of some of the key recommendations of this RESA report:

- A regional air quality monitoring program including the establishment of a continuous air quality monitoring station by the NSEZ management through BEZA HQ in collaboration with DOE shall be required. Based on the review of regional monitoring data, DOE shall need to consider appropriate steps to regulate industries by linking it with the issue of Environmental Clearance or decisions about new industries in the region.
- Regional water quality monitoring including a continuous and online base monitoring system at the CSTPs and CETPs outlets needs to be established by NSEZ management through BEZA HQ in collaboration with DOE.
- Regular monitoring of groundwater tables in the region shall be ensured by DPHE and permission should be taken from WARPO for the abstraction of groundwater. In addition, a groundwater quality monitoring program should be established particularly for landfill sites.
- Segregation of solid waste at sources is strongly recommended and all waste management should comply with the requirements of the Solid Waste Management Rules 2021 in collaboration with DOE, municipalities, medical institutions, or license vendors.
- Fully functional and cost-effective central wastewater treatment plants are recommended and treated water must meet the standards as mentioned in the ECR 2023 and ensure reuse to a maximum extent to reduce the volume of water consumption and wastewater.
- Adoption of green structures, climate-friendly construction materials, renewable energy, electric vehicles, carbon trading, and emission monitoring for the industries.
- To protect terrestrial and mangrove flora, BEZA allocated 13,646.28 acres (40.37%) of land as mangrove, green areas, vegetation, and open spaces to maintain native habitats and ecological balance within the EZ.

- To protect wildlife, preserve forest habitat, reforest open spaces, limit night-time construction, control noise and light pollution, and develop wildlife corridors. Protect Important Bird Areas and migratory routes. Relocate vulnerable species proactively and manage waste to deter opportunistic species.
- To protect dolphins and hilsa fish, restrict dredging and construction during peak spawning and migration periods, enforce noise reduction measures, manage runoff and pollution, and protect hilsa spawning grounds in the Sandwip Channel.
- Establish an emergency control center under a disaster management committee to monitor and manage natural disasters in the EZ and maintain coordination with other emergency response teams. A green belt development is strongly recommended outside of the existing super dike.
- NSEZ management through BEZA HQ, in collaboration/technical input from BWDB, shall prepare a regional drainage management plan and monitor the function of drainage in the region specifically before monsoon & take precautionary measures to reduce floods and waterlogging.
- Compensation as per the national legislation and WB ESSs, and development of a livelihood restoration plan for the affected communities.
- A township development for the workers in collaboration with NHA, considering the distance between the living and working sites.
- Develop infrastructures phase by phase in coordination with relevant government agencies and ministries, and local government institutions.
- Improvement of the existing Master Plan, including a detailed phase-wise assessment of utilities, revise boundary by excluding tourist spots, adopting BNBC 2020 for infrastructure development, provision for fisherman shelter house and boat parking facilities outside of the Super Dyke, and provision for the livestock-dependent community regarding the alternative grazing land and access to Sandwip Channel.
- Based on the assessment, ES risk management measures have been provided to mitigate the environmental and social impacts in the region. Considering the ES risk management mitigation measures and monitoring requirements, BEZA should develop environmental and social management plans including but are not limited to air quality management plan, noise level management plan, waste management plan, drainage management plan, traffic management plan, biodiversity management plan, livelihoods restoration plan, grievance management plan, etc., and clauses incorporating necessary terms and conditions in the land lease agreement with investors as well as developers.

1 INTRODUCTION

1.1 Background

Bangladesh has an impressive track record of growth and development. It has been among the fastest-growing economies in the world over the past decade, supported by a demographic dividend, strong ready-made garment exports, remittances, and stable macroeconomic conditions. Bangladesh sets a target to reach a middle-income country by 2031. To achieve its vision of attaining upper middle-income status by 2031, Bangladesh needs to create jobs and employment opportunities through a competitive business environment, increased human capital and skilled labor force, efficient infrastructure, and a policy environment that attracts private investments. In this regard, the Government of Bangladesh (GOB) has launched an initiative to provide industrial land and infrastructure to increase private investments with the support of the Bangladesh Economic Zones Authority (BEZA).

National Special Economic Zone (NSEZ) at Chattogram, Bangladesh is a successful initiative of BEZA to fulfill the dream of regeneration of that congregational tradition in modern Bangladesh. NSEZ with multi-dimensional features is a great junction of domestic and foreign investment, industrialization, and economy at the entrance of the southeastern part of the country. One of the largest economic and industrial zones in South Asia, NSEZ will be a state-of-the-art industrial city. It is one of the priority projects of the government for industrialization and job creation. Among the initiatives taken by the GOB to establish five economic zones in the country, NSEZ has the highest priority.

Smart Bangladesh is the bold flagship slogan as well as the outcome of the new vision of the GOB, "Vision 2041" aiming to create a more resilient, innovative, smart, and digitally equipped nation by 2041. The smart Bangladesh will be built on four pillars i.e., developing smart citizens, assuring a smart government, managing a smart economy, and building a smart society. It will help the country to achieve its long-term development goals, such as becoming a developed and prosperous country by 2041, boosting economic growth and prosperity by attracting foreign investment and creating new jobs, more attractive destination for businesses and investors, and improving the quality of life for all Bangladeshis by providing them with access to better education, healthcare, and other essential services. The NSEZ will be a part of the long-term development goals and support to overcome the challenges to achieving Smart Bangladesh 2041 through infrastructure development, capacity building of manpower, and significant investment from private sectors and international donors.

1.2 Objectives of the RESA

The main objective of the RESA is to examine the associated environmental and social risks and impacts due to the implementation of the master plan of NSEZ. It will pay particular attention to potential cumulative risks and impacts of multiple activities in a region but may not include the site-specific analysis of a specific project. The specific objectives of the RESA are as follows:

- Assess potential environmental and social risks and impacts due to the implementation of the NSEZ master plan in the region, including cumulative impacts of the other planned and/or ongoing projects/activities/related facilities in the region.
- Assess potential risks and vulnerabilities associated with climate change, natural hazards, and other external factors to the NSEZ, marginalized communities, and ecologically sensitive areas.
- Recommend broad measures to mitigate adverse environmental and social impacts, enhance positive outcomes, and promote sustainable development within the region. This includes identifying best practices, technologies, and strategies for minimizing environmental degradation and addressing social challenges.
- Facilitate meaningful participation and engagement of stakeholders, including local communities, civil society organizations, government agencies, private sector actors, and development partners, throughout the assessment process. Ensure transparency, inclusivity, and accountability in decision-making processes.

- Contribute to the sustainable development of the region by mainstreaming environmental and social considerations into development planning and implementation of the NSEZ master plan. Foster partnerships and collaboration among stakeholders to promote responsible and inclusive growth while safeguarding environmental and social well-being.
- Analyze the existing procedures of BEZA for assessment and management of ES risk and impacts and recommend procedures (including the implementation of a formalized ESMS) to be followed to ensure ES compliance with national laws and ESF. This would include a) screening criteria for the selection of investment in NSEZ, (b) setting up of environmental, health and safety standards for the industrial city in line with GOB and the World Bank requirements, (c) general guidelines for long-term ES monitoring and evaluation, and (d) recommendations to strengthen social inclusion aspects for the future investments.
- Assess the present ES management capacity of BEZA and recommend necessary measures/institutional structure for the implementation of the master plan.

Overall, the objective of the regional environmental and social assessment of NSEZ is to support sustainable and inclusive development that balances economic growth with environmental protection, social equity, and resilience-building efforts in the region. By addressing environmental and social challenges holistically, the assessment aims to contribute to the long-term prosperity and well-being of the NSEZ community and the broader Bay of Bengal region.

1.3 Scope of Work

As per the Terms of Reference (TOR), the scope of work for the assignment is as follows:

- Collection, review, and analysis of the environmental and social (E&S) baseline information of the region. The baseline would be mainly captured on the basis of authentic secondary information. Primary data collection would also be required in cases of the absence of reliable secondary data. Some primary data collection might also be required to validate secondary information as necessary.
- Analysis of the institutional and legal framework for the assessment and management of E&S risks and impacts in the region, identify institutional and jurisdictional gaps against the GOB rules and regulations and World Bank's Environmental and Social Framework (ESF) and Environment, Health, and Safety Guidelines (EHSG), and recommend measures to address the gaps.
- Assessment of potential E&S risks and impacts, including Occupational Health and Safety (OHS) of the proposed activities/land use plan as mentioned in the master plan of NSEZ, and recommend mitigation measures for assessing and managing those risks in line with the national and international rules, regulations, and standards.
- Assessment of potential cumulative impacts of other planned and/or ongoing projects/activities in the region and recommend mitigation measures.
- Assessment of the susceptibility of the region to various natural disasters such as cyclones, earthquakes, water surges, and/or other climatic events, etc. their possible impacts and provide a Disaster Risk Management Plan (DRMP) for combating such events.
- Analysis of the existing procedures of BEZA for assessment and management of E&S risks and impacts and recommend procedures (including the implementation of a formalized ESMS) to be followed to ensure ES compliance with national laws and ESF. This would include a) screening criteria for the selection of investment in NSEZ, (b) setting up of environmental, health, and safety standards for the industrial city in line with GOB and the World Bank requirements, (c) general guidelines for long-term E&S monitoring and evaluation, (d) recommendations to strengthen social inclusion aspects for the future investments.
- Assessment of the present E&S management capacity of BEZA and recommend necessary measures/institutional structures for the implementation of the master plan.

- Identification of key national, regional, and project-level stakeholders relevant to the project; organize public consultation meetings at various stages of the preparation of the RESA and incorporate the feedback of consultations in the final report.
- Review, update, and validate the utility (water, gas, power) sources that have already been identified by BEZA for the implementation of the NSEZ Master Plan.
- Analysis of the Mirsharai Upazila Development Plan (MUDP) prepared by the Urban Development Directorate (UDD) for Mirsharai and its implementation challenges in regard to E&S aspects.
- Analysis of the E&S impact for 1.4 million job opportunities as per the master plan, especially social aspects e.g., housing, education, livelihood, planned urbanization, planning of influence area and its management.
- Suggest implementation plan including budget to execute RESA recommendations.
- Review the development plans of other agencies for this region and assess the impacts of those plans.
- Organize six validation workshops before the finalization of the RESA (one for each Upazila - Mirsharai, Sitakunda, and Sonagazi, one District level at Feni, one regional level at Chattogram, and one national level at Dhaka) as per the stakeholder engagement plan of the NSEZ.
- Mapping of all social aspects e.g., education, health, training, road, security, etc., and providing specific suggestions.

1.4 Reference Framework

As per the TOR, the reference framework for the assignment will include:

- Bangladesh's national legal framework
- International environmental conventions adopted by the Government of Bangladesh
- World Bank's Environmental and Social Standards
 - ESS1: Assessment and Management of Environmental and Social Risks and Impacts
 - ESS2: Labor and Working Conditions
 - ESS3: Resource Efficiency and Pollution Prevention and Management
 - ESS4: Community Health and Safety
 - ESS5: Land Acquisition, Restrictions on Land Use, and Involuntary Resettlement
 - ESS6: Biodiversity Conservation & Sustainable Management of Living Natural Resources
 - ESS7: Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities
 - ESS8: Cultural Heritage
 - ESS9: Financial Intermediaries
 - ESS10: Stakeholder Engagement and Information Disclosure
- IFC Good Practice Handbook on Cumulative Impact Assessment
- World Bank Group Environmental, Health, and Safety (EHS) General Guidelines
- World Bank Group Environmental, Health, and Safety Guidelines for Construction Materials Extraction, 2007.

Additional Reference Materials:

- World Bank's Good Practice Note on Labor Influx Management
- World Bank's Good Practice Note on Addressing Gender-Based Violence
- World Bank's Good Practice Note on Addressing Sexual Exploitation and Abuse and Sexual Harassment
- World Bank's Good Practice Note on Non-Discrimination and Disability
- World Bank Environment and Social Incident Response Toolkit.

1.5 Approach and Methodology

The RESA was based on the collection of both the secondary and primary baseline environmental and social information, impact assessment, and delineation of the environmental and social risk management. The following approach and methodology were followed to complete the RESA:

- The **literature review** encompassed existing documentation and reports related to the NSEZ from various agencies, as well as relevant national and international guidelines, to understand environmental and social sensitivities and gather baseline data for informed planning and assessment.
- Delineate any specific **baseline information** required to be collected for the study area with reference to the physical, biological, and social components of the environment.
- **Consult with stakeholders** and integrate their views planning and implementation of NSEZ.
- Systematically **predict and evaluate the positive and negative changes** in these baseline conditions.
- The **cumulative impact assessment** involved evaluating the combined effects of past, present, and reasonably foreseeable future activities on the environmental and social components of the NSEZ region.
- **Disaster Risk Assessment** identified potential natural disasters in the region, analyzed risks using collected data, and proposed protective measures for effective management.
- Develop an **Environmental and Social Risk Management System** that outlines measures to mitigate identified impacts, specifying actions, monitoring requirements, responsibilities, and timelines to ensure the sustainability of NSEZ development.

The methodology followed to complete RESA is elaborated in the subsequent sections below.

1.5.1 Literature Review

Existing literature related to the NSEZ was reviewed, including the available documentation on the proposed NSEZ and related facilities from the BEZA and other agencies including the Bangladesh Forest Department (BFD), Bangladesh Water Development Board (BWDB), Roads and Highways Department (RHD), Local Government Engineering Department (LGED), Bangladesh Inland Water Transport Authority (BIWTA), Power Grid Company of Bangladesh (PGCB), Bangladesh Rural Electrification Board (BREB), Karnaphuli Gas Distribution Company (KGDCL), Department of Public Health Engineering (DPHE), Urban Development Directorate (UDD), Chattogram Water Supply and Sewerage Authority (CWASA), Bangladesh Railway (BR), Bangladesh Telecommunications Company Limited (BTCL), etc. The documents like the Master plan, IEE, EIA, and feasibility reports of different components of the NSEZ were collected and reviewed. In addition, existing literature on the NSEZ site and surrounding area was also collected and reviewed to understand any sensitive environmental and social receivers and to compile all available secondary baseline data.

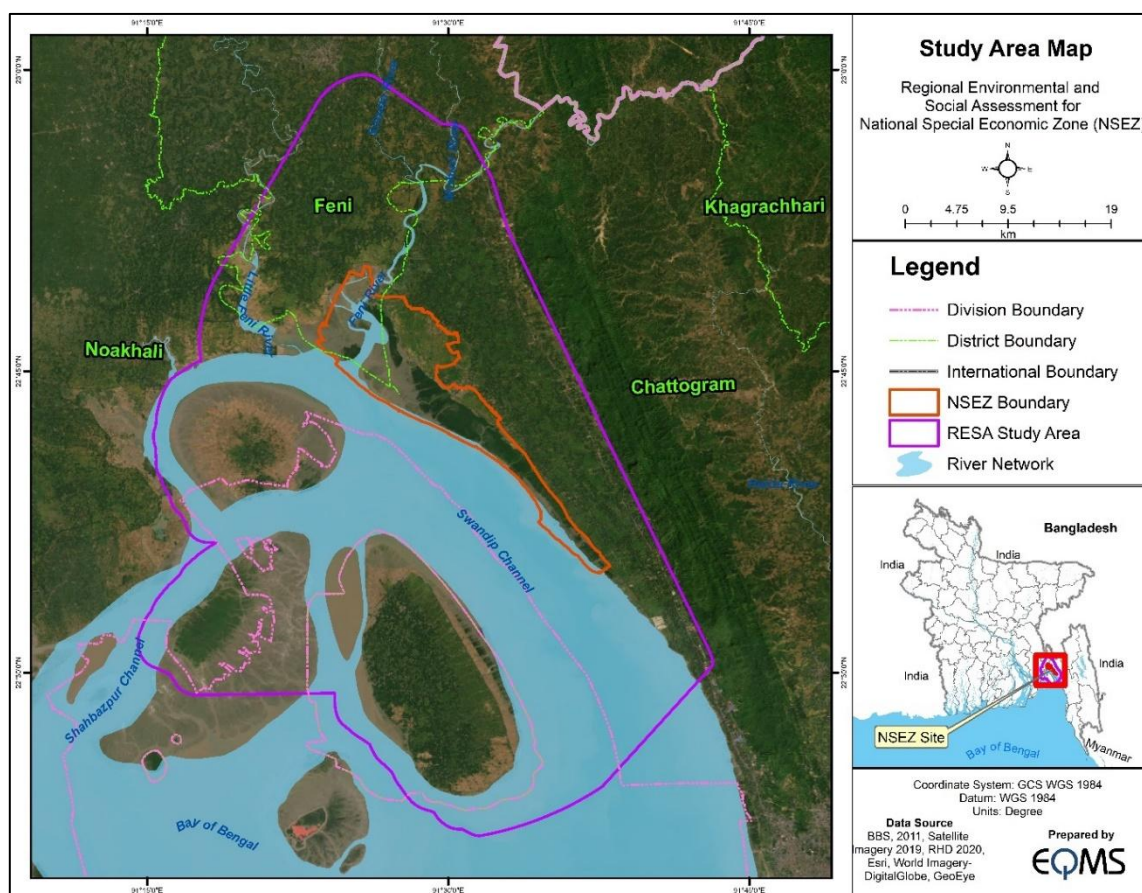
All the applicable national rules, regulations, policies, and guidelines relating to the implementation of the NSEZ master plan were reviewed. In addition, the RESA team also reviewed international standards and guidelines such as World Bank Environmental and Social Standards 1-10 under the World Bank Environmental and Social Framework and other international conventions, agreements, and treaties that are ratified by the Government of Bangladesh. A gap assessment of the existing legal and regulatory framework and necessary recommended changes in the regulations has been provided in Chapter 9 of this report.

1.5.2 Environmental and Social Baseline Conditions

For determining the study area to collect baseline information, all the geospatial data regarding the NSEZ footprint were collected from BEZA and superimposed by the consultant using GIS software. It helps to identify physical elements, aspects, and facilities that are likely to generate environmental and social risks and impacts in the context of the NSEZ footprint area (33,805 acres) and area of influence

(10 - 15 km radius of the master plan boundary/547,091 acres considering the project footprint). A map of the study area is shown in Figure 1-1

Figure 1-1: Map of the Study Area



Source: Geospatial data from BEZA and map prepared by EQMS

The baseline conditions concerning regional physical, biological, and socio-economic environment were collected from both the primary and secondary sources. All information available in publications and unpublished data available with various governments, educational, and other institutions for each discipline was analyzed to understand the environment of the region. The physical environmental baseline data mainly covers the meteorology, geology, topography, soil, physiography, land use and landcover, geomorphology, surface water hydrology, groundwater hydrology, agroecology, erosion and sedimentation, seismicity, and environmental quality (ambient air quality, ambient noise level, surface water quality, groundwater quality, soil quality, and sediment quality). The biological baseline data covers the bioecological zone, ecosystem and habitat, flora, fauna, aquatic monitoring (phytoplankton, zooplankton, and benthos), protected areas, ecologically critical areas, mangrove forest, Hilsha sanctuary and spawning ground, important bird and biodiversity areas, and RAMSAR site. Finally, the socio-economic baseline covers demography, gender, age, land ownership and tenure, community structure, employment, education and skill, housing, religion, income, livelihoods, common property resources, community health and safety, disadvantage and vulnerable groups, gender-based violence, traffic, ethnic minority, cultural and heritage sites, and tourist spots. The collected primary, as well as secondary baseline data, have been incorporated in Chapter 3 of this report.

1.5.3 Stakeholder Consultation and Public Disclosure

Stakeholder consultations were carried out throughout the whole RESA process. Consultations ensure that all stakeholder concerns are incorporated into the planning and implementation of NSEZ. This is in line with the statutory consultation requirements under World Bank Environmental and Social Standards, as well as the national regulations. Consultations were done at local, union, upazila, district,

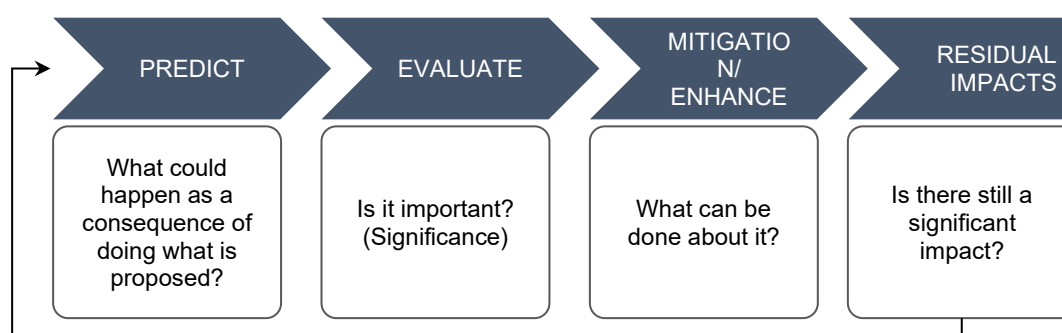
regional, and national levels. Stakeholders and methods of data collection include Key Informant Interviews (KII), Focus Group Discussions (FGDs), questionnaires with household heads, three validation workshops at the union parishad level, and six validation workshops at upazila, district, regional, and national levels. A summary of the outcome of the stakeholder consultation has been provided in Chapter 4 of this report.

1.5.4 Impact Assessment

RESA evaluated potential environmental and social risks and impacts using a methodology based on the evaluation of the “significance” of identified issues and impacts on baseline parameters. Analysis of the baseline results and the incremental impacts of the NSEZ were assessed in accordance with the national guidelines for air, water, and noise emissions standards mentioned in the Air Pollution (Control) Rules 2022, Environment Conservation Rules 2023, and Noise Pollution (Control) Rules 2006. World Bank’s Environmental and Social Standards (1-10) under the Environmental and Social Framework, WBG EHS Guidelines also followed during risk and impact assessment.

The risk and impact assessment covered the construction and operation activities. The risk and impact assessment were involved in the prediction, evaluation, and mitigation of impacts, and reported on impacts including residual impacts and cumulative impacts. Impact prediction was taken into account control measures that are part of the NSEZ design. Additional mitigation measures aimed at further reducing predicted impacts were proposed where necessary or appropriate. The impact assessment process for the RESA is shown in Figure 1-2.

Figure 1-2: Impact Assessment Process for the RESA



1.5.5 Cumulative Impact Assessment

A cumulative impact assessment was carried out following the six-step process in line with the “IFC Good Practice Handbook: Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets Handbook” to identify cumulative impacts on various physical, biological, and social environment parameters in the region.

- Step 1: Scoping Phase I – Valued Environmental and Social Components, Spatial and Temporal Boundaries.
- Step 2: Scoping Phase II – Other Activities and Environmental Drivers.
- Step 3: Establish Information on the Baseline Status of Valued Environmental and Social Components.
- Step 4: Assess Cumulative Impacts on Valued Environmental and Social Components.
- Step 5: Assess the Significance of Predicted Cumulative Impacts.
- Step 6: Management of Cumulative Impacts – Design and Implementation.

The cumulative impact assessment report has been prepared and submitted as a standalone document.

1.5.6 Disaster Risk Assessment and Disaster Risk Management Plan

The potential of various natural disasters such as floods, cyclones, earthquakes, tidal surges, tsunamis, lightning, tornadoes, landslides, droughts, and other climatic events, etc. in the region was identified,

and risk analysis was undertaken. Both the primary and secondary data relevant to the natural disasters were collected during the site visit and from the desktop review. Protective measures required to prevent the occurrence of any disaster shall also be suggested and a disaster risk management plan has been prepared and incorporated in Appendix J (Volume III).

1.5.7 ES Management System

An outline of the proposed ES management system was developed, indicating principals and decision-making process to address ES risk assessment and management issues for the development and operation of the NSEZ. A screening criterion for the selection of investment in NSEZ, an exclusion list of the activities, EHS standards for industrial city have been developed in line with the national and World Bank requirements. In addition, recommendations for preferred alternatives considering ES aspects to reach ultimate development goals with PPP projects, monitoring the implementation of PPPs, and auditing framework have been developed.

1.5.8 RESA Report

The RESA Report has been prepared and submitted upon completion of the above tasks as per the prescribed Terms of Reference (TOR) shared by BEZA. Based on comments and feedback from the BEZA, World Bank, different stakeholders, validation workshops at Union, Upazila, District, and Regional levels, and a national validation workshop at Dhaka, the draft RESA report has been updated and resubmitted as the Final RESA Report.

1.6 Limitations

This RESA report is based on scientific principles and professional judgment applied to facts with resultant subjective interpretations. Professional judgments expressed herein are based on the analysis of available data and information. The RESA report was prepared with the following limitations:

- The assessment of the environment and social risks is limited to the NSEZ information available at this stage of the development of NSEZ, discussion with stakeholders, primary and secondary data collected, consultation with the local community, and observations made during the site survey. Professional judgment and interpretation of facts have been applied to presenting inferences from the collected information. If information to the contrary is discovered, the findings in this RESA report need to be modified accordingly.
- The information contained in this report was sourced from information, data, and reports supplied by BEZA, investors/individual industries, utility providers, related facility owners, and the local community that is assumed to be complete, valid, and true.
- The existing masterplan area covers 33,805 acres in the Feni and Chattogram Districts. There is uncertainty in getting the total land area from the relevant authorities and modification of NSEZ boundaries may be required in the future. If the NSEZ boundary is changed, in such cases, revision of this report will be required following the revised area and planning.
- Currently, the NSEZ master plan is implementing phase by phase. Changes in the existing master plan may occur due to unanticipated situations. Adaptive changes may also occur during the course of the NSEZ master plan implementation. The RESA, and any associated plans/documents, are therefore intended to be 'living documents' that can be refined and modified as situations change.

1.7 Structure of the RESA Report

The RESA report has been divided into the following three volumes:

- Volume-1: Main RESA Report
- Volume-2: Cumulative Impact Assessment
- Volume-3: Appendices

Volume-1 consists of the main text of RESA, which consists of eleven chapters, and the content is briefly described in this section.

Chapter 1: Introduction: discusses the background, objectives, scope of work, reference framework, approach and methodology of the RESA, limitations, etc.

Chapter 2: Description of the NSEZ and its Area of Influence: discusses the location, master plan of NSEZ, phasing of NSEZ, key infrastructures, transport network, power network, gas, water, waste management, telecommunication, and plantation plan of the NSEZ.

Chapter 3: ES Baseline of the Region: describes the details of primary and secondary environmental and social baseline conditions with detail on physical, ecological, and socio-economic conditions.

Chapter 4: Stakeholder Mapping and Public Consultation: provide stakeholders consultation undertaken as part of the assessment process and the key issues identified from the same.

Chapter 5: Potential ES Risks and Impacts: provides the key environmental, ecological, and social risks and impacts in the region due to the implementation of the master plan.

Chapter 6: Impact Assessment Considering Uncertainties: provide scenario development considering Scenario-1, Scenario-2, and Scenario-3.

Chapter 7: Alternative Analysis: provides an analysis of alternatives for the NSEZ.

Chapter 8: ES Risk Management: provides the management system for the identified impacts and risks in the region and planned mitigation and enhancement measures, monitoring requirements, responsible authorities, etc.

Chapter 9: Existing Legal and Regulatory Framework: discusses the policy, legal, and administrative framework describing the relevant policy and legal frameworks for the RESA process.

Chapter 10: Institutional Arrangements, Capacity Assessment, and Strengthening: identify institutional requirements and capacities to implement the management measures.

Chapter 11: Conclusions and Recommendations: provide concluding remarks and recommendations.

2 DESCRIPTION OF THE NSEZ AND ITS AREA OF INFLUENCE

This chapter describes the details of the location, master plan, development phasing, key infrastructures, transportation network (internal, external road, railways, water transport-jetty), power network (source, transmission, and distribution), gas transmission, water demand and sources, waste management, stormwater drainage system, telecommunication, and plantation area of NSEZ. All this information has been taken from the master plan report of the NSEZ shared by BEZA as well as reports from the utility providers and investors.

2.1 Location of the Proposed NSEZ

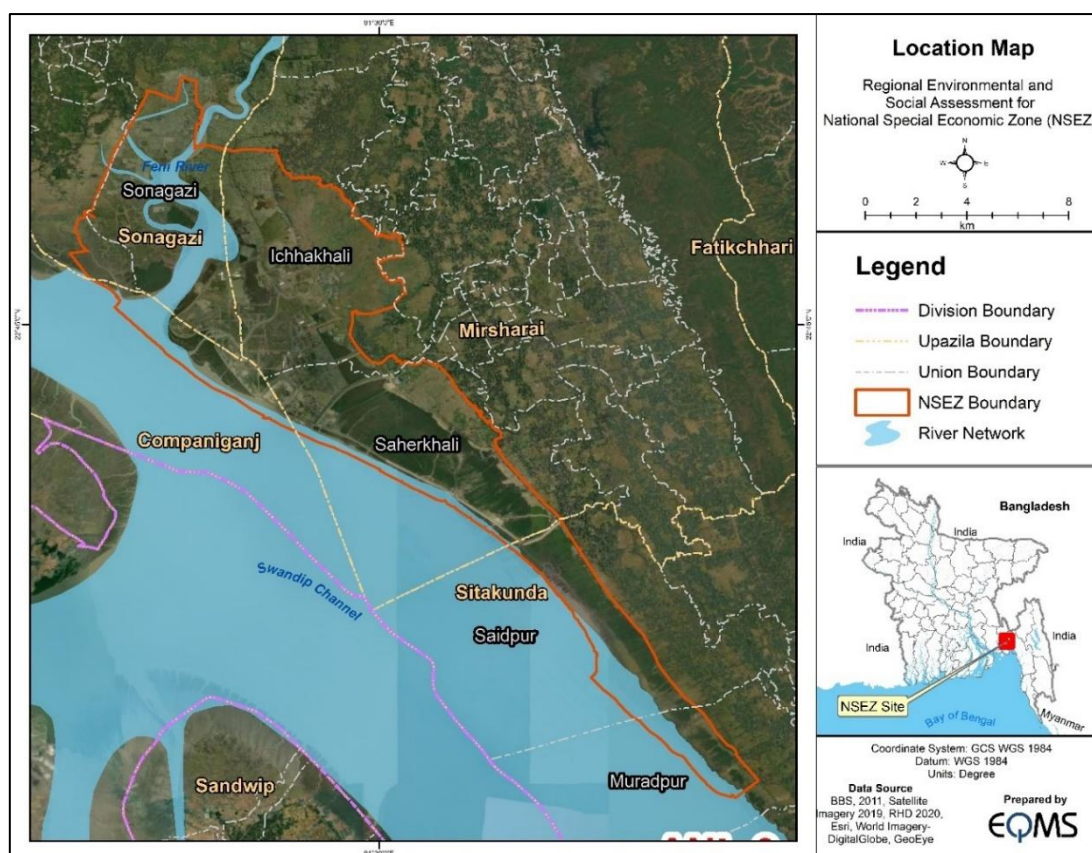
The NSEZ has been proposed to be located 200 km away from the capital Dhaka, 60 km from Chattogram, 70 km from Chattogram Port, and Shah Amanat International Airport. NSEZ site covers two Districts, three Upazilas, and six Unions and is comprised of 26 Mouzas. Details of the NSEZ location are given in Table 2-1 and a location map of the proposed site is given in Figure 2-1.

Table 2-1: Location of NSEZ

District	Upazila	Union
Chattogram	Mirsharai	Saherkhali and Ichhakhali
	Sitakunda	Muradpur and Saidpur
Feni	Sonagazi	Sonagazi and Char Chandia

Source: Master Plan of NSEZ, September 2020

Figure 2-1: Location Map of the NSEZ



Source: EQMS Consulting Limited, September 2023

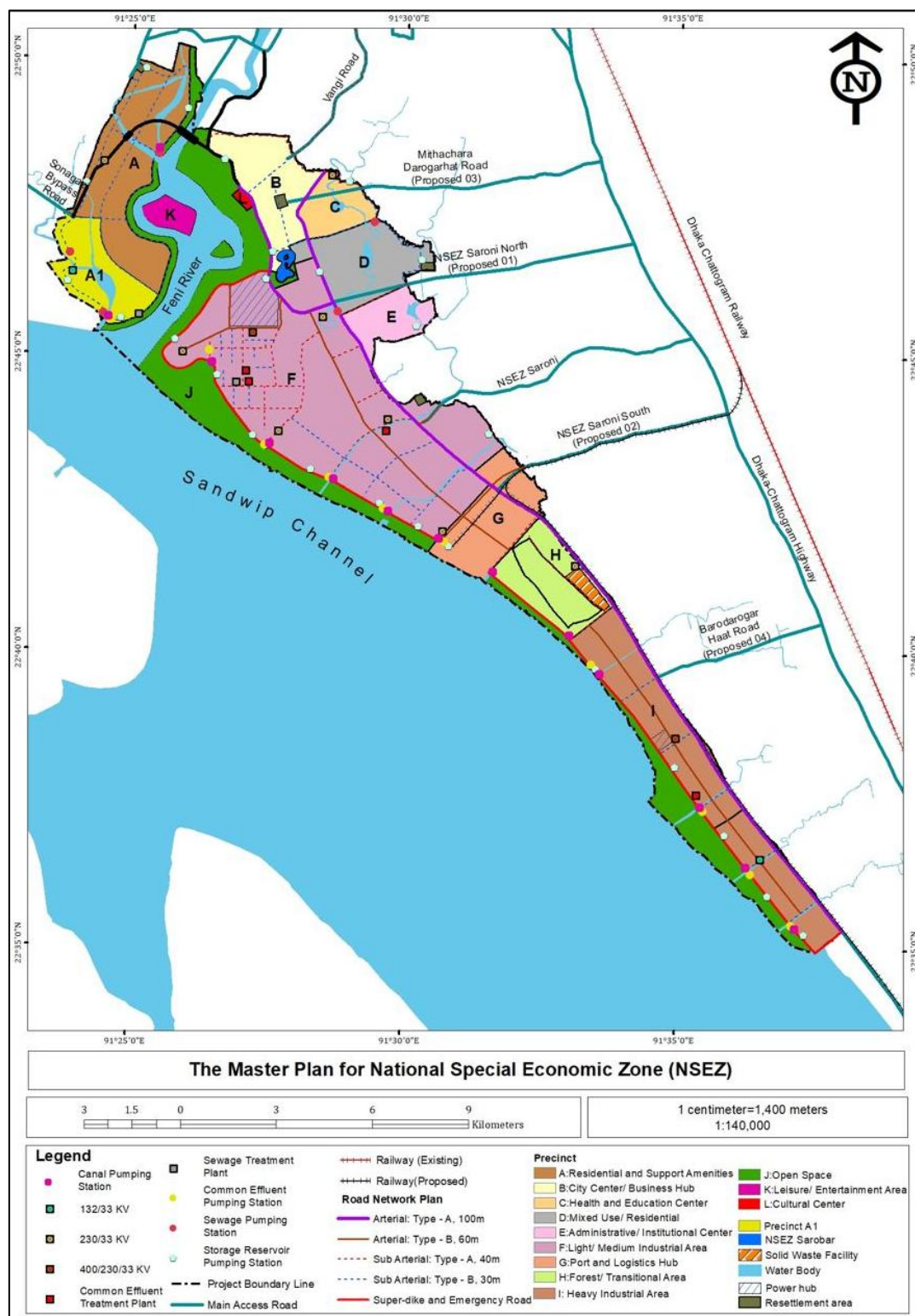
2.2 Master Plan of NSEZ

NSEZ has a total land area of 33,805 acres or 136.86 km² (mostly reclaimed land) with a 25 km coastline along the Sandwip Channel in the Bay of Bengal. The masterplan sets out: i) land uses, ii) access and transport networks, iii) precinct boundaries and characteristics, iv) zoning and permitted uses, v) development guidelines, and iv) environmental and green resilient rules to follow when implementing the zone. The NSEZ site has been divided into 12 separate precincts, which have their own land uses. Although specific plots have not been assigned in the master plan, it is intended that real estate projects following the designated land uses and design guidelines will be constructed over time and sold/leased at competitive market rates. The precincts for NSEZ are identified in Table 2-2 and a map of the NSEZ master plan has been shown in Table 2-2.

Table 2-2: NSEZ Precincts and Land Use by Size

Precinct	Land Use Designation	Land Use	Size in Acres	Size in %
A	Residential and Support Amenities	Low-scale residential units, convenience retail, and educational/ health	4,606.57	13.63
B	City Center/ Business Hub	Commercial, retail, administrative, and technology/ICT-related uses, high-rise residential towers, and support amenities	1,732.91	5.13
C	Health and Education Center	Health clinics, hospitals, educational uses, support amenities, short-term residences/ dormitories, hotels, and parking facilities	837.35	2.48
D	Mixed-Use/ Residential	Low and medium residential typologies (apartments, dormitories, rowhouses, etc.), support amenities, convenient retail, and alike	1,778.59	5.26
E	Administrative/ Institutional Center	Government buildings, libraries, museums, galleries, shopping/retail, commercial facilities, support amenities, etc.	880.68	2.61
F	Light/Medium Industrial Area	Light & medium industries, & a chemical hub only if buffered with landscaped boundaries	10,043.12	29.71
G	Port and Logistics Hub	Port and logistics-related activities and transport support amenities	1,802.29	5.32
H	Forest/Transitional Area	Forest conservation purposes but transitional to port, logistics, and/or heavy industrial uses, if required. Utility facilities are permitted	1,778.75	5.26
I	Heavy Industrial Area	Heavy industrial uses and associated support amenities	3,956.35	11.70
J	Open Space	Active and passive parks and open spaces. Limited development permitted	5,980.42	17.69
K	Leisure/ Entertainment Area	A variety of leisure and entertainment uses and support amenities	350.89	1.04
L	Cultural Center	Performing arts facilities, a cultural complex, sporting events, festivals, and large outdoor gatherings	56.85	0.17
Total Area			33,805	100

Source: BEZA, 2020a

Figure 2-2: Master Plan for National Special Economic Zone

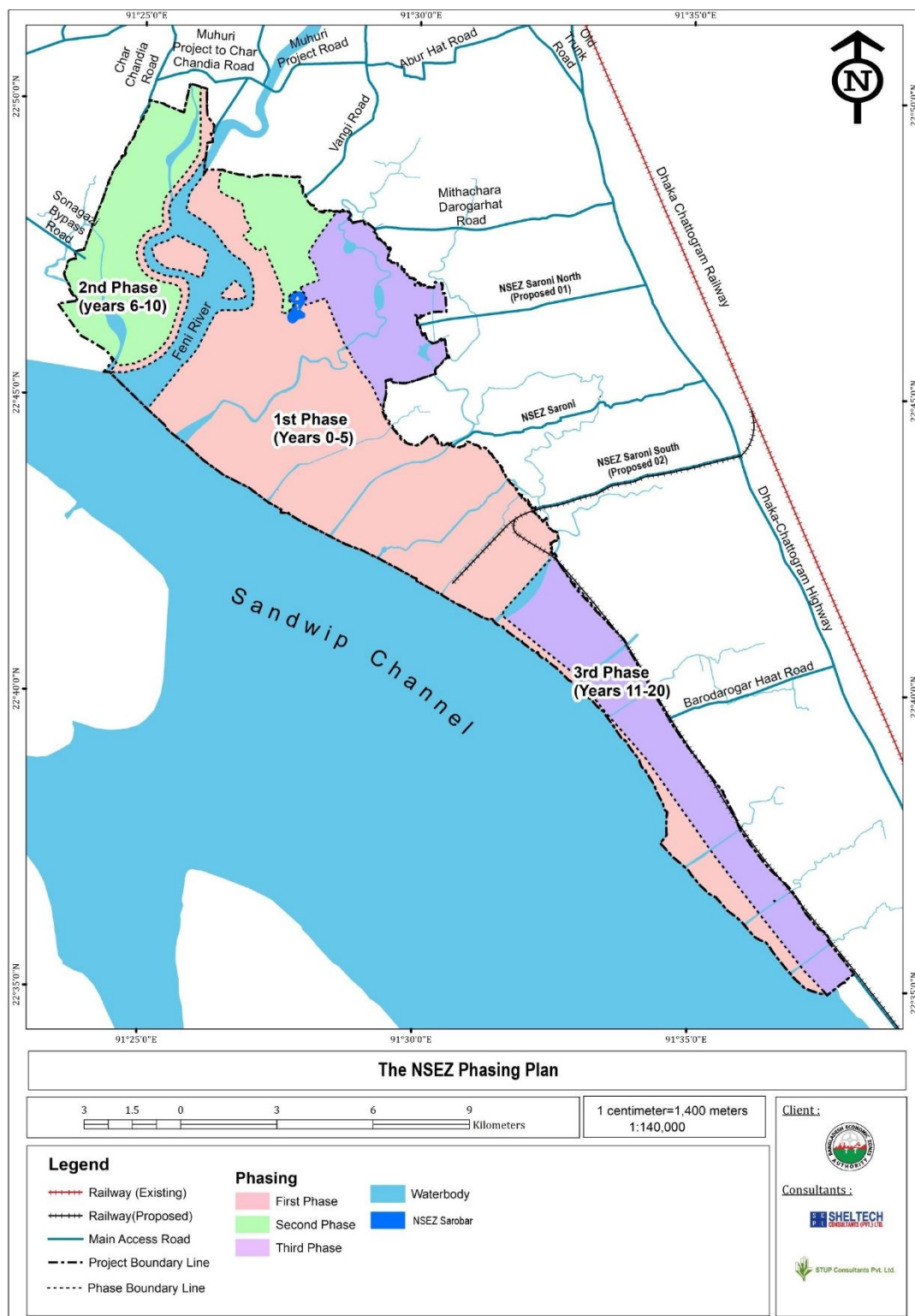
Source: BEZA, 2020a

2.3 Phasing of NSEZ

All the land within NSEZ has not yet been acquired and some lands have been allocated to investors, it is more complicated to accurately phase the site according to best practices. Considering the above facts, the Master Plan area has been divided into three phases. The execution period is divided into

three phases i.e., a) Phase-I: years 0 - 5, b) Phase-II: years 6 -10, and c) Phase-III: years 11-20. A map of the NSEZ phasing plan has been shown in Figure 2-3.

Figure 2-3: NSEZ Phasing Plan



Source: BEZA, 2020a

2.4 Key NSEZ Infrastructure

Various types of infrastructure/utilities will be developed following international standards within NSEZ to provide world-class networks, structures, and services, which will make NSEZ a competitive,

sustainable, and resilient zone. These infrastructures/utilities differ in their structural characteristics, services and functions, and performance standards. Table 2-3 provides an overview of the types of general infrastructure envisioned for NSEZ.

Table 2-3: Key Types of Infrastructure Services and Assets Planned for NSEZ

Key Infrastructure, Services, and Functions	Types of Infrastructure/Utility Assets
Flood Protection and Management	Coastal embankments, river dykes, canals, sluice gates, pumps, stormwater drainage, etc.
Water Storage/Recreation	NSEZ Sarobar (Lake)
Transport	Roads, Bridges, Jetties, inland container depot, Rail, Light Rapid Transit, etc.
Buildings	Industrial sheds, Administration Buildings, Residential/Commercial/Retail/Educational/Medical/Hotels/Club and Community Services Buildings, Fire Services, etc.
Telecommunication	Towers, Cables, Fiber Optics, Backbone, Switches, etc.
Water Supply and Sanitation	Water Supply System (Potable/Grey), Sewage Treatment Plants (STP), Water Treatment Plants (WTP), Water Reservoirs, Deep Tubewells (DTW), Desalination Plants, etc.
Energy	Power Plants, Sub-Stations, Power Supply Network, provision of use of Solar Energy (including Floating Solar), Renewable, Gas Supply Network, District Regulating Station (DRS), City Gas Station (CGS), etc.
Waste Water Management	Sewage Treatment Plants (STPs) and Common Effluent Treatment Plants (CETPs)
Solid Waste Management	Municipal and Industrial Solid Waste (ISW), Biomedical Waste, and Bio-Gas Plant facilities

Source: BEZA, 2020a

2.4.1 Transport Network

2.4.1.1 Road Network

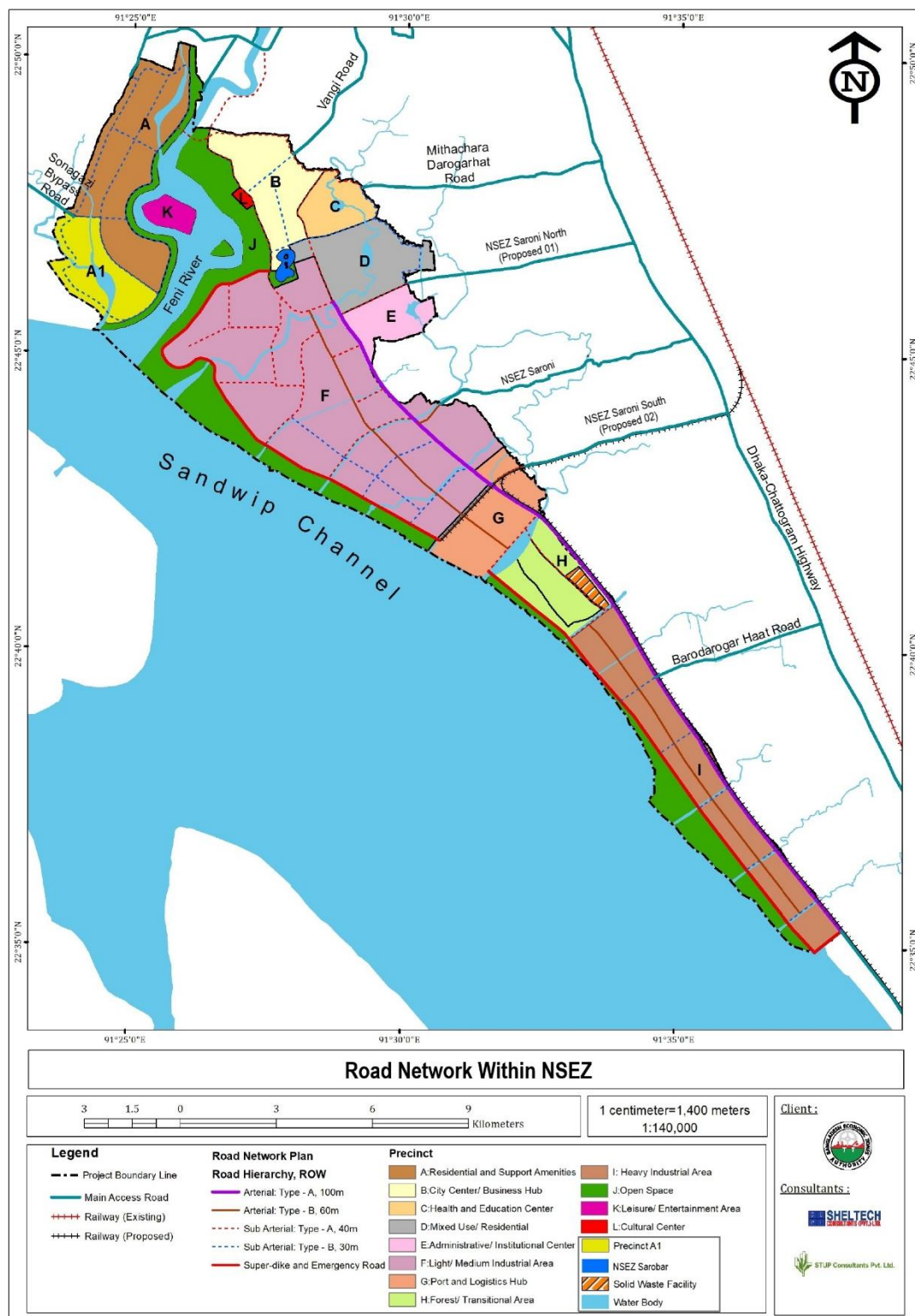
2.4.1.1.1 On-Site Road Network within NSEZ

A hierarchy of roads has been designed within NSEZ. All road networks will have services and utilities integrated into their design. The hierarchy of roads within NSEZ are:

- **An Emergency Road - Super Dyke (100m ROW)** - Road on the high embankment along the seaside offering limited access and acts as an emergency exit from NSEZ (will be mainly used for inspection and maintenance of super dyke), if required.
- **Arterial Roads - Type A (100m ROW)** - For traffic moving along the periphery of NSEZ to have quicker access to Precincts.
- **Arterial Roads - Type B (60m ROW)** - For through traffic on a continuous route within NSEZ.
- **Sub Arterial Roads - Type A (40m ROW)** - For collection and distribution of traffic connecting to the arterial road network, however, offering a lower level of service than an arterial road.
- **Sub Arterial Roads - Type B (30m ROW)** - For collection and distribution of traffic connecting to the arterial road network, however offering a lower level of service than an arterial road. Providing access to large plots of land within Precincts F, G, H, and I.
- **Collector Street - (20m ROW)** - For collection and distribution of local traffic and providing access to arterial and sub-arterial roads. Most common in Precincts A, B, C, D, E, and K.

The road network plan within NSEZ is shown in Figure 2-4.

Figure 2-4: Road Network Within NSEZ



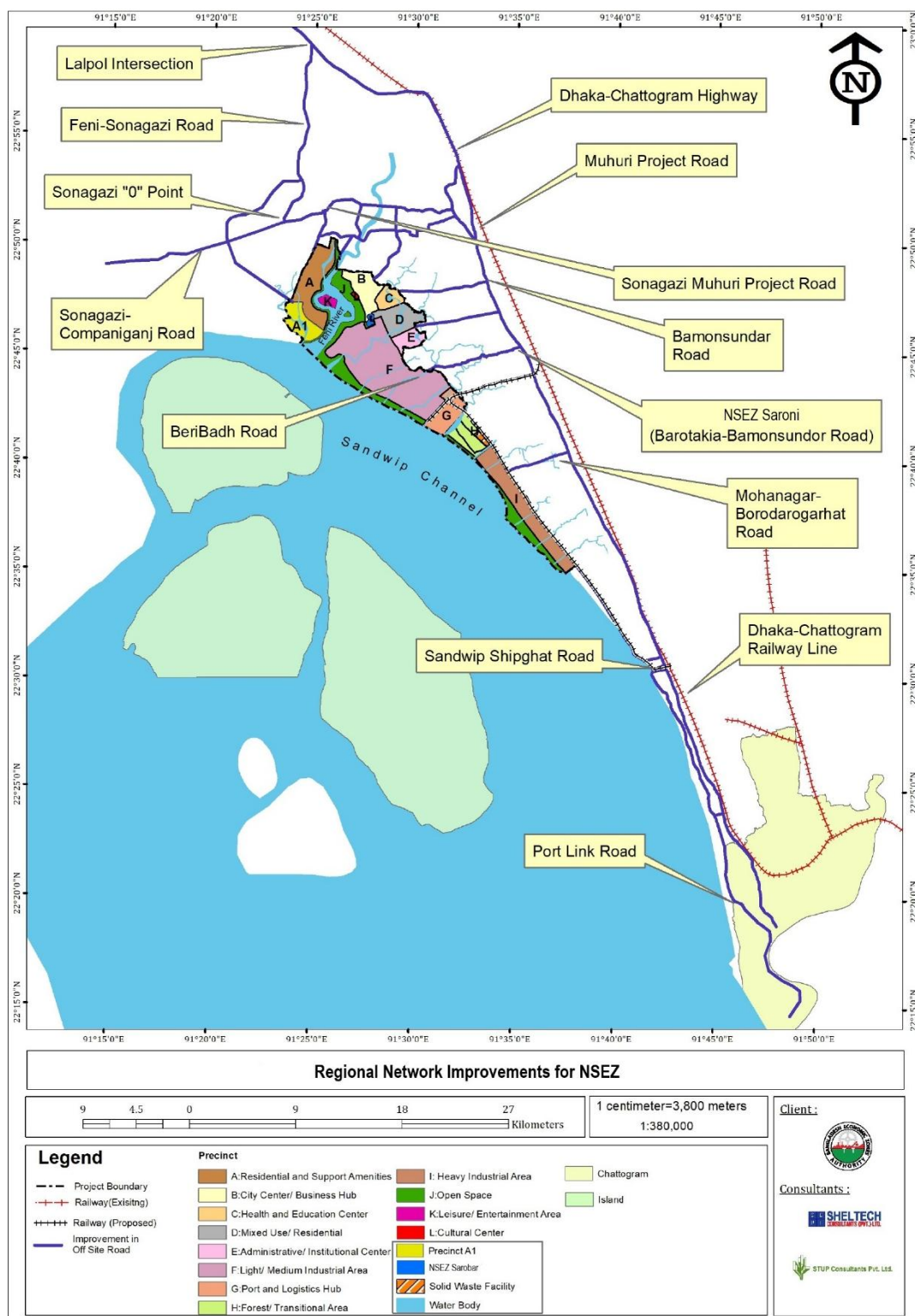
Source: BEZA, 2020a

2.4.1.1.2 Access Road Network

At present, the capacity of the local access roads adjacent to NSEZ is quite limited and the number of existing links to NSEZ is inadequate to cater to the additional volume of traffic likely to be generated by NSEZ. Hence, the road network will need to be upgraded and improved. Considering the functional

characteristics of NSEZ and the anticipated movement pattern of passenger and freight, Dhaka - Chattogram Highway (N1) and Feni - Sonagazi Road are likely to assume greater importance, especially for predominant north-south movement. The connecting roads are mainly from Dhaka-Chattogram Road and can be listed as Muhuri Project Road (Zorarganj - Muhuri Project), Bamonsundar Road, Saroni North, Saroni Main, Saroni South, and Mohan Nagar Barodarogarhat Road. A map of the external network is shown in Figure 2-5.

Figure 2-5: Regional Network Improvements for NSEZ

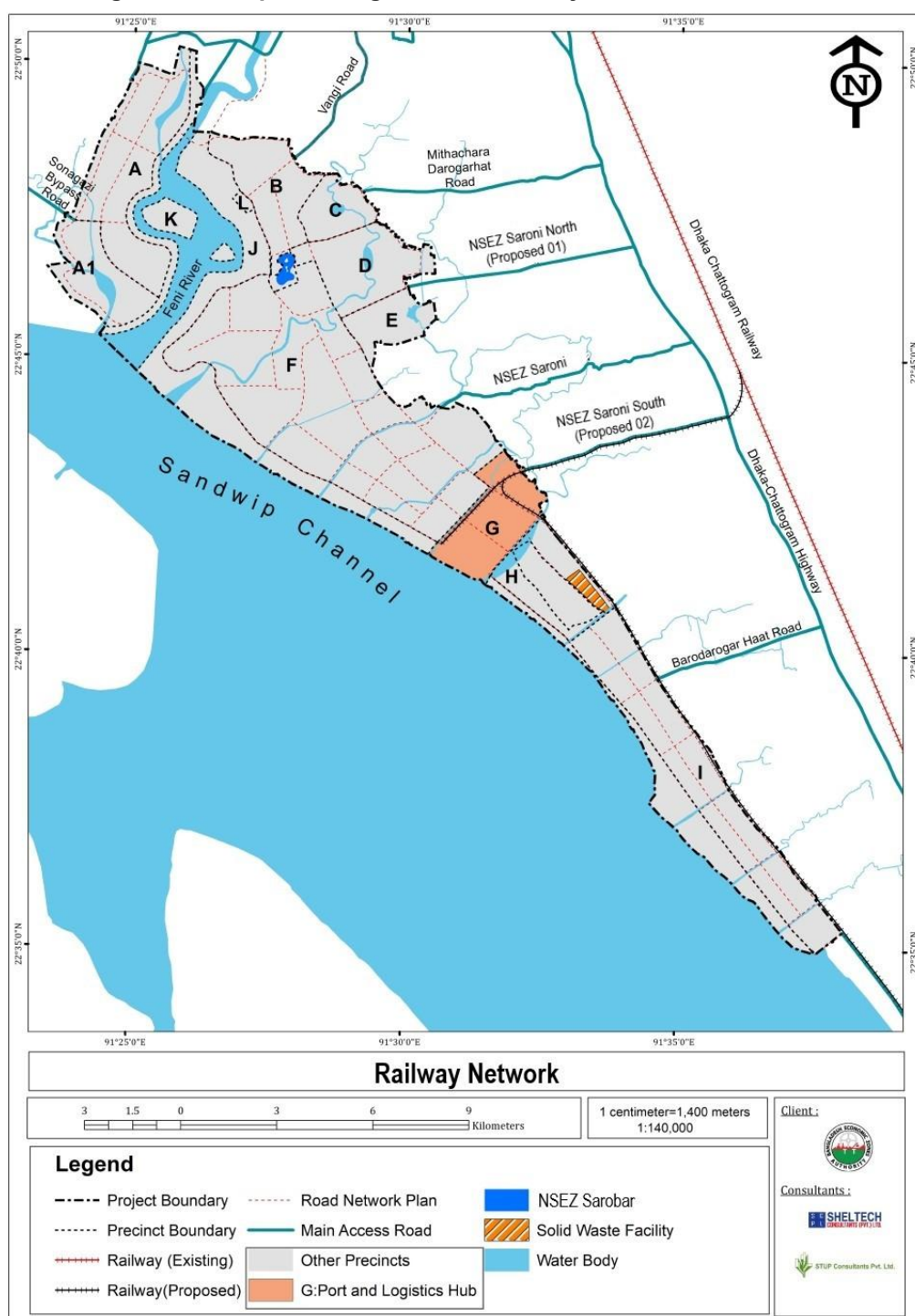


Source: BEZA, 2020a

2.4.1.2 Railway Network

A new railway line has been proposed to establish the connectivity between the NSEZ and the existing Dhaka-Chattogram railway line. The proposed railway line will take off from the Nijampur railway station having a length of 13.4 KM. A new railway station will be constructed at the NSEZ, which will be a “B” class station as per railway standards. For efficient operation facilities at the proposed NSEZ station, provisions will be made for one main line and three loop lines with clear standing lengths of 880m, 720m, and 620m. In addition to that one marshaling yard will be kept on the left side of the proposed station with four siding lines. A location map of the proposed railway line is shown in Figure 2-6.

Figure 2-6: Proposed Alignment of Railway Line to Connect NSEZ



Source: BEZA, 2020a

2.4.1.3 Water Transport

According to the consultation with BIWTA, a permanent jetty will be constructed at Sandwip channel for carrying the materials/goods and it will be operated by BIWTA. This particular site is situated in the eastern part of the Sandwip channel. The geographical coordinates of Jetty Stem starting point A (bank line) is 22°42'44.72"N and 91°28'25.07"E. A location map of the proposed jetty is given in Figure 2-7. The capacity of the jetty will be 2,500 to 3,000 tons. The jetty will have provisions like a terminal building, parking yard, boundary wall, etc. Capital and maintenance dredging and land development will be required during the jetty construction and operation.

Figure 2-7: Jetty Location at NSEZ, Mirsharai



Source: BIWTA, June 2019

According to the Feasibility Study report, the required jetty stem length at the proposed site was first 1.5 km with an available draft of 4.1m - 5m. However, decreasing the jetty stem to 1 km, for instance, would decrease the available draft to 3.1m - 4m and, thus, would require capital and maintenance dredging. Information on different jetty features is provided below:

- Jetty type: multi-purpose
- Jetty head length: 118m
- Jetty head width: 40.3m
- Jetty stem length: 1000m
- Jetty stem width: 13.5m (6 m for pedestrians +7.5m for non/motorized vehicles)

According to the BEZA, two private jetties will be constructed by the private sector investors (Samuda and Bashundhara).

2.4.2 Power Network

According to the discussion with BEZA, a memorandum of understanding (MOU) has been signed with the Bangladesh Rural Electrification Board (BREB) for power network distribution within the NSEZ. BREB provides all sorts of electrical services for the NSEZ. Apart from installing and providing electrical services, BREB also built substations from the BEZA fund. Further, the organization is constructing a 10 MVA substation from its own funds for the NSEZ. According to the Master plan, based on the demand forecast and load center, the following primary transmission network is outlined (Figure 2-8).

2.4.2.1 Power Demand

According to the Master Plan, the maximum electricity demand for the NSEZ is 3,248.17 MW. According to the discussion with BEZA, the phase wise power demand for NSEZ is shown in Table 2-4.

Table 2-4: Phase Wise Power Demand in NSEZ

Phasing	Power Demand (MW)
Phase 1	1,895.56
Phase 2	517.56
Phase 3	3,248.17

Source: BEZA, August 2025

The precinct wise power demand for NSEZ is presented in Table 2-5.

Table 2-5: Demand of Electricity for NSEZ

Precinct	Area (in Acres)	KVA/Acres	Demand KVA		Demand Factor	Max. Demand (MW)
			KVA	KW		
A	4606.57	182	958439.30	862595.37	0.6	517.56
B	1682.91	182	323930.88	291537.79	0.7	204.08
C	837.35	182	148202.60	133382.34	0.7	93.37
D	1778.59	182	367710.98	330939.88	0.6	198.56
E	880.68	182	159082.56	143174.30	0.7	100.22
F	10043.12	182	1836875.04	1653187.54	0.8	1322.55
G	1802.29	121	217591.88	195832.69	0.7	137.08
H	1778.75	121	213014.45	191713.01	0.7	134.20
I	3956.35	182	720055.70	648050.13	0.8	518.44
J	6030.42	-	0.00	0.00	0	0.00
K	350.89	100	35089.00	31580.10	0.7	22.11
L	56.85	-	0.00	0.00	0	0.00
Total	33804.76					3248.17

Source: Master Plan, 2020 Table 2-6 shows the on-site generation source for the economic zone. The rest of the electricity will be sourced from the national grid.

Table 2-6: Expected On-site Phase Wise Generation

Phasing	Electricity Generation (MW)
Phase 1	350
Phase 2	600
Phase 3	650
Total	1,600

Source: Master Plan, 2020

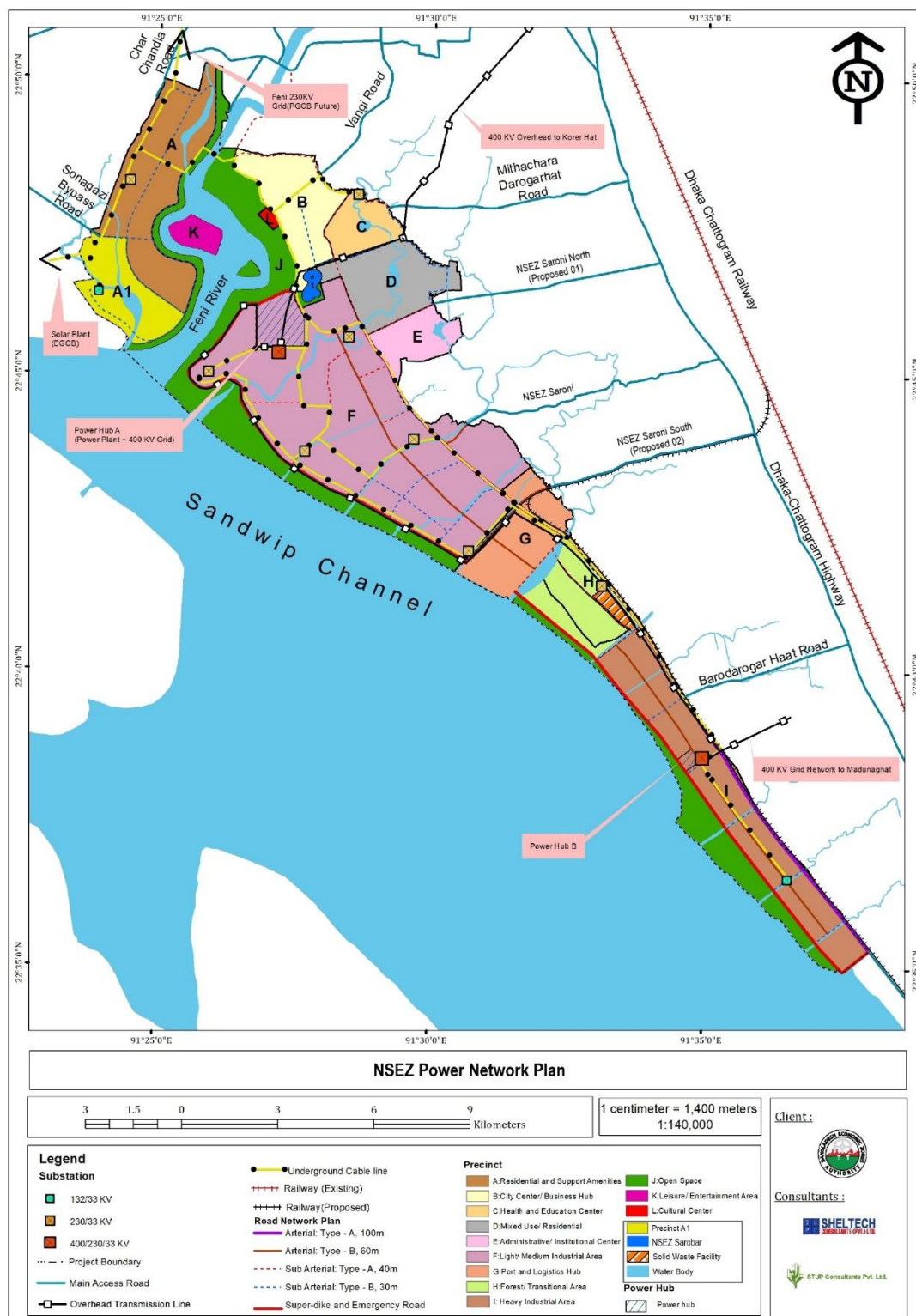
BR Powergen Limited (BRPL) has already established a 150 MW dual-fuel (Gas/HFO) engine-based power plant in the NSEZ. The powerplant started its operation in December 2018 and will be operated

Final Report

Regional Environmental and Social Assessment for National Special Economic Zone

for 20 years (PPA tenure). The main objective of the power plant is to ensure reliable and quality electricity to developers and unit investors as an Independent Power Producer (IPP). The total land area of the power plant is approximately 16 acres. Natural gas and HFO are the main raw materials for the power plant. Net plant capacity is $150 \pm 10\%$ MW. Electricity generated in the power plant is supplied to the PGCB's 230KV/33KV Grid Substation at Mirsharai.

Figure 2-8: Power Network Plan Within NSEZ



Source: BEZA, 2020a

2.4.2.2 Sources of Power

By 2040, the projected power demand of NSEZ is expected to reach around 3,248 MWh (maximum) of power. To supply power to the NSEZ, a reliable transmission infrastructure has been proposed to be constructed internally in the industrial hub by the BEZA through the PGCB, along with the upgradation of the existing grid network. Additionally, a 150MW power generation station, developed by BR Power Gen Company, has been constructed and is now operational. Furthermore, a 150MW solar power station has been set up in the nearby Musapur Union, which is also integrated into the PGCB power hub within the NSEZ. After conducting the total load demand assessment through, the feasibility study, and proposed specific transmission infrastructure interventions for NSEZ are given in Table 2-7.

Table 2-7: Proposed Project Interventions

S/N	Name of the Substation	Associated Transmission Line	Bay Extension	Implementation Agency	Status of Implementation	Demand (MW)
A. Phase-1 (2022 – 2027)						
1.	Bashundhara IEZL 230 kV substation (Zone-15)	Existing Mirsharai 230/33 kV grid substation (Hub A) to Bashundhara IEZL 230 kV four circuit overhead (O/H) line (two circuits for Bashundhara): xy1 km	2 no's of 230 kV GIS bay extension at Mirsharai 230/33 kV grid substation	Consumer	Proposed	200
2.	PHP Steel Works 230 kV substation (Zone-20)	Bashundhara to PHP Steel 230 kV four circuit O/H line (two circuits for PHP): xy km	2 no's of 230 kV GIS bay extension at Mirsharai 230/33 kV substation	Consumer	Not yet done	335
3.	BSRM 230 kV substation (Zone-3)	Mirsharai 230/33 kV grid substation to BSRM 230 kV D/C underground line: xy km	2 no's of 230 kV GIS bay extension at Mirsharai 230/33 kV substation	Consumer	Not yet done	220
4.	ACI 132/33 kV substation (Zone-2A)	Mirsharai grid substation to ACI 132 kV D/C underground line: xy km	2 no's of 33 kV GIS bay extension at Mirsharai 230/33 kV substation	BEZA & Consumer	Not yet done	24
5.	BEPZA 132/33 kV Substation (Zone-14)	Mirsharai grid substation to BEPZA 132 kV D/C line: xy km	2 no's of 33 kV GIS bay extension at Mirsharai	BEZA & Consumer	Not yet done	30

S/N	Name of the Substation	Associated Transmission Line	Bay Extension	Implementation Agency	Status of Implementation	Demand (MW)
			230/33 kV substation			
6.	Mango Teleservices Limited 132 kV substation (Zone-4)	Mirsharai grid substation to Mango 132 kV D/C underground line: xy km	2 no's of 33 kV GIS bay extension at Mirsharai 230/33 kV substation	Consumer	Not yet done	60
7.	Capacity upgradation of Mirsharai 230/33 kV grid substation with 2x140 MVA Transformer (3 rd & 4 th)	-	-	PGCB	Not yet done	300
8.	Upgradation of Mirsharai 230/33 kV substation with 400/230kV, 2x1000 MVA transformer	-	-	PGCB	Not yet done	740
B	Phase-2 (2028-40)					
1.	Upgradation of Mirsharai 400/230/33 kV substation to 400/230/132/33 kV grid substation: 400/132kV, 3x325 MVA transformer additions	-	-	PGCB	Proposed	1700
2.	400/230 kV, 3x750 MVA Mirsharai-2 grid substation	Mirsharai-2 substation to planned Mirsharai 765/400 kV grid substation: xy km	2 no's of 400 kV GIS bay extension at Mirsharai 765/400 kV grid	PGCB	Proposed	1400
3.	ACI 132/33 kV substation, 3x80/120 MVA GIS grid substation (Zone-2A)	2 no's of 132 kV GIS bay extension at Mirsharai substation (Hub A)	-	BEZA & Consumer	Proposed	66
4.	BEPZA 132/33 kV substation, 3x80/120 MVA	2 no's of 132 kV GIS bay extension at	-	BEZA & Consumer	Proposed	120

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S/N	Name of the Substation	Associated Transmission Line	Bay Extension	Implementation Agency	Status of Implementation	Demand (MW)
	GIS grid substation (Zone-14)	Mirsharai substation (Hub A)				
5.	Mango Teleservices Limited 132 kV substation (Zone-4)	-	2 no's of 132 kV GIS bay extension at Mirsharai substation (Hub A)	Consumer	Proposed	100
6.	230/132/33 kV Common grid substation at Zone 20 (230/132 kV, 2x300/450 MVA, 132/33 kV, 3x80/120 MVA) (Zone 20)	Mirsharai-2 substation to Zone-20 230 kV D/C line: xy km	2 no's of 230 kV GIS bay extension at Mirsharai-2 substation 230 kV Bus and Bay extension at PHP for Zone 20 common grid substation	BEZA & Consumer	Proposed	170
7.	230 consumer substations at Zone 25 (Zone 25)	Mirsharai-2 substation to zone-25 consumers substation 230 kV D/C line: xy km	2 no's of 230 kV GIS bay extension at Mirsharai-2 substation	Consumer	Proposed	170
8.	Mirsharai Residential Area 132/33 kV, 2x80/120 MVA GIS grid substation (Zone 29)	Mirsharai grid substation (Hub A) to residential area 132 kV D/C line: xy km	2 no's of 132 kV GIS bay extension at Mirsharai substation (Hub A)	BEZA	Proposed	90
9.	Zone-7 132/33 kV, 3x80/120 MVA GIS grid substation (Zone-7)	Mirsharai grid substation (Hub A) to Zone-7 132 kV D/C line: xy km	2 no's of 132 kV GIS bay extension at Mirsharai grid substation (Hub A)	BEZA	Estimation ongoing	90
10.	Indian Economic Zone 132 kV substation (Zone-19)	Zone 20 common grid to Indian Economic zone 132 kV D/C underground line: 1.20 km	2 no's of 132 kV GIS bay extension at PHP common grid	Consumer	Not yet decided	N/A
11.	Zone 22 Consumer 132 kV substation (Zone-22)	Zone 20 common grid to Zone 22 Consumer 132 kV D/C	2 no's of 132 kV GIS bay extension at PHP common grid	Consumer	Proposed	90

S/N	Name of the Substation	Associated Transmission Line	Bay Extension	Implementation Agency	Status of Implementation	Demand (MW)
		underground line: 1.46 km				

NB: Line length xy shall be finalized after the route survey and consultation with BEZA.

Source: PGCB, 2023

2.4.2.3 Transmission and Distribution Network

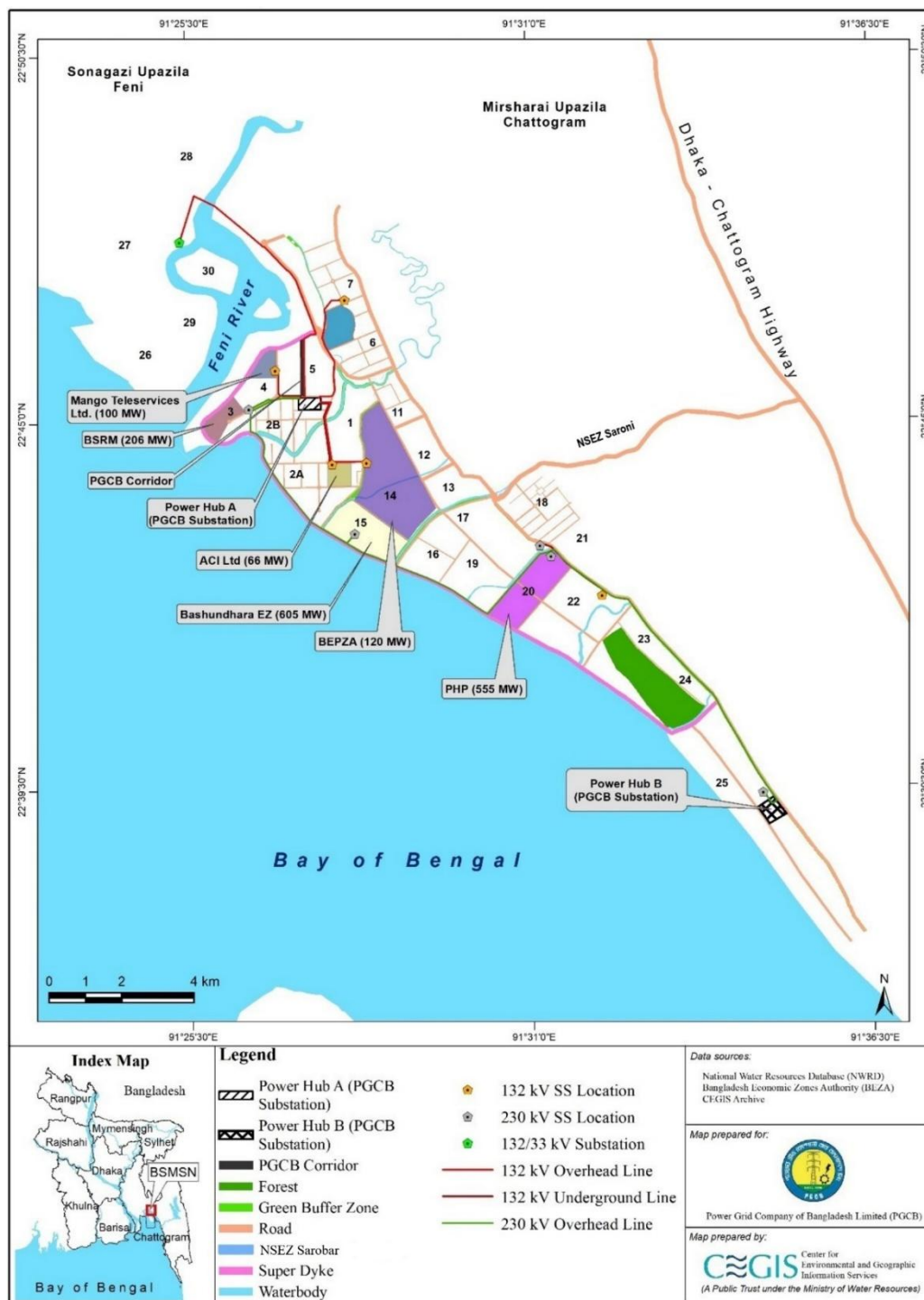
To provide a reliable power supply to NSEZ, transmission utilities have already been extended to the grid network by constructing a 7 km dedicated 400 kV overhead line, presently powered by 230 kV voltage and a 230/33 kV substation from at the site. In infrastructure planning, more links in 400 kV and 230 kV voltage levels may be considered with the national grid network to enhance the power supply reliability.

A 230/33 kV Substation having a capacity of 2 x 120/140 MVA (+ Future: 2x120/140 MVA) has been commissioned on 20th May 2020, feeding through a 400 kV architecture transmission line for a reliable power supply in the NSEZ. The substation is for a 400/230/33 kV substation, the rest 400/230kV substation section has with 2x1000 MVA capacity. The present power supply capacity through the Mirsharai-BSRM 230kV Double circuit line is around 1100 MW (conductor: Twin ACCC, 3000 Amp).

Currently, power is mainly supplied through the existing Baroirhat-Hathazari 132 kV double circuit line link from Baroirhat and Sitakundu substations. The distribution utility of PBS is supplying power through a 33 kV feeder at NSEZ. The link will be strengthened in the near future by making Line IN Line Out (LILO) at Korerhat and Fatikchari, having a capacity of 120 MW (ACSR Finch, 630 Amp).

There are two 33 kV source lines with a 477 sq mm conductor getting power from the Baroirhat 132/33 kV grid substation. One 2x20/28 MVA substation has already been established by Bangladesh Steel Re-Rolling Mills Ltd. (BSRM). Three substations are under construction, having a capacity of 2x10/14 MVA, 2x20/28 MVA, and 2x20/28 MVA, respectively.

The way of the corridor of cable lines and the right of way of the overhead line shall also be accommodated in the road plan and site plan of the precincts. The utilities shall develop their electrical infrastructure over the development period on the land and roadways reserved for electrical lines. All project interventions inside of NSEZ have been shown in Figure 2-9.

Figure 2-9: Map Showing all Project Interventions Inside NSEZ

Source: PGCB, 2023

2.4.3 Gas

2.4.3.1 Gas Demand

According to the Master Plan, the total gas demand in NSEZ is 584.03 MMCFD. The phase-wise gas demand in NSEZ is shown in Table 2-8 and gas demand for different industrial categories in NSEZ is shown in Table 2-9 respectively.

Table 2-8: Phase Wise Gas Demand in NSEZ

Phasing	Gas Demand (in MMCFD)
Phase 1	339.73
Phase 2	448.76
Phase 3	584.03

Source: Master Plan, 2020

Table 2-9: Gas Demand for Different Industrial Categories in NSEZ

Industrial Category	Area (in Hectares)	Area (in Acres)	Gas Demand (in m ³ /day/acre)	Total Gas Demand (m ³ /day)	Total Gas Demand (in mmcf)
Chemical Hub					
Chemical	34.52	85.31	99	4222.64	0.15
Chemical, Foam	8.34	20.61	99	1020.37	0.04
Chemical, Paints	20.35	50.28	3,700.00	93014.45	3.28
Garments	4.11	10.15	3,642.17	18482.21	0.65
Sub Total	67.32	166.35		116739.66	4.12
Heavy Industrial					
Sub Total	1,565.56	3,868.50	606.32	938221.25	33.13
Light/ Medium Industrial					
Automobile, Mango	48.16	119.01		0	14.42
Bashundhara	228.67	565.03		0	79.79
Chemical	4.59	11.33	99	504.89	0.02
Food and Beverage	18.22	45.03	404.69	9111.93	0.32
Garments	383.66	948.02	3,642.17	1726421.55	60.96
Garments Accessories	2.03	5.02	99	248.36	0.01
Light and Medium Industrial Areas	2,620.72	6,475.80	226.05	585541.58	20.68
Light Engineering	4.19	10.35	95	491.48	0.02
LNG Petro Chemical	22.71	56.11		0	0
Pharmaceuticals	12.22	30.19	99.96	1508.81	0.05
Power Plant, B-R Power	6.49	16.04	99	0	40.25
Power Plant, B-R Power Extension	20.23	50			107.75
Power Plant, BSRM Power	7.87	19.44		0	52.97
Steel Industry, BSRM	80.92	199.96		0	2.06
Steel Industry, PHP	246.76	609.76		0	121.7
Steel Product	43.27	106.91	300	16036.52	0.57

Industrial Category	Area (in Hectares)	Area (in Acres)	Gas Demand (in m ³ /day/acre)	Total Gas Demand (m ³ /day)	Total Gas Demand (in mmcf/d)
Textile	277.25	685.08	3,642.17	1247592.86	44.05
Utility	13.35	33		0	0
Sub Total	4,041.31	9,986.08		3587457.98	545.61
Port/ Logistics/ Light/ Medium Industrial					
Sub Total	236.67	584.81	226.05	33049.06	1.17
Grand Total	5,910.86	14,605.74		0	584.03

Source: NSEZ, 2020

2.4.3.2 Sources of Gas

According to discussion with BEZA, gas for all phases of NSEZ will be supplied by the Karnaphuli Gas Distribution Company Limited (KGDCL)/ Gas Transmission Company Limited (GTCL). KGDCL under the Ministry of Power, Energy, and Mineral Resources has initiated a project entitled "Construction of Gas Pipeline for Mirsharai Economic Zone and KGDCL, Gas Distribution Network Up-gradation Project by KGDCL". Objectives and targets of the project are to upgrade the KGDCL existing gas distribution network capacity from 350 MMSCFD to 500 MMSCFD to facilitate adequate gas supply to bulk and industrial customers of KGDCL, make arrangements for supplying 200 MMSCFD gas to the upcoming industrial customers in NSEZ from national gas network, and construct dedicated pipelines to supply of gas from Anowara CGS to three bulk customers like KAFCO, CUFL & Sikalbaha Power Station (SPS), isolating them from the existing ring main, to make necessary arrangements/modifications at Shahmirpur manifold station of KGDCL to receive R-LNG from GTCL's offtake to facilitate supply to the existing ring main. Officially, the gas distribution started on 30 August 2019.

There will be two high-pressure Transmission Pipelines (Bakhrabad - Chattogram to Mirsharai Economic Zone and Anowara to Shikalbaha) and associated installations, i.e., City Gate Station (CGS), District Regulator Stations (DRSs), Valve Station, etc. (GTCL, 2021). The physical components/ interventions of the two transmission lines are given in Table 2-10.

Table 2-10: Physical Components/Interventions of the Two Transmission Lines

Proposed Gas Transmission Line	Diameter (inch)	Pressure (psig)	Length	Associated Installations
Gas Transmission Line 1 (Mirsharai Economic Zone (BKB to MEZ))	16	1,050	17 km	• DRS is located at Ichhakhali Village • DRS is located at Char Sadar Bangla Bazar Village • Valve Station - 4 at Mirsharai • CGS is located at Noapara
Gas Transmission Line 2 [Karnaphuli Gas Distribution Company Limited (KGDCL) Gas Distribution Network (Anowara to Sikalbaha Upazila)]	16	350	20 km	• Valve Station-1 is located at Shahmirpur • Valve Station - 2 is located at Char Patharghata • Valve Station - 3 is located at Lakhera

Source: GTCL, 2021

2.4.4 Water

2.4.4.1 Water Demand

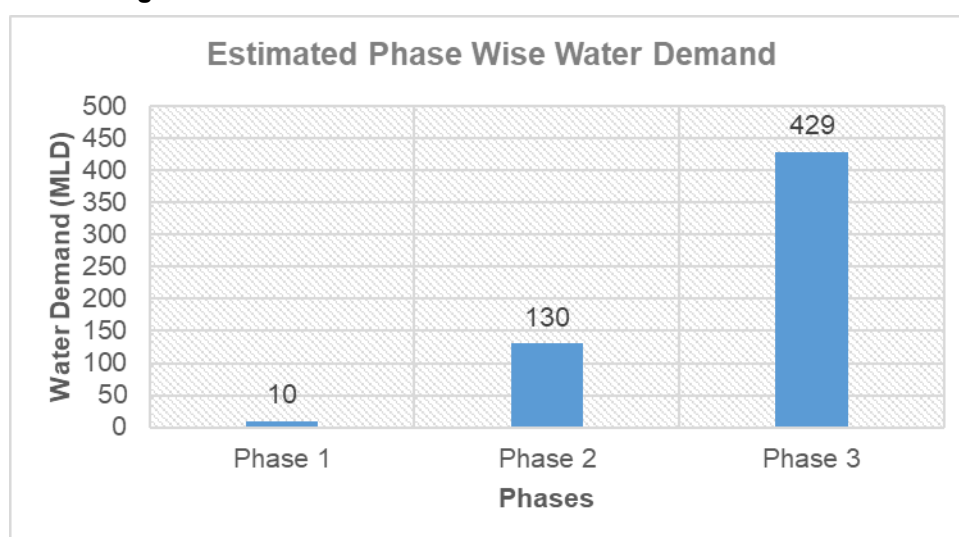
The NSEZ is planned for development in multiple phases, and water demand will be different in different phases of development. According to the discussion with BEZA, the estimated phase-wise water demand in the EZ is shown in Table 2-11 Figure 2-10

Table 2-11: Phase Wise Water Demand in NSEZ

Phases	Water Demand (MLD)
Phase 1	10
Phase 2	130
Phase 3	429

Source: BEZA, August 2025

Figure 2-10: Phase Wise Estimated Water Demand for NSEZ



Source: BEZA, August 2025

2.4.4.2 Source of Raw Water

According to the discussion with BEZA, various sources of raw water and the expected quantum of raw water that can be utilized/withdrawn to meet the water requirement of NSEZ are summarized below.

First Phase

- 10 Million Litter per Day (MLD) of groundwater will be extracted using Deep Tube Wells (DTW).

Second Phase

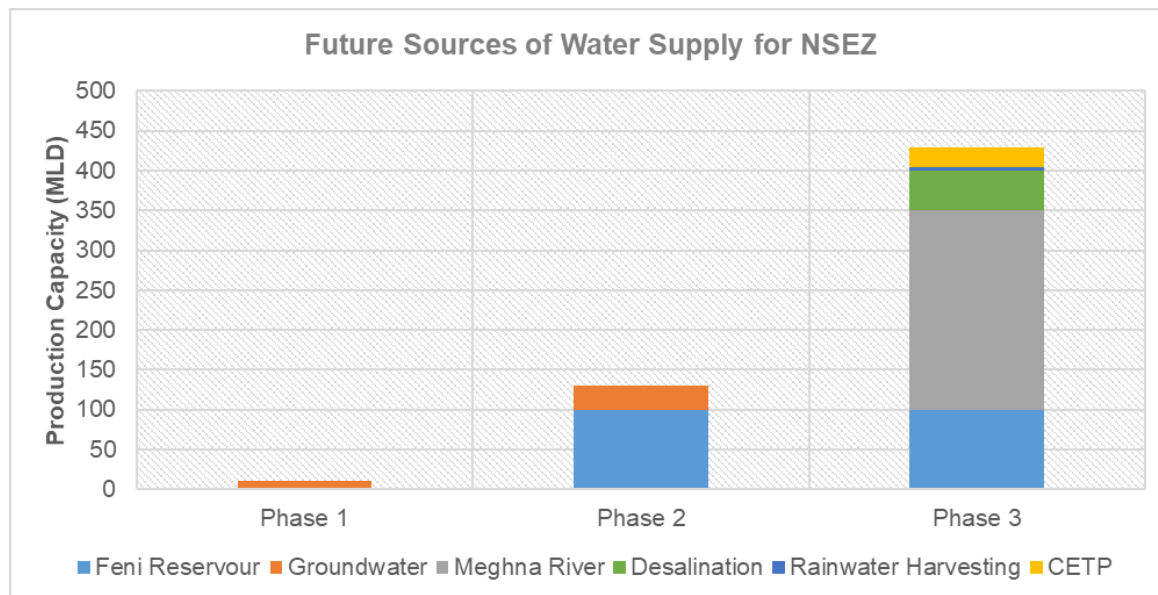
- 30 MLD of groundwater will be extracted using DTW.
- 100 MLD of surface water will be extracted from the Feni reservoir.

Third Phase

- 100 MLD of surface water will be extracted from the Feni reservoir.
- 250 MLD water will be extracted from the Meghna River at Chandpur.
- 50 MLD water will be sourced from from desalination plant.
- 5 MLD water will be sourced from the rainwater harvesting system.
- 24 MLD water will be sourced from CETP.

The development of the NSEZ area has been divided into three main time horizons- 2020-2025, 2026-2030, and 2031-2040. Accordingly, the production of water from surface water (Feni and Meghna River), groundwater, desalination plant, rainwater harvesting system, and, CETP's has been planned for NSEZ as shown in Figure 2-11.

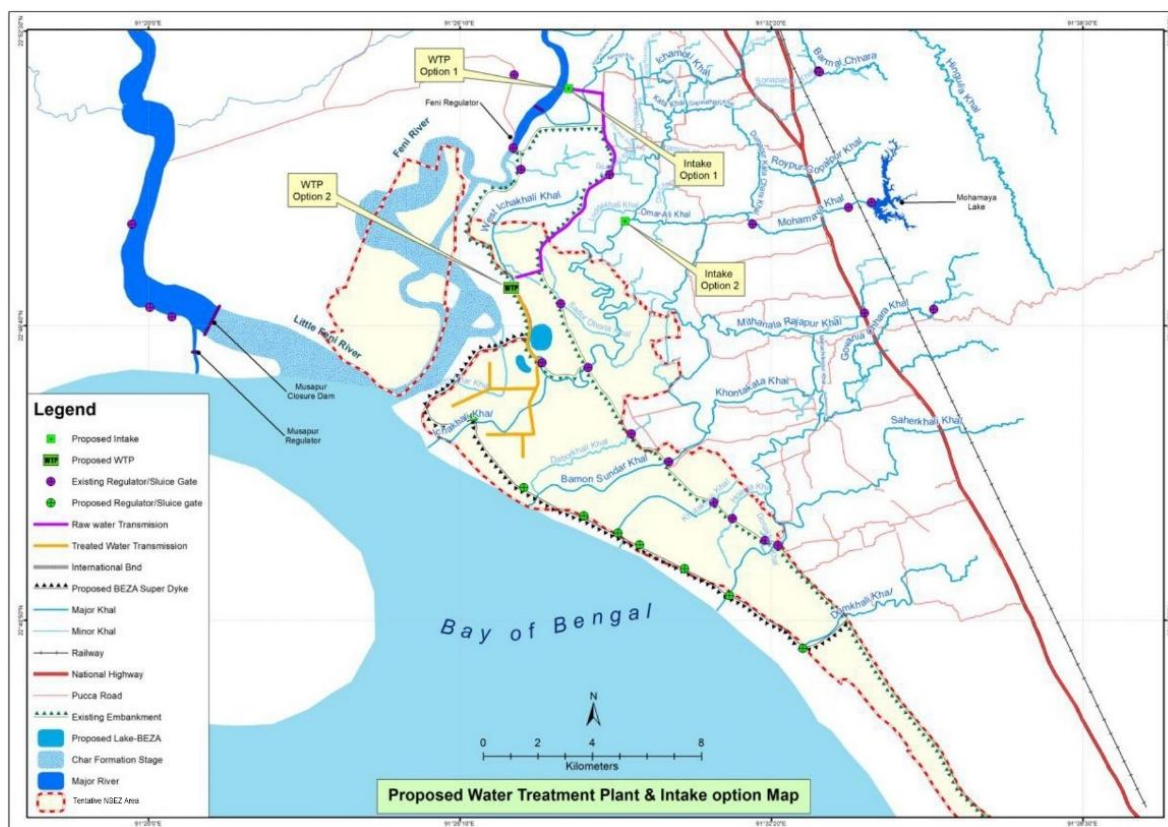
Figure 2-11: Future Sources of Water Supply for NSEZ



Source: BEZA, August 2025

The location of the proposed intakes and water treatment plant map considering the source of the Feni Reservoir is shown in Figure 2-12.

Figure 2-12: Proposed Intake and WTP Map Considering Source Feni Reservoir



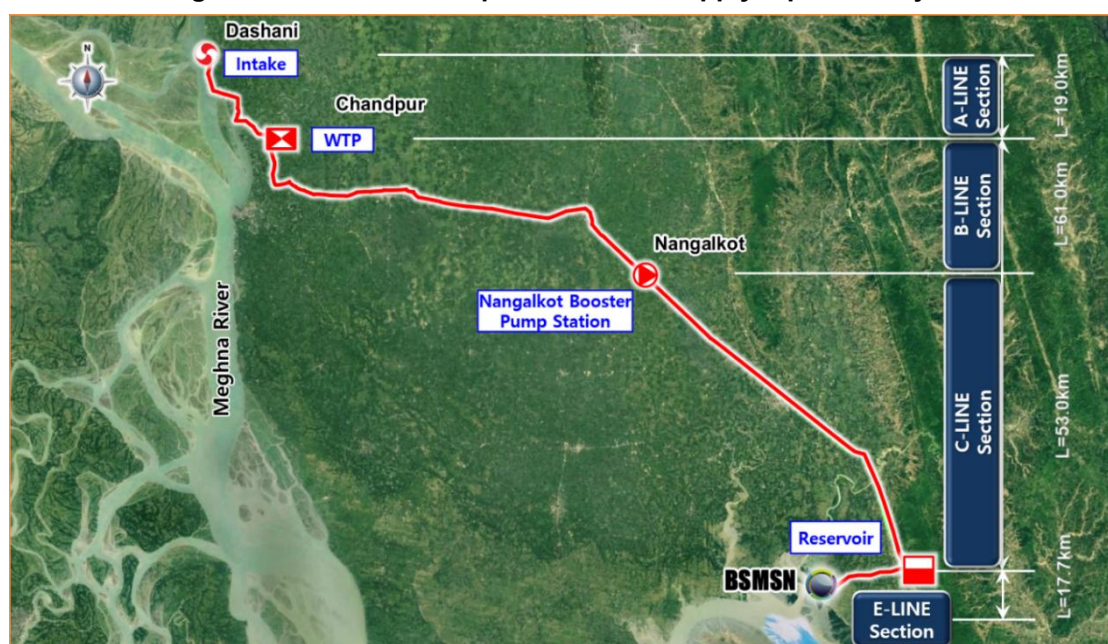
Source: BEZA, 2020b

2.4.4.3 Water from the Meghna River

According to the TOR for the transaction advisory service for the supply of treated water from Meghna River to NSEZ prepared by the CWASA (as contracting authority), the water demand in NSEZ will increase to 98.1 crore liters (981 MLD) by the year 2040 (BEZA Master Plan). In order to meet the water demand, CWASA sent a concept note to the local government division mentioning a source of water supply to NSEZ through a transmission line after extracting and purifying water from the Meghna River. A review of the said concept notes shows that after extraction and purification of 95 crores liters (500 MLD) of water from the Meghna River in Chandpur is possible to supply water to NSEZ through 132 km-long transmission lines to meet the water demand during the third phase implementation of the master plan. The water intake point for this water supply project has been selected as a point along the left bank of the Meghna River in the area of Mathavanga in Chandpur District.

NSEZ has a large demand for water to support its various industrial units, the workers' population needs, landscaping, and ancillary services. However, there are limited sources of surface water in the NSEZ region, and groundwater cannot sustainably support the full build-out scenario. An existing groundwater crisis is also present in the Mirsharai and Sitakunda area, as well as aquifer depletion risks, salinity intrusion, etc. Considering this factor, it is important to search for reliable surface water sources. The Meghna River (one of the largest and perennial rivers in Bangladesh) could be considered a dependable source of water, even during dry periods. The river has sufficient flow year-round to support bulk water withdrawal with treatment. A location map of the water supply pipeline project from Chandpur to NSEZ is shown in Figure 2-13.

Figure 2-13: Location Map of the Water Supply Pipeline Project



Source: <https://thefinancialexpress.com.bd/trade/korean-cos-awarded-preferential-rights-for-water-supply-project-in-bangladesh>

2.4.5 Waste Management

2.4.5.1 Domestic and Industrial Effluent Collection and Disposal System

The entire quantum of liquid waste (biological waste and/or industrial waste, as the case may be) likely to be generated from NSEZ shall be catered to two Sewage Treatment Plants (STPs) and four Common Effluent Treatment Plants (CETPs) aided by intermediate pumping stations. Strategically, the pumping stations shall be located in proximity to natural drainage channels to minimize the lengths of pumping mains. The different drainage channel crossings shall be affected by pipe-supporting structures. In addition, terminal pumping stations shall be provided at the location of all the treatment plants.

Sewage Treatment Plant (STP)

Raw sewage generated from EZ which produces predominantly biological liquid waste shall be treated using conventional biological treatment processes. According to the master plan, two STPs has been proposed. Capacity and area requirement for the two STPs is given in Table 2-12.

Table 2-12: Capacity and Area Requirements for the STPs

STP	Proposed Capacity (MLD)			Precinct	Area Requirements (acres)
	Phase 1	Phase 2	Phase 3		
STP-1	-	-	45	A	20
STP-2	-	-	80	B, C, D, E	40

Source: BEZA, August 2025

Common Effluent Treatment Plant (CETP)

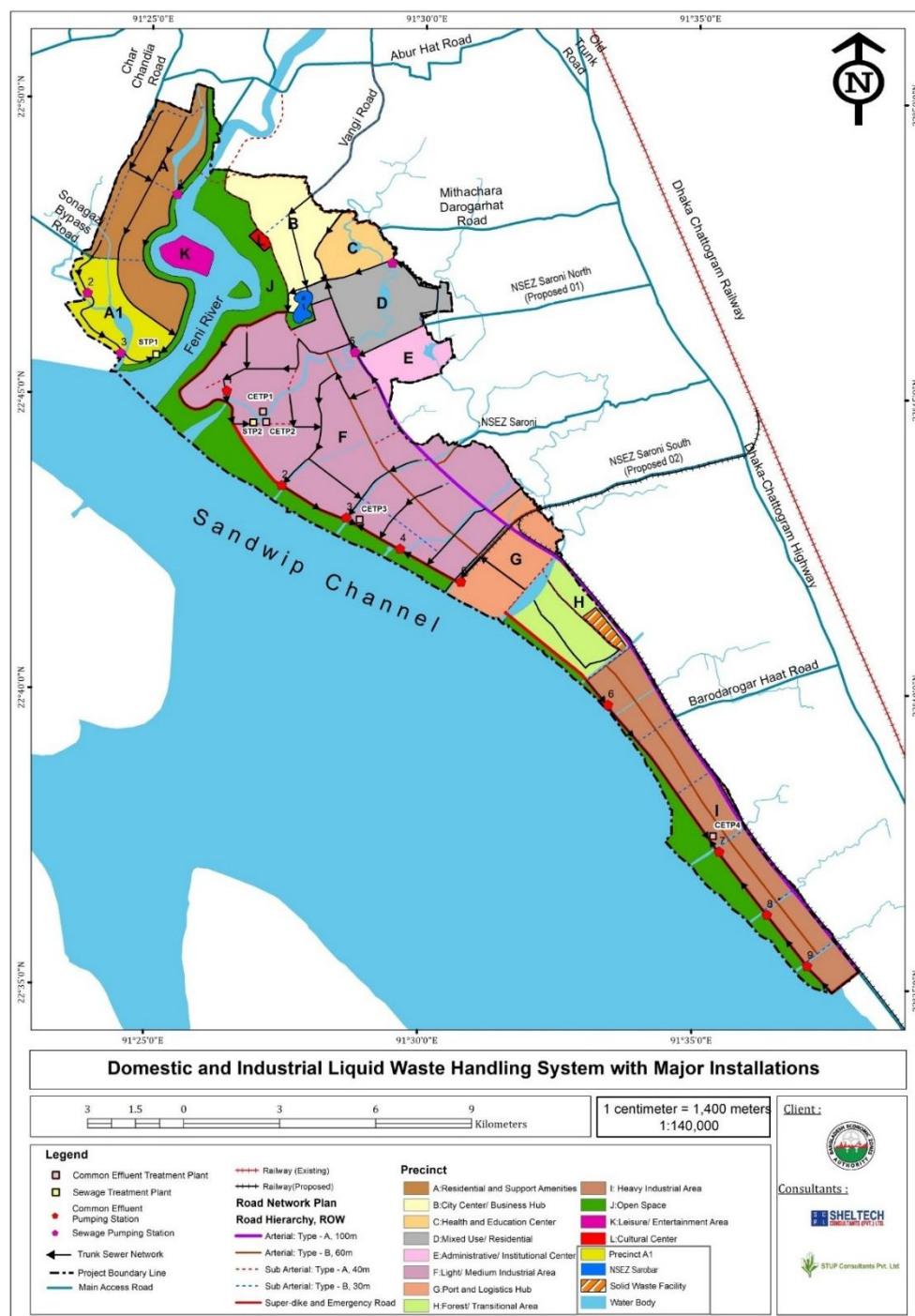
Raw sewage generated from EZ will be taken to common effluent treatment plant for treatment. According to the master plan, four CETPs has been proposed. Capacity and area requirements for the four CETPs are given in Table 2-13.

Table 2-13: Capacity and Area Requirements for the CETPs

CETP	Proposed Capacity (MLD)			Precinct	Area Requirements (acres)
	Phase 1	Phase 2	Phase 3		
CETP-1	-	50	50	F (2A, 2B)	15
CETP-2	-	50	50	F (2A, 2B, 3, 4 & 5)	15
CETP-3	-	-	100	G & F	45
CETP-4	-	-	150	I	80

Source: BEZA, August 2025

Figure 2-14 shows the sewerage system planning together with the locations of different pumping stations.

Figure 2-14: Liquid Waste Handling System with Major Installations

Source: BEZA, 2020a

2.4.5.2 Solid Waste Generation

According to the Master Plan, in the economic zone, approximately 33,805 acres of land have been proposed for development. Out of which approximately 15,781 acres have been proposed exclusively for industrial activities, and approximately 18,024 acres have been proposed for non-industrial activities. Municipal solid waste will be generated from household activities, commercial activities, institutions, and health care units. Industrial solid waste will be generated from industries. According to the master plan, the phase-wise expected quantity of solid waste generation is given in Table 2-14.

Table 2-14: Phase Wise Estimated Quantity of Solid Waste Generation in NSEZ

Phase	Estimated Quantity of Industrial Solid Waste (tons/year)	Estimated Quantity of Municipal Solid Waste (tons/year)	Total Solid Waste Generation (tons/year)
Phase 1	122,822	216,372	339,194
Phase 2	184,233	324,558	508,791
Phase 3	245,644	531,440	777,084

Source: Master Plan

However, considering different unexpected situations, the progress of phase 1 development of EZ is far behind. Considering the existing actual progress, the estimated volume of total solid waste generation from the EZ site is 11166.06 tons/year, including 7296.42 tons/year of industrial solid waste and 3,870 tons/year of municipal solid waste.

The quantity of industrial solid waste arrived by assuming the unit quantity (in kg) of production of waste per industry per 1 acre. The estimated volume of industrial solid waste is given in Table 2-15.

Table 2-15: Quantification of Industrial Solid Waste

Industry Category	Area Requirement (Acres)	NH ISW Generation ton/year/acres	NH Waste Generation (tons)	Hazardous Waste ISW Generation ton/year/acres	Hazardous Waste Generation (Tons)
Textile	-	4.45	0.00	0	0.00
Textile Accessory	-	9.27	0.00	0.24	0.00
Steel and Steel Products	130	20.65	2684.50	0.45	58.50
Pharmaceuticals	40	1.01	40.40	5.79	231.60
Chemicals (Paint Industry)	200	1.01	202.00	2.11	422.00
Food Processing and Agro-Processing	-	13.36	0.00	6.88	0.00
Electronic Industry	50	13.36	668.00	17.81	890.50
Automobile Industry	100	16.07	1607.00	3.24	324.00
Power and Energy Industry	16	5.26	84.16	4.86	77.76
Leather Product Industry	-	1.01	0.00	0.45	0.00
Light Industry (Motorcycle Assembly, Machinery Parts, General Assembly)	-	24.29	0.00	2.83	0.00
Paper Board Industry	-	5.26	0.00	1.62	0.00
Cement Industry	-	0	0.00	0.2	0.00
Chemical - Battery Industry	10	0.4	4.00	0.2	2.00
Total	546	115.4	5,290.06	46.68	2,006.36

Source: BEZA, August 2025

The quantity of municipal solid waste arrived by assuming the per capita production as 0.5 kg/capita/day for all the employees working within the zone and 0.3 kg/capita/day for the floating population¹. The estimated municipal solid waste quantity is given in Table 3.

Table 2-16: Estimation of Municipal Solid Waste

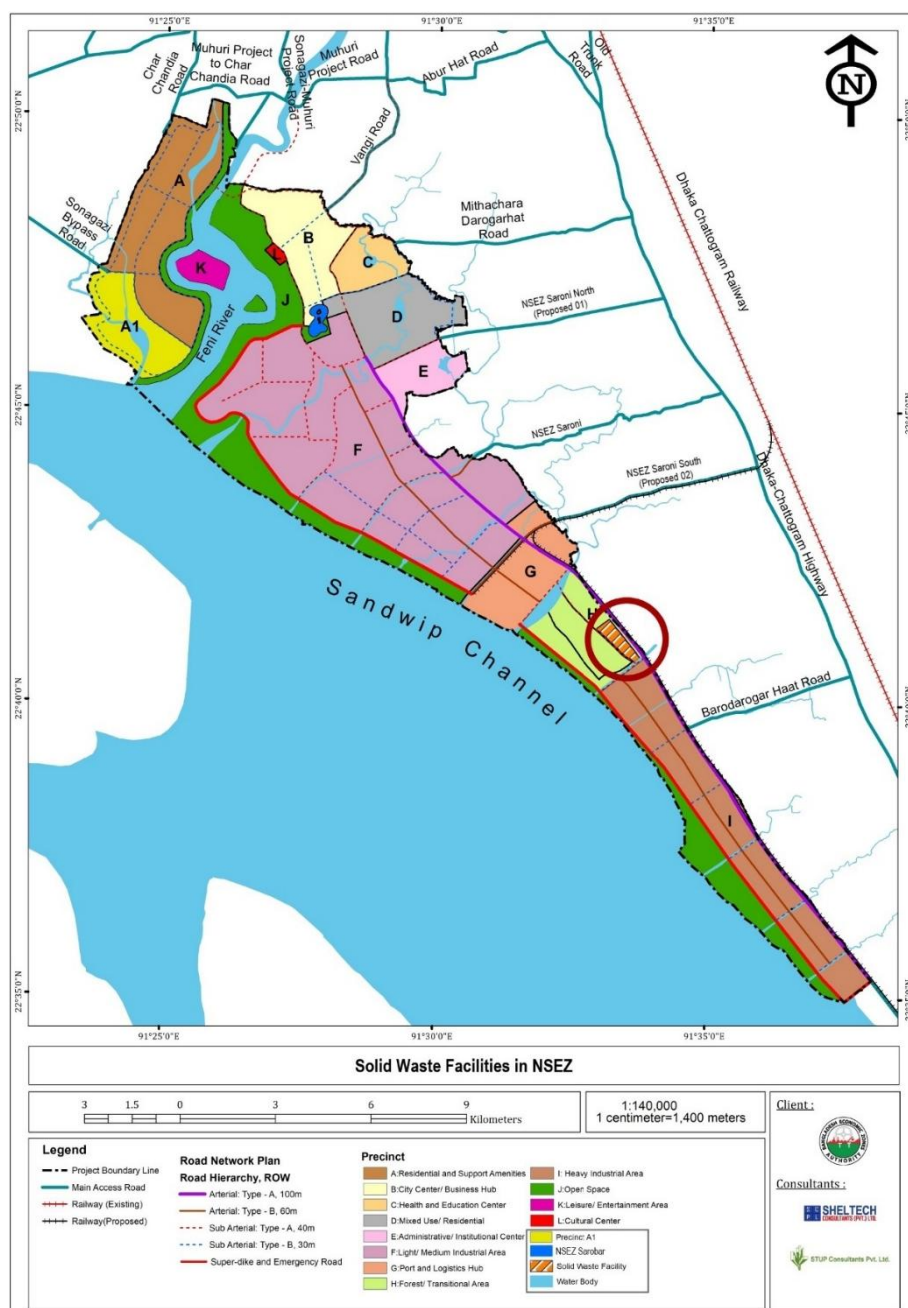
Employee	Unit factor (kg/capita/day)	Floating Population ²	Unit factor (kg/capita/day)	Total Municipal Solid Waste Generation (kg/d)	Total Municipal Solid Waste Generation (Ton/d)	Total Municipal Solid Waste Generation (Ton/year)
10194	0.50	18,349	0.30	10,602	11	3,870

Source: BEZA, August 2025

According to the master plan, about 185 acres of land has been kept for a solid waste landfill site, considering other facilities like a composting plant, different infrastructure, an area for biomedical waste, and a separate area for hazardous waste storage and management, will be about 274 acres (Figure 2-15). A specific site in Precinct H (Transitional Area) is selected as the landfill site, land for storage and primary processing of industrial solid waste, and land for storage and transfer station. If the industrial city authorities adopt the 3R/4R/5R strategy, then the land demand for landfills will be reduced.

¹ Draft Preliminary Viability Assessment Report on Green and Smart Zone prepared by PWC

² It is assumed that 40% are single employees and 60% living with their families, based on an average family size of 4 members (Population and Housing Census, 2022)

Figure 2-15: Solid Waste Management Facilities in NSEZ

Source: BEZA, 2020a

2.4.5.3 Stormwater Drainage System

The NSEZ study area includes several upstream rivers and internal khals that drain into the Sandwip Channel, which lies west of the super dyke and connects to the Bay of Bengal. Key waterways in the area include the Feni River, Little Feni River, Ichakhali Khal, Daborkhali Khal, Bamansundar Khal, Hoania Khal, Saherkhali Khal, and Domkhali Khal. These water bodies collectively shape the hydrodynamics of the region.

The Feni River stretches approximately 116 km from its source in Tripura to the Sandwip Channel in Bangladesh. During the monsoon, it experiences flash floods with rapid currents and eddies at sharp turns. Inside Bangladesh, its drainage area covers only 181 sq. km. The river features a closure structure with a 40-vent regulator near Muhurighat Bazaar, commonly known as the Feni Regulator and Dam (Muhuri Reservoir). The upstream of the Muhuri Dam serves as a reservoir and recreational area.

The river acts as a drainage pathway for upstream flash floods and empties into the Sandwip Channel at the northern boundary of the NSEZ.

The Little Feni River originates from the Tripura hills in India and flows into the upper mouth of the Sandwip Channel, north of the NSEZ. Flowing along the western and southern borders of Sonagazi Upazila near the NSEZ, the river's original course is now closed, with a 23-vent regulator on its diversion channel at Musapur. The reservoir created upstream of the Musapur closure is used for agricultural irrigation and fisheries. While these two rivers—Feni and Little Feni—are outside the NSEZ, they contribute to the Feni-Mirsharai drainage system during floods without directly affecting the NSEZ boundary or super dyke area.

Ichakhali Khal receives irrigation water from the Feni Reservoir. It also collects flows from upstream tributaries such as Barmai Chhara, Roypur Gopalpur Khal, and Mohamaya Khal, which originate in the eastern hills. These tributaries contribute to Ichakhali Khal's flow before it empties into the Sandwip Channel through a newly constructed regulatory gate. During heavy monsoons, this khal carries floodwater from the upper catchment while its gate prevents tidal saline intrusion during high tides.

Originating from the Komoldoho waterfalls in the eastern hills, Domkhali Khal crosses the Dhaka-Chittagong Highway near Choto Komoldoho in Mirsharai. Upstream, the khal bifurcates near a degrading BWDB embankment before converging downstream near the super dyke. It ultimately discharges into the Sandwip Channel west of the NSEZ boundary. Regulatory gates at both the upstream and downstream ends of Domkhali Khal help manage flash flooding, minimize local flooding during low tides, and prevent saline water intrusion during high tides.

Saherkhali Khal merges with Gobania Khal upstream and runs approximately 5 km from the Dhaka-Chittagong Highway before reaching the super dyke area, where it discharges into the Sandwip Channel. Regulatory gates located upstream and downstream of Saherkhali Khal serve as tidal and flood control systems. This khal receives water from tributaries such as Mohamaya Khal, Mithanala Rajapur Khal, and Khontakata Khal, which carry flows from the eastern hills. Bamansundar Khal transports upstream floodwater and is regulated by a gate at its downstream end, which controls tidal water intrusion.

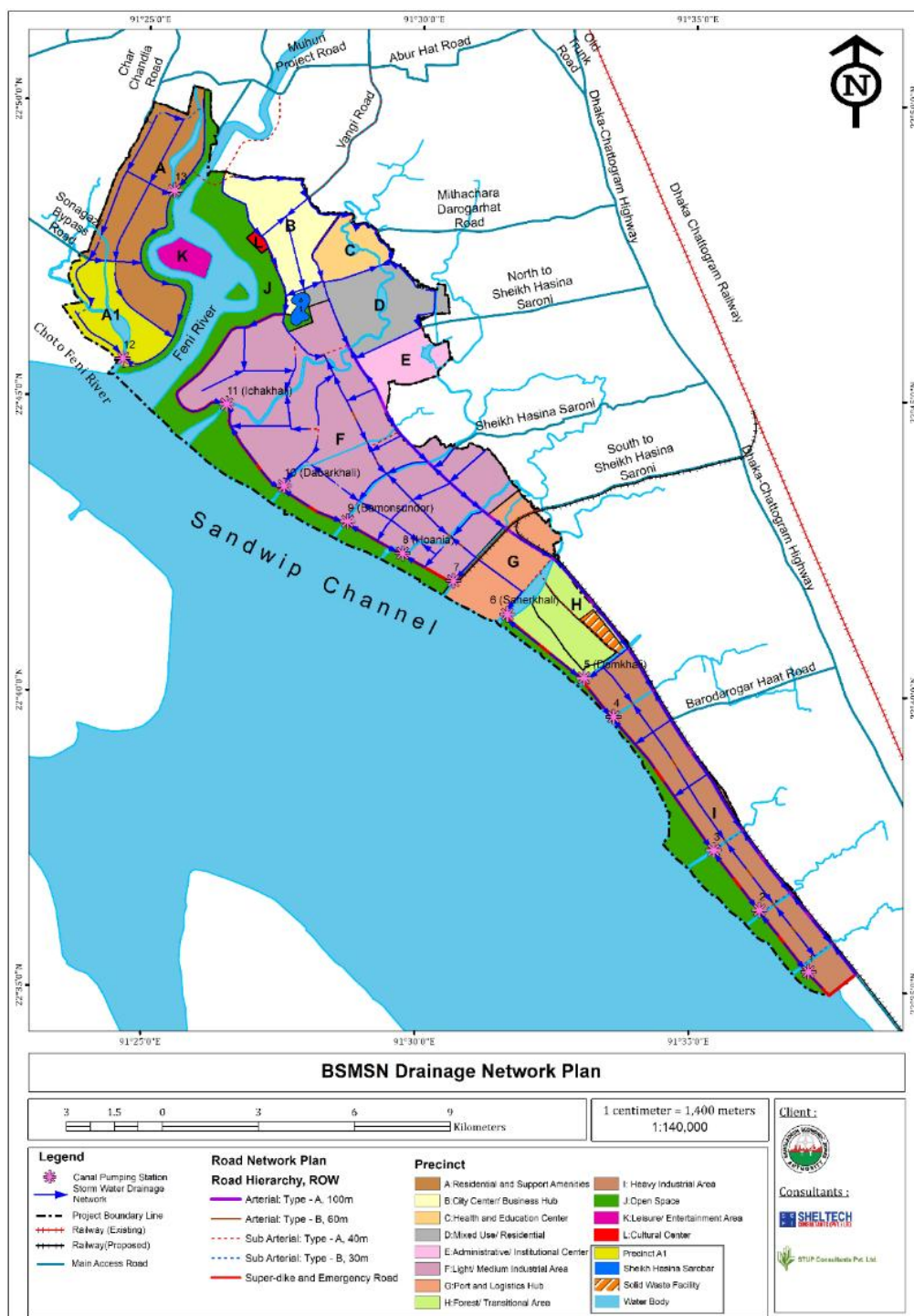
In summary, these interconnected rivers and khals play crucial roles in managing floods, controlling tidal saline intrusion, and drainage systems in the NSEZ and its surrounding areas.

As per the public consultation meeting, local people suggested improving the existing drainage canals. The canals' drainage capacity is poor during the heavy monsoon and high tide times, sometimes causing drainage congestion and inside water logging in the local community area outside of the NSEZ development zones. Some of the existing regulatory and sluice gates located upstream or downstream of the khals are in poor condition. As per the local consultation and environmental point of view, the bed slope, side wall, and freeboard of the drainage canals can be upgraded, thus improving the drainage system of the NSEZ development area.

Stormwater drains shall be provided on either side of the proposed road network of the area to collect the storm runoff generated from the catchment and get it discharged to the drainage channel for ultimate disposal to the sea.

An assessment of storm runoff contribution from NSEZ and areas outside NSEZ for individual drainage catchment areas has been made, considering the rainfall intensity of 34.4 mm/hr. and average runoff coefficient of 0.60 (keeping into consideration that rainwater harvesting will be extensively practiced in NSEZ for the area within NSEZ and an average runoff coefficient of 0.40 for the area outside NSEZ). The drainage network plan of NSEZ is given in Figure 2-16.

Figure 2-16: NSEZ Drainage Network Plan



Source: BEZA, 2020a

2.4.6 Telecommunication Network

According to the consultation with Bangladesh Telecommunications Company Limited (BTCL), a 22 km Optical Fiber Cable (OFC) was laid from the main road of the Dhaka-Chattogram highway to NSEZ on both sides of the access road. Besides, another 15 km of OFC will be laid from Sonagazi of Feni to Mirsharai EZ through Dasherhat (Charchandia) to ensure more redundancy. DWDM equipment will be installed at the NSEZ, which will be connected to Chattogram. Telephone and internet facilities for 20,000 subscribers will be required. To provide internet facilities and bandwidth of 150 Gbps capacity, a core router, and a switch with redundancy (1+1), access switches will be installed. Now, the

construction activities of a 4-story telecom building are ongoing, which will house all telecom, transmission, IP, and power systems equipment, offices and customer service centers, engine and substation rooms, residential buildings, etc. BTCL will also install an access network with universal duct systems as well as overhead OFC to facilitate telephone and internet using GPON technology.

2.4.7 NSEZ Plantation Plan

There are a number of ways to make green NSEZs in order to create pleasant environments, which are sustainable and resilient to climate change. A comprehensive plantation plan has been proposed along the road and rail networks, natural water channels, coastal area along the Bay of Bengal, Feni Reservoir, open spaces, and in Precincts K and L of the NSEZ Master Plan.

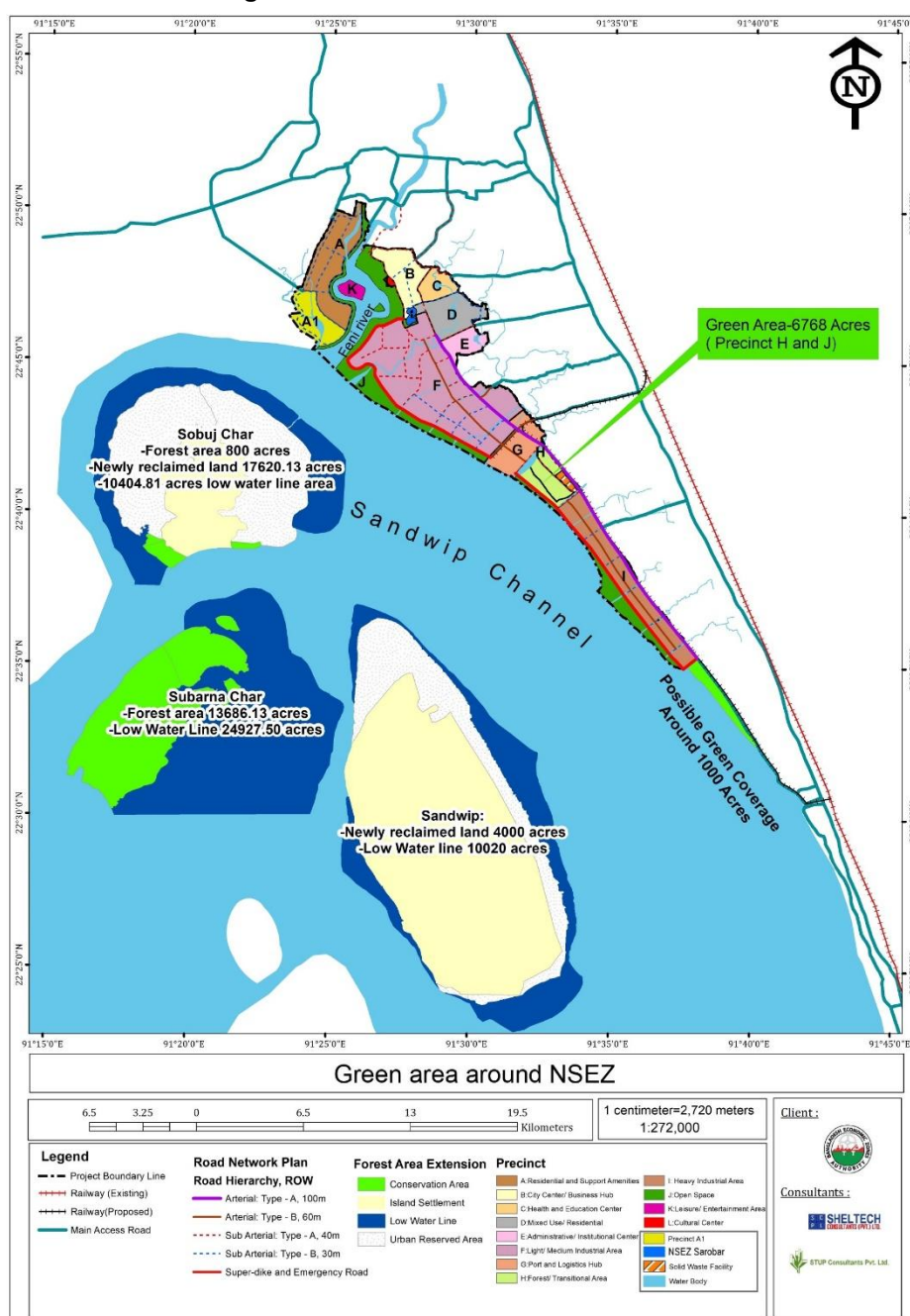
After a detailed consultation with the Divisional Forest Officer (DFO) Coastal Plantation, Chattogram it was suggested that BEZA can take the initiative for plantation in other potential areas which are shown in Table 2-17 and Figure 2-17. The total plantation costs are estimated at approximately 107 million BDT, considering the per square meter cost at 70 BDT.

Table 2-17: Other Potential Areas for Plantation

Proposed Plantation Locations	Area (Acres)
Total Subarna Char - the low line water line area of Subarna Char will be kept for green coverage	24,924.00
40% of the reclaimed Sabuj-Char	7048.00
Sabuj Char - the low line water line area of Sabuj Char will be kept for green coverage	10,404 .00
60% - low line water line area of Sandeep Char will be kept for green coverage	6,000.00
Total Plantation Area	48,376.00

Source: BEZA, 2020a

Figure 2-17: Green Areas Around NSEZ



Source: BEZA, 2020a

2.4.7.1 Progress of Plantation

According to the Consultation with Sitakunda O&M Subdivision of BWDB, reveal that the existing super dyke length is 22.5 km, and they have a plan to extend it by an additional 12.5 km towards Sitakunda. Within the existing 22.5 km, they don't have any plans for green zone development on this specific land. However, they agreed to finance the Bangladesh Forest Department (BFD) for planting trees in an area of 100 acres to create a green zone along the coastline of the Bay of Bengal as well as the NSEZ. In addition, the officials from the Coastal Afforestation Division of Sitakunda and Mirsharai range of BFD confirmed that currently they are implementing their coastal afforestation program, which began in 1966 and has continued since then to protect the population in the coastal areas from cyclones and storm surges and maintain environmental balance, as well as to stabilize newly accrued Charlands. Currently,

BFD has no specific green development plan focusing on NSEZ. However, they have a plantation plan under their coastal afforestation program along the coastline of the Bay of Bengal as well as the NSEZ.

According to the consultation with BEZA, the Bangladesh Rural Advancement Committee (BRAC) has already planted approximately 42,000 trees on 68 acres of land in Mirsharai, part of NSEZ, financed by HSBC Bank. BEZA has planted 4,00,000 trees so far in the NSEZ site and the closest road networks of NSEZ. The Forest Department also planted trees along the super dyke with their own financing. In the NSEZ Sarobar area, BEZA has planted trees on approximately 3 acres of land. In the Sonagazi part, they have already planted some trees along the road. The plantation program that has already been implemented by the FD and BWDB is given in Table 2-18.

Table 2-18: Plantation by Department of Forest and Bangladesh Water Development Board

S/N	Name of Department/ CSR Partner	Planted Year	Area (Hectares/km /Acres)	Number of Trees Planted	Name of Trees
1.	Department of Forest under the SUFAL project	2020-2023	400	2,000,000	Bain, Kewra, Geawa, & Jhau
2.	Department of Forest's Char Afforestation Project	2021-2022	200	1,000,000	Bain, Kewra, Geawa, & Jhau
3.	BWDB with the help of DOF	2021-2022	100	500,000	Bain, Kewra, Geawa, & Jhau
Total			700	3,500,000	

Source: BEZA, April 2024

2.4.8 Embankment/Super Dyke

According to the NSEZ³, the Bangladesh Water Development Board (BWDB) has constructed a coastal embankment (super dyke) with slope protection of 18.488 km, hydraulic structures, etc. for the protection of the NSEZ area from flood, saline intrusion, erosion caused by tidal surge, and natural disaster. The length of the embankment is approximately 22.5 km, and 9 nos. of sluices have been constructed. In addition, a 30 km re-excavation of the khal has been done.

According to the consultation with BWDB, a 12.5 km embankment will be constructed along the coastline from Domkhali in Mirsharai to Guliyakhali in Sitakunda. The embankment, 27 meters high with a 60-meter base and 9.8-meter top, will host a two-lane road. Additionally, 6 to 8 sluice gates will be constructed. In addition, BWDB will also construct a super dyke for protecting the Feni EZ.

³ <https://beza.gov.bd/economic-zones-site/government-owned-sites/mirsharai-chittagong/>

3 ES BASELINE OF THE REGION

This chapter describes the previous and present conditions of the physical, biological, and socioeconomic environment of the study region. This would help in the understanding of the resources available and environmental and social issues in the region. The outline of the baseline conditions would establish benchmarks to assist in the assessment of potential risks and impacts (both positive and negative) of the NSEZ. The issues identified in this chapter are linked to the primary profile of the region described in subsequent chapters.

3.1 Area of Influence

For a good understanding of the process of risks and impacts assessment and management, it is worthwhile to clarify the difference between the NSEZ area and the area of influence, as these overlap, but are not identical. This is described below.

- **NSEZ Area (NSEZ Footprint):** an area where the activities are realized. In other words, where development and operation take place.
- **Area of Influence:** an area where impacts from the activities may manifest, which can be larger than the NSEZ area, and considered areas that might be affected by indirect effects.

3.1.1 Area of NSEZ

The area that may reasonably be expected to be physically touched by development and operation activities across all phases. The NSEZ site is located on the coastline of Bangladesh. Administratively, the area falls in Mirsharai and Sitakunda Upazila of Chattogram District and Sonagazi Upazila under Feni District. The footprint for the NSEZ includes land used for flood protection and management, transport, buildings, telecommunication, water supply and sanitation, energy, waste management, power transmission and distribution line, gas transmission and distribution line, dredging area, and plantation area.

3.1.2 Area of Influence

The Area of Influence (AOI) for the NSEZ is defined as the area over which the impacts of the NSEZ are likely to be felt, including all its related facilities as identified above, as well as any reasonably foreseen unplanned developments induced by the NSEZ or cumulative impacts. The AOI is comprised of areas of direct and indirect impacts as follows:

- **Direct area of influence:** considers the physical footprint (inside of the master plan boundary having an area of 33,805 acres) of the development activities, such as the site layout, work staging areas, and areas affected during development and operation works (e.g., traffic patterns).
- **Indirect area of influence:** includes an area (10 - 15 km radius of the master plan boundary/547,091 acres considering the project footprint) that may experience EZ-related changes, combining with activities, not under the direct control of the development activities (e.g., labor influx, induced development, access to employment, etc.).

The AOI is generally larger than the NSEZ boundary to address all possible relevant risks and impacts. In this context, the impact area is the geographic area that may experience impacts on the physical, biological, or socio-economic environments from the development and operation of the NSEZ components. This area includes the lands permanently and temporarily affected by the NSEZ features.

The effects of the NSEZ activities on a particular resource or receptor will have spatial (distance) and temporal (time) dimensions. Some activities would impact a larger radius than other identified impact sources. The scale of which is dependent on a number of factors, including:

- Nature of the activity
- Specific resource or receptor

- Sensitivity of that resource or receptor
- Whether the impact is direct or indirect (e.g., a secondary effect)

The AOI for the NSEZ with respect to the environmental, biological, and social resources was determined considering the following spatial and temporal dimensions and possible risks and impacts:

Environmental Parameters

The AOI for individual environmental attributes is as below:

- Air Quality: dust emissions, fugitive dust, etc., are typically observed within 200-500 meters of the construction area. A minimum of 500 meters AOI has been taken to capture all sources of these emissions, including vehicular movement across access roads. It is assumed that during the operation phase, impacts on air quality would manifest in a 5 km radius of the NSEZ boundary, and therefore, different aspects in the area need to be studied further in detail in the RESA stage.
- Noise pollution: noise can often be detected up to 400-500 meters from any construction and operation.
- Surface Water Resources: freshwater bodies located in the vicinity of NSEZ and adjacent (Ichakhali, Daborkhali, Bamon Sundor, Khutakhali, Haonia, Saherkhali, Domkhali Khals, and Feni reservoir) may get impacted due to activities at the NSEZ footprint and allied sites. The drainage condition of the NSEZ footprint may be impacted. In addition, marine water bodies, i.e., Sandwip Channel and the Bay of Bengal, may be impacted due to the vessel's movement and dredging activities in the navigation channel.
- Groundwater Resources: Impact on groundwater quality and quantity - on the groundwater acquirer of the NSEZ region.
- Land resources: impact on soil and land is often restricted to the NSEZ footprint area. An AOI of 500 meters, taking into account indirect effects, usually occurs due to vehicular/heavy machinery movements and activities at allied sites.

Ecological Parameters:

- Terrestrial Flora and Fauna - this includes the areas immediately adjacent to the NSEZ footprint within which a zone of ecological disturbance is created through increased dust, human presence, and related activities (e.g., trampling, and transportation activities). This kind of disturbance has been estimated to occur within 2 km to 5 km of the NSEZ footprint.
- An AOI of a 5 km radius is considered for ecological study. The 5 km radius provides an understanding of the use of forested habitats around the proposed NSEZ.
- Marine ecology - the nearest water bodies, i.e., Sandwip Channel, are sensitive to Hilsa fish and Dolphins, and the Feni reservoir is sensitive to birds. These resources could be impacted due to the jetty construction and operation, ship movement, and dredging activities in the channel. Therefore, the Feni reservoir and Sandwip channel, including islands, i.e., Urirchar, Sandwip, and Jahaijjar Char, have been included in the AOI. Protected areas, including IBAs in the study area, were identified and analyzed during the data collection stage.

Socio-economic Parameters:

- Consists of the social aspects within the NSEZ site, the surrounding settlements, and receptors within the 500-meter corridor along the NSEZ access roads, gas transmission, and electricity transmission line that will potentially be affected by the NSEZ development activities and operations, and the cumulative impacts of nearby communities and projects.
- Potential impacts on the availability of natural resources for use by the community, demographics, and economic activities in the area, community health, and culturally significant sites and activities. It is assumed that within a 1 to 2 km radius, most of the social impacts would manifest, and therefore, different social aspects in the area need to be studied further in detail in the RESA.

- With respect to potential impacts related to the required labor during development and operation, has been set at a wider radius of 10 km, to include Mirsharai, Sonagazi, and Sitakunda Upazila Headquarters within its reach. The reason for this is that workers may be housed in the Upazila area, which means that the impacts of a worker influx (e.g., demand for services, perceptions of community safety, local demographics, etc.) could extend. This is not to say that impacts necessarily manifest in this wider radius, but that due consideration should be given to this possibility.
- The potential social changes assessed such as the study have any impact on the local school, service facilities, graveyard, religion, etc.
- A primary survey was conducted following a determined sample size for the collection of socio-economic data, emphasizing demographic and socioeconomic features of the targeted areas of four main concentrated unions, namely Shaher Khali, Ichhakhali, Mogadia, and Sonagazi. Stakeholder consultation will also cover issues like employment opportunities, loss of livelihoods (grazing and agricultural land), and increased anthropogenic/ vehicular activity in remote areas.

3.2 Physical Environment

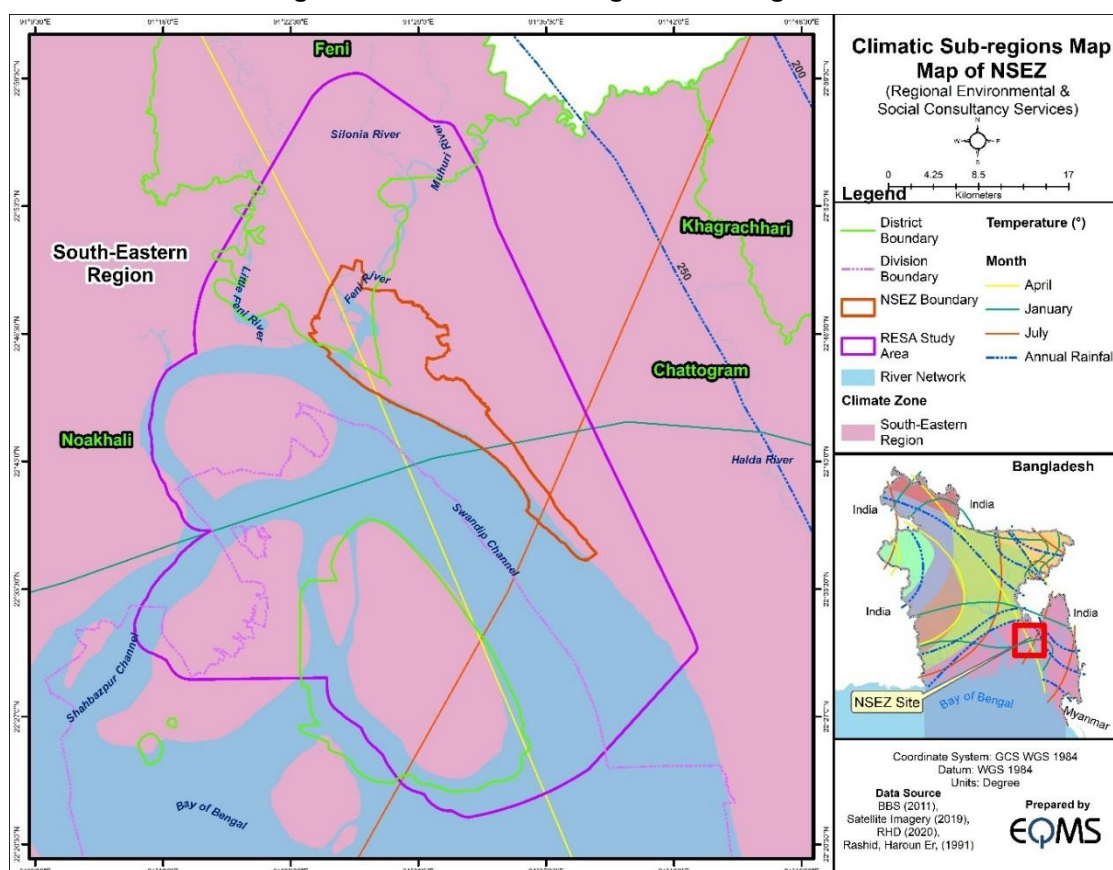
3.2.1 Meteorology

Bangladesh has a subtropical monsoon climate with annual heavy rainfall. Fortunately, there are six seasons in Bangladesh, including summer, rainy season, autumn, late autumn, winter, and spring. Brammer, 1996 has identified four distinct seasons resulting from this weather pattern, namely:

1. **Pre-Monsoon Season (March to May):** Characterized by the highest temperatures of the year - up to 36°C. Some rainfall occurs, with tropical cyclones occasionally affecting coastal areas.
2. **Monsoon Season (June to September):** Period of highest rainfall (up to 80% of the annual rainfall), humidity, and cloud cover. Increased rain and cloud cover generally cause a small reduction in mean daily temperatures.
3. **Post-Monsoon Season (October to November):** Temperature remains hot and humid, though cloud cover decreases in this season. Limited tropical thunderstorms may still occur, particularly in coastal areas.
4. **Dry Winter Season (December to February):** Coolest time of the year with mean minimum temperatures falling below 10°C in some areas. Reduced humidity and cloud cover. Rainfall is scarce.

Despite the general predictability of the seasons in Bangladesh, local conditions may still vary widely across the country. As such, Bangladesh can be divided into seven climatic sub-zones based on differences in a range of factors, including rainfall, temperature, evapotranspiration, and local seasonality (Rashid, 1991). According to the climatic sub-regions of Bangladesh, the NSEZ region is located in the Southeast region (Figure 3-1). The climatic data for the study area were obtained from three meteorological stations, i.e., Sitakunda, Sandwip, and Feni of the Bangladesh Meteorological Department.

Figure 3-1: Climatic Sub-regions of Bangladesh



Source: Rashid, 1991

3.2.1.1 Temperature

Based on the temperature recorded at Sitakunda, Sandwip, and Feni meteorological stations for the last 30 years (1992-2021), the maximum and minimum temperatures are observed to range between 23.3°C to 40.2°C and 5.7°C to 28.1°C. May is the hottest month of the year with an average temperature range between 24.8°C to 29.0°C. The lowest average temperature was 12.0°C in January 2013, and the highest average temperature was 32.1°C in April 2014 at Sitakunda station.

3.2.1.2 Rainfall

The annual rainfall based on rainfall data recorded at Sitakunda, Sandwip, and Feni meteorological stations for the last 30 years is 3,277.1 mm, 3,734.1 mm, and 2,898.6 mm, respectively. The highest rainfall was recorded at Sandwip station in June 2001 (3001 mm). An insignificant amount of rainfall has also been recorded in winter (November to February).

3.2.1.3 Humidity

Due to the heavy rainfall and proximity to the Bay of Bengal, the humidity levels in the region remain high. The relative humidity in the region generally varies between 77% to 81% throughout the year. Humidity remains higher in the monsoon (June to October) season and comparatively lower in the winter season. February is the driest month, having a relative humidity range between 72.8 to 77.5%.

3.2.2 Geology

According to Alam et. Al., 1990, the NSEZ site falls under the geological units of “Beach and Dune” and “Tidal Deltaic Deposit”. Table 3-1 shows the geological units that fall within the NSEZ site.

Table 3-1: Geology unit within NSEZ

S/N	Geology Unit	Area		
		sq km	Acres	%
1	Beach and Dune	121.99	30143.24	84.01
2	Tidal Deltaic Deposits	23.23	5739.10	15.99

Source: EQMS Consulting Limited, 2024

The study area falls under the geological units of “Tidal Deltaic Deposits”, “Beach and Dune”, “Tidal Mud”, “Valley Alluvium and Colluvium”, “Estuarine Deposits”, “Chandina Alluvium”, “Bhuban Formation”, and “Boka Bil Formation”. Table 3-2 shows the geological units that fall within the study area.

Table 3-2: Geology unit within the study area

S/N	Geology Unit	Area		
		sq km	Acres	%
1	Tidal Deltaic Deposits	676.37	167134.18	32.92
2	Beach and Dune	590.71	145968.40	28.75
3	Tidal Mud	384.11	94914.68	18.69
4	Valley Alluvium and Colluvium	180.25	44540.73	8.77
5	Estuarine Deposits	175.19	43291.12	8.53
6	Chandina Alluvium	41.57	10272.15	2.02
7	Bhuban Formation	3.42	845.71	0.17
8	Boka Bil Formation	3.07	759.25	0.15

Source: EQMS Consulting Limited, 2024

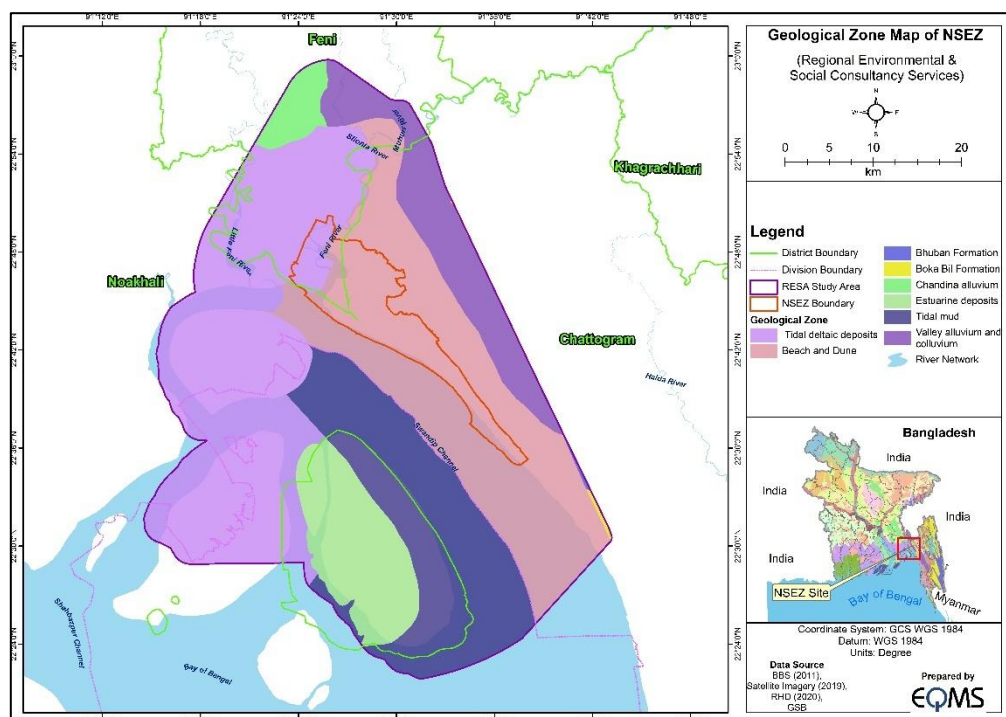
A brief description of the geology units is given below.

- **Beach and Dune Sand:** light to whitish-grey sand. Medium to fine, well-sorted, subrounded; contains concretions, shell fragments, heavy minerals, and rare clasts. Includes small mud-flat deposits. Unconformable overlies late tertiary formations (Alam, et. al., 1990).
- **Tidal Deltaic Deposits:** tidally influenced sedimentary environments, tide-dominated deltas are perhaps the most variable and difficult to characterize. This variability is due in part to the major role that fluvial systems play in defining their delta, with rivers differing widely in discharge, sediment load, seasonality, and grain size.
- **Tidal Mud:** dark to bluish-grey saturated silty clay containing shell fragments. Contains scattered lenses of beach sand. Zone defined by high and low tides. Tidal mudflat deposits are areas of active deposition (Alam, et. al., 1990).
- **Valley Alluvium and Colluvium:** medium to dark-grey or light brown silt, clayey silt, and fine to medium sand; locally contains coarse debris derived from local bedrock and organic matter. Unit is susceptible to mass movement processes such as landslides (Alam, et. al., 1990).
- **Estuarine Deposits:** fine to very fine sand is found along channels and edges of islands and represents ephemeral levee deposits. Most estuarine islands are actively eroding on the upstream side and aggrading on the downstream end (Alam, et. al., 1990).
- **Chandina Alluvium:** most topsoils are calcareous, but some are non-calcareous. The agricultural potential of these soils ranges from high to low. Most of these soils belong to chromic-calcaric gleysols (Biswas, et. al., 2010).

- **Bhuban Formation:** the upper part is predominantly sandstone and claystone. The middle part is predominantly claystone interbedded with siltstone and sandstone, and the lower part is dominantly sandstone interbedded with siltstone & claystone (Alam, et. Al., 1990).
- **Boka Bill Formation:** In the upper and lower parts, shale commonly dominates and is interbedded with siltstone and sandstone, and the middle part is dominated by massive, hard, locally calcareous, conglomeratic sandstone. The middle and lower parts contain calcareous lenses and concretions (Alam, et. Al., 1990).

The geological map of the study area is presented in Figure 3-2.

Figure 3-2: Geology Map of the Study Area



Source: GSB, 1990

3.2.3 Topography

The study area is generally flat and low-lying towards the Bay of Bengal and Sandwip Channel. The site belongs to the sea-land interactive sedimentary plain, and the terrain appears to be relatively flat. No hilly area has been found inside the NSEZ site and its immediate surroundings. Table 3-3 shows the elevation ranges and the covered area for the NSEZ site.

Table 3-3: Topographic Elevation Profiles within the NSEZ Site

S/N	Elevation Range (mMSL)	Area (km ²)	Area (Acre)	Area (%)
1	-7.90 - -6.44	2.66	656.06	1.83
2	-6.45 - -4.50	2.47	610.64	1.70
3	-4.51 - -3.54	2.34	578.29	1.61
4	-3.55- -2.08	2.27	561.45	1.56
5	-2.09 - -0.63	9.74	2,406.65	6.71
6	-0.64 - 0.82	11.34	2,801.48	7.81
7	0.83 - 2.28	9.70	2,397.78	6.68
8	2.29- 3.73	42.76	10,565.36	29.44

S/N	Elevation Range (mMSL)	Area (km ²)	Area (Acre)	Area (%)
9	3.74- 6.49	37.54	9,275.63	25.85
10	6.50	24.40	6,029.03	16.80

Source: EQMS Consulting Limited, 2024

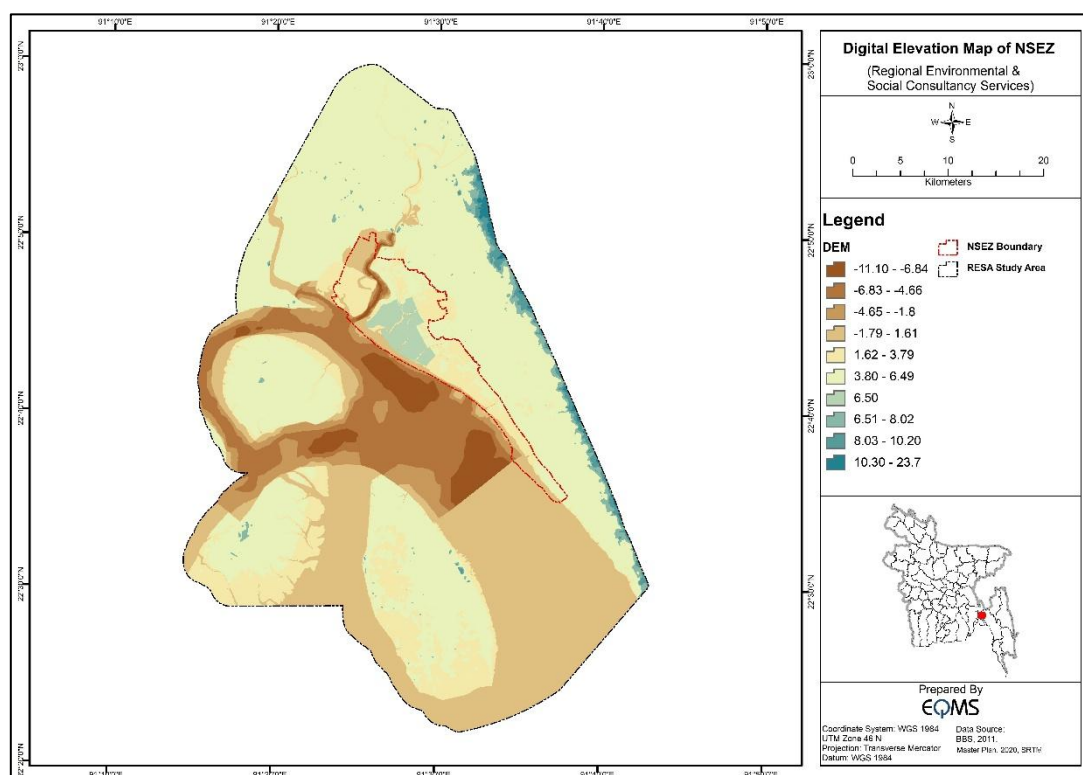
In the NSEZ site, topographic elevation ranges between -7.90 mMSL to 6.50 mMSL. In the downstream of the Feni River and the low-lying area, topographic elevation ranges in negative values like -7.90 mMSL to -0.64 mMSL. Over the NSEZ land site, topographic elevation ranges between 2.28 mMSL to 6.50 mMSL.

From the spatial analysis of the study region, the topographic elevation ranges between -11.07 mMSL to 23.7 mMSL. The DEM of the study region is shown in Figure 3-3. Ocean front areas like the Sandwip channel, NSEZ site, and the surrounding area's elevation profile and their covered area have been shown in Table 3-4. The lowest elevation range indicates the bathymetric area, like the Sandwip channel, downstream of the Feni River, and Muhuri Closure.

Table 3-4: Topographic Elevation Profiles within the NSEZ Site

S/N	Elevation Range (mMSL)	Area (km ²)	Area (Acre)	Area (%)
1	-11.10 - -6.84	59.97	14,817.21	2.94
2	-6.83 - -4.66	181.54	44,857.99	8.89
3	-4.65 - -1.8	89.14	22,024.97	4.37
4	-1.79 - 1.61	536.64	132,601.36	26.28
5	1.62 - 3.79	219.68	54,281.40	10.76
6	3.80 - 6.49	880.20	217,495.17	43.11
7	6.50	24.67	6,095.05	1.21
8	6.51 - 8.02	25.61	6,328.36	1.25
9	8.03 - 10.20	18.32	4,527.70	0.90
10	10.30 - 23.7	6.07	1,500.67	0.30

Source: EQMS Consulting Limited, March 2024

Figure 3-3: Digital Elevation Model of the Study Region

Source: EQMS Consulting Limited, March 2024

3.2.4 Soil

The SRDI has identified about 500 soil series in Bangladesh, and FAO-UNDP has identified 21 different general soil types based on the diagnostic horizons and diagnostic properties of the soil (FAO-UNDP, 1988). According to the SRDI soil database of Bangladesh, the NSEZ site falls under “Grey Piedmont Soils” and “Calcareous Alluvium”. Table 3-5 shows the soil types and covered areas for the NSEZ site.

Table 3-5: Soil type within NSEZ

S/N	Soil Type	Area		
		sq km	Acres	%
1	Grey Piedmont Soils	87.10	21522.85	70.57
2	Calcareous Alluvium	36.32	8975.48	29.43

Source: EQMS Consulting Limited, 2024

The study area falls under the unit of calcareous alluvium, old Meghna estuarine floodplain soils, mainly deep brown soils on low hills, grey piedmont soils, deep and shallow brown soils on very steep, high hill ranges. Table 3-6 shows the soil types and the covered areas for the study area.

Table 3-6: Soil types in the Study Area

S/N	Soil Type	Area		
		sq km	Acres	%
1	Calcareous Alluvium	819.35	202464.62	63.43
2	Grey Piedmont Soils	404.94	100062.20	31.35
3	Old Meghna Estuarine Floodplain Soils	67.41	16656.39	5.22

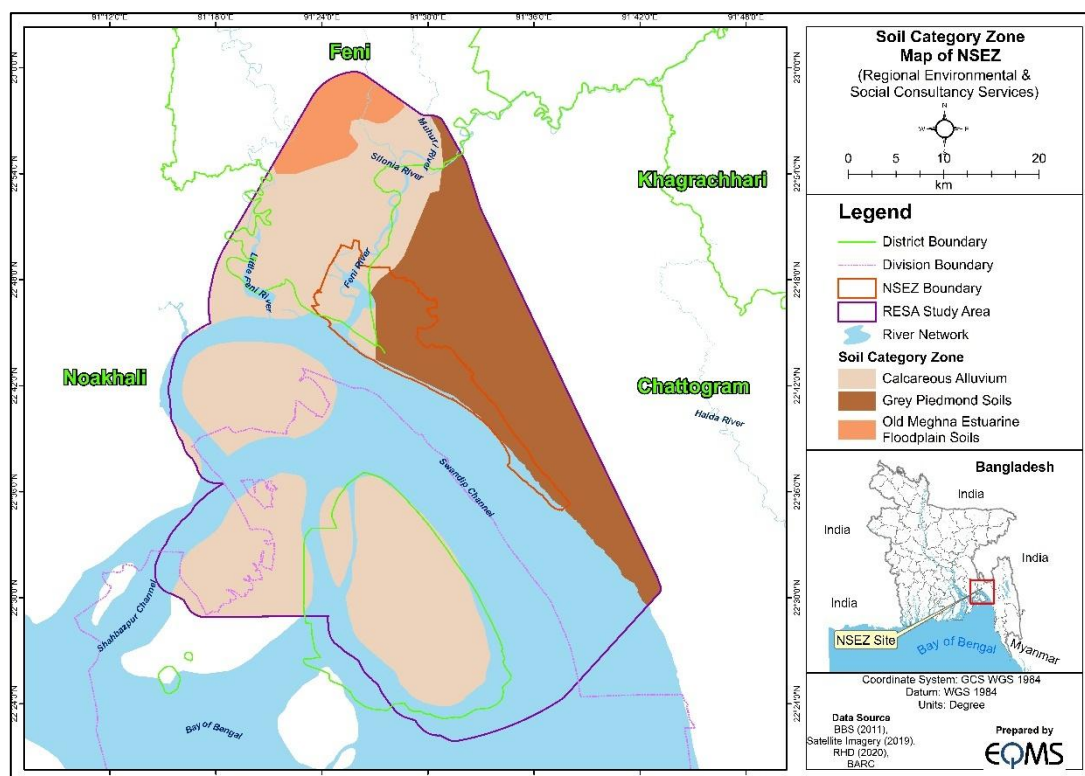
Source: EQMS Consulting Limited, 2024

A brief description of the soil units is given below.

- **Grey Piedmont Soils:** these soils occur on alluvial outwash fans at the foot of the northern and eastern hills and locally on the Chittagong coastal plain. Seasonal flooding is shallow, but they are severely affected by occasional flash floods caused by heavy rainfall. The topsoil has a 5-10 cm thick cultivated layer. They are grey to pale brown when dry and grey to olive-grey when wet. The subsoils vary from 15 cm to more than 60 cm in thickness. The agricultural productivity of these soils is mainly moderate to low. Most soils, except sandy ridge soils, are much better suited for paddy cultivation than dryland crops (Huq and Shoaib, 2013).
- **Calcareous Alluvium:** soils are stratified or there is raw alluvium throughout or below the cultivated layer. The soil of the Ganges floodplains is moderately to deeply flooded by river water during the rainy season, whereas the soils of the Meghna estuary are flooded by tidal water from the sea. The agricultural productivity of these soils ranges between moderate and poor. Large areas of relatively older soils on the Young Meghna estuarine floodplain are well suited for paddy cultivation, especially transplanted Aman (Huq and Shoaib, 2013).
- **Old Meghna Estuarine Floodplain Soils:** topsoil consists of 5-10 cm thick layers. The subsoils are 15-50 cm thick and have a coarse prismatic structure. The soil texture varies both within the profile and at different positions of the floodplain relief. On most floodplains, the highest ridge soils have a silt loam texture, and the basin soils are silty clay loam to silty clays. These soils are seasonally flooded. In most areas, flooding is caused by rainwater or a raised groundwater table. The moisture holding capacity is moderate to high in silt loam and silty clay loam soils. These soils are among the most productive soils in the country. In general, they are suitable for both dryland crops as well as paddy cultivation (Huq and Shoaib, 2013).

A soil map of the study area is shown in Figure 3-4.

Figure 3-4: Soil map of the study area



Source: Data from SRDI and map prepared by EQMS

3.2.5 Physiography

According to the physiography of Bangladesh, the NSEZ site falls under the physiographic units of “Chittagong Coastal Plain” and “Young Meghna Estuarine Floodplain”. Table 3-7 shows the physiographic units and the covered areas for the NSEZ site.

Table 3-7: Physiographic unit within NSEZ

S/N	Physiographic Unit	Area		
		sq km	Acres	%
1	Chittagong Coastal Plain	116.22	28719.74	83.71
2	Young Meghna Estuarine Floodplain	22.62	5589.52	16.29

Source: EQMS Consulting Limited, 2024

The study area falls under the physiographic units “Young Meghna Estuarine Floodplain”, “Chittagong Coastal Plain”, “The Low Hill Ranges”, and “Old Meghna Estuarine Floodplain”. Table 3-8 shows the physiographic units and the covered areas for the study area.

Table 3-8: Physiographic unit within the study area

S/N	Physiographic Unit	Area		
		sq km	Acres	%
1	Young Meghna Estuarine Floodplain	819.43	202485.65	56.14
2	Chittagong Coastal Plain	527.90	130447.49	36.17
3	Low Hill Ranges	64.61	15965.71	4.43
4	Old Meghna Estuarine Floodplain	47.56	11752.80	3.26

Source: EQMS Consulting Limited, 2024

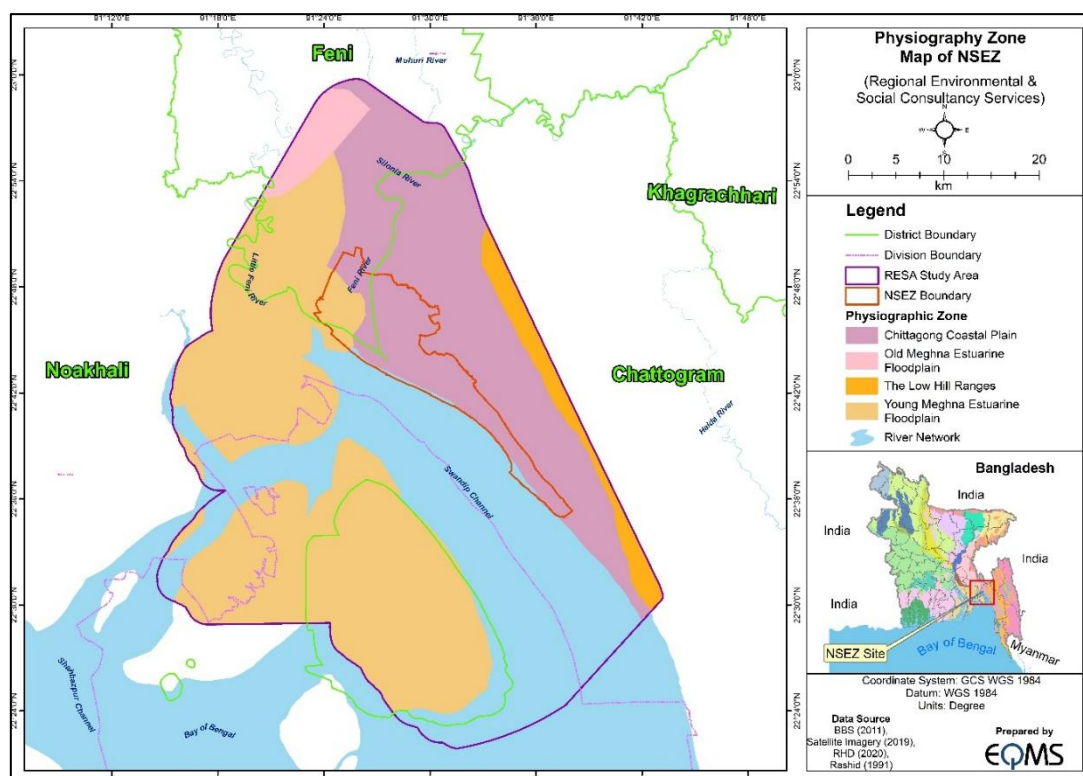
A brief description of the physiographic units is given below.

- **Chittagong Coastal Plain:** along the coast extends from the Feni River to the mouth of the Matamuhuri delta, a distance of 121 km. It comprises gently sloping piedmont plains near the hills, river floodplains alongside the Feni, Karnafuli, Halda, and other rivers, tidal floodplains along with the lower courses of these rivers, a small area of a young estuarine floodplain in the north, and sandy beach ridges adjoining the coast in the south. Sediments near the hills are mainly silty, locally sandy, with clays more extensive in floodplain basins. The whole of the mainland area is subjected to flash floods.
- **Young Meghna Estuarine Floodplain:** occupies almost the level land within and adjoining the Meghna estuary. It includes both island and mainland areas. New deposition and erosion are constantly taking place on the margins, continuously altering the shape of the land areas. The sediments are deep silts, which are finally stratified and are slightly calcareous. Seasonal flooding is mainly shallow but fluctuates tidally and is caused mainly by rainwater or non-saline river water. Flooding by saltwater occurs mainly on the lamed margins and during exceptionally high tides during the monsoon, also when storm surges associated with tropical cyclones occur.
- **Low Hill Ranges:** occupy synclinal areas between the high hill ranges, as well as isolated areas outside the main hill areas. These hills are formed over Dupi Tila and Dihing rocks of the mid-Miocene to Pliocene age. They mainly comprise unconsolidated sandstones, but they include soft siltstones and clays, and there are conglomerate and limestone beds in the north of Sylhet. The relief varies from level to very steeply sloping.
- **Old Meghna Estuarine Floodplain:** occupies an almost-level landscape of smooth, broad ridges and basins, which are underlain by deep silty deposits. In some basins, those silts have been buried by a layer of clay, which is usually less than 50 cm thick. Seasonal flooding is

mainly caused by accumulated rainwater. It is moderately deep or deep in the north and west, but it is shallow in the southeast. Only a few rivers, such as the Gumti, Dakatia, and Little Feni, cross the subunit, bordered by a narrow strip of their own, more variable floodplain deposits. Deposition of the Meghna sediments occurred over a period of several thousand years.

A physiography map of the NSEZ site and the study area is presented in Figure 3-5.

Figure 3-5: Physiography Map of the Study Area



Source: SRDI, 1997, Rashid 1991, and Reimann, 1933

3.2.6 Land Use and Land Cover

According to the Master plan, before the development of the NSEZ, the site was comprised of 24.6% idle/barren lands, 31.65% mangroves/forest/vegetation, 8.71% water bodies/canals, and 6.53% under development. These mangroves are planted by Bangladesh Forest Department.

In the study area, the major share of the land is under the water bodies, which is about 188,929.07 acres, covering 37.21% of the total land cover. Agricultural land is also present in the study area, which consists of 140,105.62 acres and accounts for only 27.59% of the total area. The mudflat and Settlement with Homestead Vegetation areas cover 15.04% and 13.89% of the total study area. Besides, Mangrove Plantation, aquaculture, developed land, built-up area, mixed hill forest, and railway area covering 3.03% (15402.09 acres), 1.76% (8952.48 acres), 0.70% (3534.19 acres), 0.40% (2048.77 acres), 0.30% (1503.99 acres), 0.07% (378.50 acres) respectively. The land use pattern of the study area is given in Table 3-9 and the land use map of the study area is given in Figure 3-6.

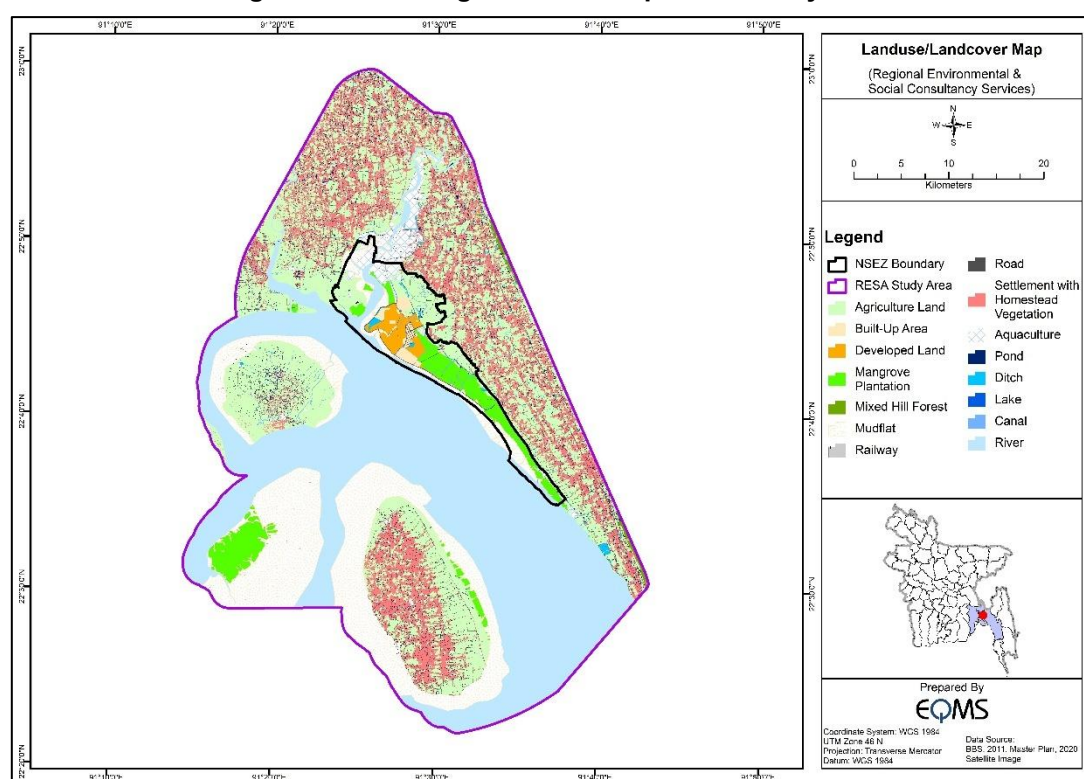
Table 3-9: Existing Land Use and Land Cover Pattern of the Study Area

S/N	Land Use Type	Area (km ²)	Area (Acre)	Area (%)
1	Waterbodies	764.57	188,929.07	37.21
2	Agriculture Land	566.99	140,105.62	27.59
3	Mudflat	308.98	76,351.51	15.04

S/N	Land Use Type	Area (km ²)	Area (Acre)	Area (%)
4	Settlement with Homestead Vegetation	285.39	70,521.93	13.89
5	Mangrove Plantation	62.33	15,402.09	3.03
6	Aquaculture	36.23	8,952.48	1.76
7	Developed Land	14.30	3,534.19	0.70
8	Built-Up Area	8.29	2,048.77	0.40
9	Mixed Hill Forest	6.09	1,503.99	0.30
10	Railway	1.53	378.50	0.07
Total		2,054.71	507,728.16	100

Source: EQMS Consulting Limited, October 2024

Figure 3-6: Existing Land Use Map of the Study Area



Source: EQMS Consulting Limited, October 2024

3.2.7 Geomorphology

According to Ahmed et. al., 2004, there are three geomorphologic divisions of Bangladesh vis-à-vis its soil formation. These are Tertiary Hills, Pleistocene Uplands, and Holocene Plains (Piedmont Plains, Flood Plains, Deltaic Plains, Depressed Lands, and Coastal Plains). The NSEZ site falls under the geomorphic unit of “Coastal Plains and Deltaic Plains”. Table 3-10 shows the geomorphology units that fall within the NSEZ site.

Table 3-10: Geomorphology unit within NSEZ

S/N	Geomorphology Unit	Area		
		sq km	Acres	%
1	Coastal Plains	124.06	30,654.93	99.91

S/N	Geomorphology Unit	Area		
		sq km	Acres	%
2	Deltaic Plains	0.11	28.35	0.09

Source: EQMS Consulting Limited, 2024

The study area falls under the geomorphic unit of Coastal Plains, Deltaic Plains, and Tertiary Hills. Table 3-11 shows the geomorphology units that fall within the study area.

Table 3-11: Geomorphology unit within the Study Area

S/N	Geomorphology Unit	Area		
		sq km	Acres	%
1	Coastal Plains	1,088.92	269,078.13	78.16
2	Deltaic Plains	303.64	75,030.87	21.79
3	Tertiary Hills	0.65	160.50	0.05

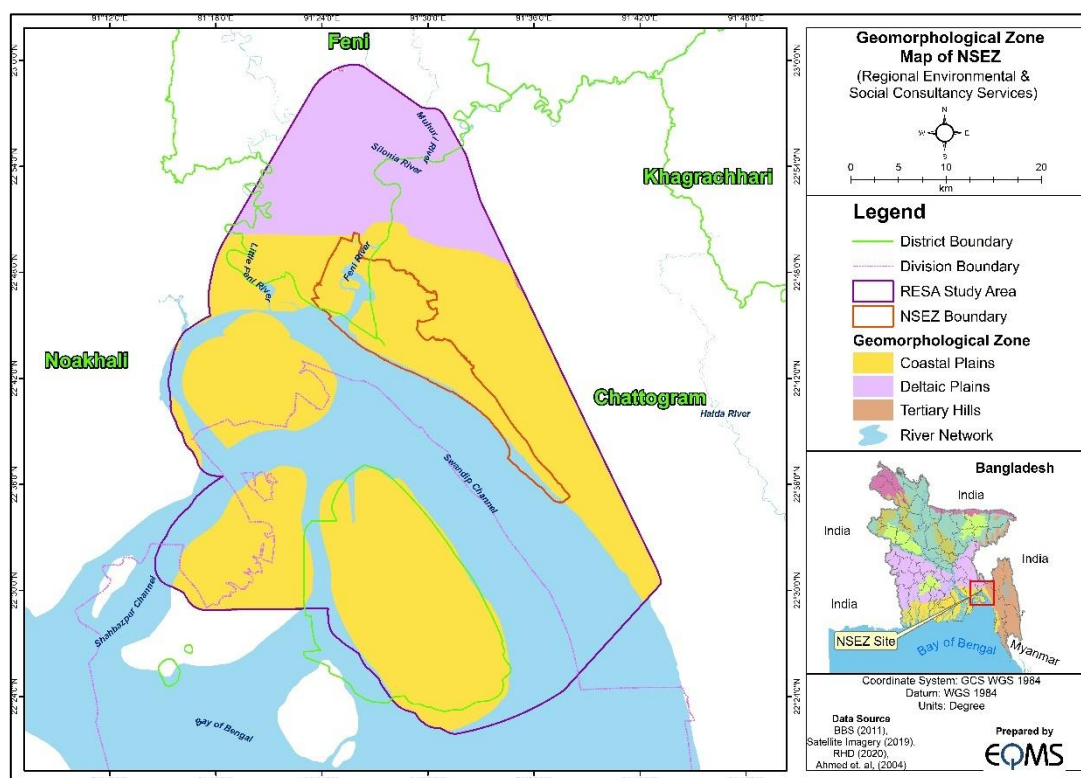
Source: EQMS Consulting Limited, 2024

A brief description of the geomorphic units is given below.

- **Coastal Plains:** the landforms are characterized by tidal lowland with weakly developed natural levees distributed in an irregular pattern. Swamps and depressions are also present in the area. Estuarine deposits of silt and silty clay dominate this area. The landforms in the area are temporary as they are changing due to cyclones and other natural calamities.
- **Deltaic Plains:** In the southwest, a part of the delta has been classified as the inactive delta, but the major part in the south and southeast is very active. The elevation of the delta is about 15m to 20m above sea level in the northwest and 1m to 2m in the south. Many swamps have developed in the substantial part of the delta.
- **Tertiary Hills:** Tertiary Hills areas constitute 12% of the total land surface of Bangladesh. Northern and eastern tertiary hills cover most of the Chittagong Hill Tracts. The overall pattern of the northern and eastern hill ranges is long ridges running generally north-south along the eastern border of Bangladesh.

A geomorphology map of the study area is given in Figure 3-7.

Figure 3-7: Geomorphology Map of the Study Area



Source: Ahmed, et al., 2004

3.2.8 Surface Water Hydrology and Drainage

Feni and Little Feni are the two major rivers that flow down to the Bay of Bengal on the northwest of the NSEZ. The major khals which flow through the NSEZ site are Ichakhali, Bamon Sundar, Saherkhali, and Domkhali Khal. Others are Daborkhali, Khutakhali, Hoania, and Donakhali Khals. A brief description of the rivers and khals is given below:

Feni River

Feni River is a transboundary river that originates in the eastern hills of Tripura and enters Bangladesh at Belchhari of Matiranga Upazila of Khagrachhari District. It flows through Ramgarh, Fatikchhari, and then flows along the border of Chattogram and Feni Districts and discharges into the Bay of Bengal near Sonagazi Upazila. The length of the river is approximately 108 km. The water level difference between high tide and low tide is a maximum of 1.2m. It is a perennial river but has tidal influence when it is fully inflated during the monsoon, and the measured flow rate is 10,800 m³/s (at Kaliachari) at that time. The flow decreased from February to April, and the flow rate was identified at that time as 1.35 m³/s (at Kaliachari). The course of this river is meandering, and the flood flow slope is nearly 15 cm/km. The water level of the Feni River is considered a non-tidal water level at Ramgarh and Kaliachari and a tidal water level at Dhumghat and Sonapur.

Little Feni River

Little Feni River is a transboundary river in Bangladesh. It originates from the Hill Tripura in India and enters Bangladesh near the Cumilla District, and after running in the southeastern direction, it crosses over the Noakhali District. Flowing further south, the Little Feni debouches into falling into the Bay of Bengal. The river contains a lot of meanders. A number of streams, e.g., the Dakatia and Gumti, meet the river on its course. It flows closely along the west and south border of Sonagazi Upazila. The original course of the Little Feni River has a closure on it and a 23-vent regulator on its diversion channel at Musapur. Upstream of the Musapur closure serves as a reservoir and recreation place as well (BEZA, 2020b).

Domkhali Khal

Domkhali Khal originates from the Komoldoho waterfalls in the eastern hills of Bangladesh. After flowing from its source, it crosses the Dhaka-Chattogram Highway near Choto Komoldoho. Domkhali Khal bifurcates upstream of the existing BWDB embankment, and they again meet immediately downstream of the embankment. A three-vent regulator has been constructed on the main channel and a two-vent regulator on its branch channel. Regulators are provided with flap gates downstream to prevent the intrusion of seawater (BEZA, 2020b). This canal has been used to maintain the natural drainage system of the catchment inside and outside of the NSEZ.

Saherkhali Khal

Saherkhali Khal, the main course originates from Napittachora waterfalls at Ujainnapara in Bangladesh and crosses the Dhaka-Chattogram Highway at 1 km south of Boro Takia Bazar. A six-vent regulator with flap gates has been constructed on Saherkhali Khal, crossing the embankment. A small khal, namely Golla Donakhali Khal, originates from open land and meets with Saherkhali Khal after crossing the embankment. A one-vent regulator has been constructed on Golla Donakhali Khal (BEZA, 2020b).

Bamon Sundar Khal

Mohamaya Khal, Mithanala Rajapur Khal, and Khontakata Khal are the major tributaries of Bamon Sundar Khal. These tributaries convey water from the eastern hills to Bamon Sundar Khal. Mohamaya Khal conveys its catchment runoff and releases from Mohamaya Lake to Bamon Sundar Khal at Sattar Bhuiyar Hat. Bamon Sundar Khal traverses through Sattar Bhuiyar hat, Bamon Darogar hat, Sufia Bazar, and flows down across the existing BWDB embankment. A nine-vent regulator with flap gates has been constructed on Bamon Sundar Khal (BEZA, 2020b).

Daborkhali Khal

Daborkhali Khal is located inside the NSEZ and flows through the Ichakhali Union (besides the BEPZA economic zone under NSEZ) in Mirsharai Upazila of Chattogram District. This khal meets the Sandwip channel downstream at the west side of the NSEZ super dyke area. The upstream of Daborkhali Khal is connected with the upper catchment of the watershed through a culvert and sluice gate, and at the upper catchment area outside of the NSEZ. Daborkhali khal is connected with Shusham khal through Ichakhali khal. The major industrial plots area is surrounded by the Daborkhali khal on the north side of zone-2A, zone-1, zone-14, & zone-12, and on the south side, zone-15, zone-14, & zone-13 are located.

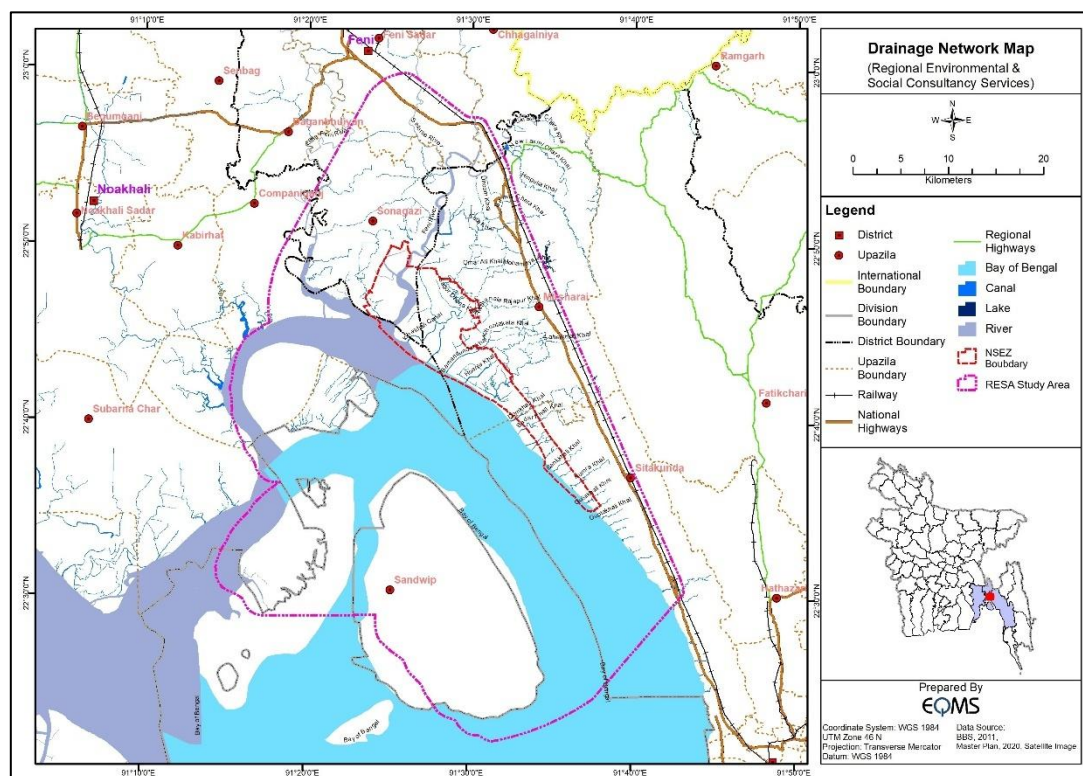
Hoania Khal

Hoania Khal is located inside the NSEZ in Mirsharai Upazila of Chattogram District. Downstream of Hoania Khal meets with the Sandwip channel. There is a sluice gate at the upstream and downstream of this khal to control the monsoon flood water from the upper catchment and to prevent the saline water during tidal surges. At the north and south sides of the Hoania khal industrial zones, like zone-19, zone-20, zone-18, and part of zone-21 are located.

Ichakhali Khal

Barmai Chhara, Roypur Gopalpur Khal, and Mohamaya Khal convey water from the eastern hills and make tributary contributions in Ichakhali Khal. The main course of Ichakhali Khal has been closed off with a BWDB embankment, and a diversion channel has been made with the construction of 9 vent regulators on the diversion. Purba Ichakhali Khal is a major drainage Khal in the countryside that crosses the embankment and flows down to Ichakhali Khal. It has a 5-vent regulator on it (BEZA, 2020b). The drainage system of the study area is shown in Figure 3-8.

Figure 3-8: Drainage System of the Study Area



Source: EQMS, 2023

3.2.9 Groundwater Hydrology

Groundwater is one of the major natural resources of Bangladesh. According to the detailed study on total water demand & water availability assessment for NSEZ, the hydrogeological investigation shows that the topsoil in the study area is composed mainly of silty clay. The shallow (10m to 121m) aquifer consists of very fine to fine sand that is mainly brackish in nature and shows a resistivity range between 0.9 Ω m to 12 Ω m. The aquitard thickness is highly variable and varies from ~15m to ~100m. The resistivity of the aquitard ranges between 1.24 Ω m to 17 Ω m and is composed of clay or silty clay. The deep aquifer shows a resistivity range varying between 23 Ω m to 73 Ω m and confirms having fine to medium sand with fresh pore water. The depth of the deep aquifer varies between ~50m to ~150m and is increasing towards the southeast. It is observed that shallow or deep aquifers in the study area are interrupted by discontinuous clay deposition at multiple depth levels of different thicknesses. Aquifers containing saline water show low resistivity values, and it is difficult to identify lithology or pore water quality unless direct information about the texture of the formation or the water quality of the formation water is available.

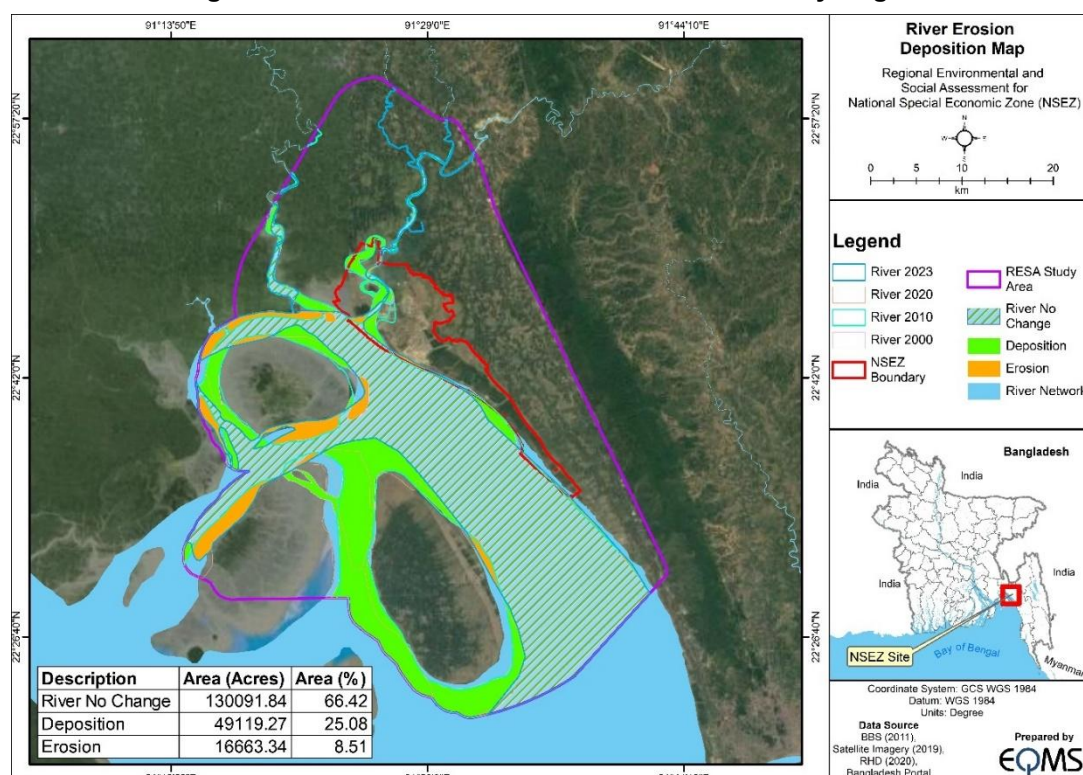
3.2.10 Erosion and Sedimentation

Sandwip is an offshore island along the southeastern coast of Bangladesh, which is very dynamic and unique in nature due to its geographical position and hydro-geomorphic settings. The island has been experiencing severe morphological and hydrological changes over time due to the combination of the effects of the estuary and tidal effects of the Bay of Bengal. Different parts of Sandwip Island exhibit cyclic accretion and erosion. The erosion and accretion of the island resulted from physical and anthropogenic causes. The water depth around the island exhibits similar dynamics in response from/to the erosion-accretion of the shoreline (Emran et. al., 2019).

In the Meghna estuary region, a distinct sedimentation is observed in the region between Sandwip and Uirichar, which will eventually join these two landforms (WARPO and BUET, 2020). The islands of Uirichar, Shwarno Dwip, Bhashan Char, and Sandwip had a higher accretion rate, and each had a

different setting from the other areas. Southward erosion and northward accretion were seen in these areas (Sultana et. al., 2023). The most accretion-prone areas of the Meghna Estuary are the Sandwip, Urirchar, and Shwarno Dwip areas, where about 0.22m/year deposition is found (IWM, 2010). Another study was carried out in 2013 to plan and detail design the Urirchar-Noakhali Cross-dam and predicted that about 11,000 hectares of land could be reclaimed in seven years (HaskoningDHV, 2014). A map showing the erosion and sedimentation in the study region is given in Figure 3-9.

Figure 3-9: Erosion and Sedimentation in the Study Region



Source: EQMS, December 2023

3.2.11 Traffic

To understand the traffic load, a road traffic survey was conducted continuously for 24 hours, once during the study period at one location beside Borotakia to NSEZ road. For the traffic survey, two video cameras were established at the monitoring locations, and later the record of vehicles was input into an Excel file manually from the recorder file. Vehicular movement has been counted for both directions (Borotakia to NSEZ and NSEZ to Borotakia) on the road. The road traffic survey was conducted from 7th December 202 (7:00 AM) to 8th December 2023 (7:00 AM). The details of the road traffic survey locations are shown in Table 3-12, and photographs of the traffic survey are given in Appendix A (Volume III).

Table 3-12: Road Traffic Monitoring Locations

Code	Locations	Road Name	Date	Geographical Coordinates
T-1	Borotakia, EZ Gate, Mirsharai	Borotakia to NSEZ	07/12/2023	22.75506 & 91.58576

Source: Field Survey by EQMS Team, December 2023

3.2.11.1 Present Condition of Traffic Load

The traffic data between Borotakia and NSEZ indicates a high volume of daily vehicular movement, with a total of 3,997 PCUs traveling from Borotakia to NSEZ and 3,848 PCUs in the reverse direction. A summary of the traffic survey results is presented in Table 3-13.

Table 3-13: Status of Traffic

Types of Vehicles	Borotakia to NSEZ (PCU/day)	NSEZ to Borotakia (PCU/day)
Heavy Truck (3-axle)	201	213
Medium Truck (2-axle)	165	119
Light Truck (Pickup/Small Truck)	310	312
Standard/Large Bus/ Double Decker (>40 seats and >36 feet chassis)	36	36
Mini-Bus (16-39 seats and < 36 feet chassis)	24	21
Microbus (Up to 16 seats)	124	125
Utility (Jeep/SUV/Pajero)	14	15
Private Car	176	198
Baby Taxi/CNG/Auto	1,577	1,482
Tempo/Human Hauler/Leguna	19	21
Motorcycle	452	503
Bicycle	73	65
Rickshaw	776	678
Rickshaw Van	50	60
Total	3,997	3,848

Source: Field Survey by EQMS Team, December 2023

From the survey, it was observed that the largest contributors to traffic in both directions are Baby Taxi/CNG/Auto vehicles, followed by motorcycles, rickshaws, and light trucks. These four categories dominate the traffic, reflecting a heavy reliance on smaller, more versatile vehicles for daily transportation. It was also observed that vehicle movement increased from 6-7 AM, and it was the peak at 3-4 PM. The number of vehicles on the road decreased after 8-9 PM, and it was a minimum at midnight. It is expected that the current traffic volume will increase during the full-fledged development and operational activities in the NSEZ.

3.2.11.2 Future Traffic Forecast

A future traffic forecast in the EZ area was conducted considering population and industrial growth. The forecast was made considering the following assumptions:

- Population growth rate: an annual growth rate (e.g., 2% per year).
- Industrial growth rate: an industrial growth rate (e.g., 5% per year) reflecting expanding activities in the 33,000-acre industrial zone.
- Traffic elasticity: a 1.2 elasticity factor for traffic growth concerning population and industrial activity.

Traffic Growth Formula:

- Future Traffic = Current Traffic × (1 + Annual Growth Rate)^{Years}

Based on the assumed growth rates and elasticity, the projected future traffic in the study area is as follows:

- *Projected traffic volume for Borotakia to NSEZ (PCU/day)*: traffic is projected to increase from 3,997 PCUs/day to approximately 8,954 PCUs/day by 2030 and 20,053 PCUs/day by 2040.
- *Projected traffic volume for NSEZ to Borotakia (PCU/day)*: traffic is projected to increase from 3,848 PCUs/day to approximately 8,620 PCUs/day by 2030 and 19,299 PCUs/day by 2040.

These projections indicate that traffic volumes could more than double by 2030 and quintuple by 2040 due to the combined effects of population and industrial growth. This emphasizes the need for infrastructure upgrades to manage the anticipated traffic volume in the EZ area.

3.2.12 Ambient Air Quality – Secondary

To understand the historical ambient air quality baseline condition of the study region, an extensive secondary documentation review was conducted. From the secondary literature review, a total of 28 ambient air quality monitoring results between July 2016 to November 2021 have been identified. A summary of the analysis of the secondary ambient air quality has been provided below, and details of the ambient air quality, including monitoring date, locations, results, etc., have been provided in Appendix A (Volume III).

3.2.12.1 Ambient Air Quality Monitoring Results (Secondary)

A summary of the ambient air quality monitoring results is presented below:

- **Particulate Matter (PM_{2.5})**: PM_{2.5} concentration was recorded in the range of 14.8 - 304.0 µg/m³. Observed values at AAQ-7 (11 No. South Mougadia Union, Mirsharai), AAQ-8 (5 No. Jetty, Dhomkhali Sea Beach Mirsharai), AAQ-9 (1 No. Jetty, Helipad, Mirsharai), and AAQ-10 (Cyclone Shed, Mirsharai) exceeded the Air Pollution (Control) Rules 2022 standard (65 µg/m³) for 24 hours. However, all observed values except AAQ-6 (Mirsharai Site 2) exceed the IFC/WB standard (15 µg/m³) for 24 hours.
- **Particulate Matter (PM₁₀)**: PM₁₀ concentration was recorded in the range of 32.4 - 310.0 µg/m³. Observed values at AAQ-7 (11 No. South Mougadia Union, Mirsharai), AAQ-8 (5 No. Jetty, Dhomkhali Sea Beach Mirsharai), AAQ-9 (1 No. Jetty, Helipad, Mirsharai), AAQ-10 (Cyclone Shed, Mirsharai), and AAQ-15 (within 2A & 2B Zones) exceeded the Air Pollution (Control) Rules 2022 standard (150 µg/m³) for 24 hours. All observed values except AAQ-6 (Mirsharai Site 2), AAQ-13 (Mirsharai 2 Economic Zone), AAQ-18 (In front of the Municipal Office, Mirsharai), AAQ-22 (Project Area -Wet), and AAQ-26 (Purbo Barodhuli Village - Wet) exceed the IFC/WB standard (45 µg/m³) for 24 hours.
- **Sulphur Dioxide (SO₂)**: SO₂ concentration was recorded in the range of 3.0 - 45.98 µg/m³. All the observed values were within the Air Pollution (Control) Rules 2022 standard (80 µg/m³) for 24 hours. However, observed values at AAQ-16 (Near Bamon Sundar Khal) exceed the IFC/WB standard (40 µg/m³) for 24 hours.
- **Oxides of Nitrogen (NO₂)**: NO₂ concentration was recorded in the range of 20.5 - 32.2 µg/m³. All the observed values were within the Air Pollution (Control) Rules 2022 standard (80 µg/m³) for 24 hours. However, observed values at AAQ-5 (Mirsharai Site 1), AAQ-11 (Feni River, Osmanpur Union), and AAQ-12 (Poshchim Ichakhali) exceed the IFC/WB standard (25 µg/m³) for 24 hours.
- **Carbon Monoxide (CO)**: CO concentration was recorded in the range of <0.3 - 1 mg/m³. All the observed values were within the Air Pollution (Control) Rules 2022 standard (5 mg/m³) and IFC/WB (10 mg/m³) for 8 hours.
- **Lead (Pb)**: Pb concentration was recorded in the range of 0.0313 - 0.0616 µg/m³. All the observed values were within the Air Pollution (Control) Rules 2022 standard (0.05 µg/m³) for 24 hours, and IFC/WB has no standards.
- **Ozone (O₃)**: O₃ concentration was recorded in the range of 16.6 - 24.5 µg/m³. All the observed values were within the Air Pollution (Control) Rules 2022 standard (100 µg/m³) and IFC/WB (100 µg/m³) for 8 hours.

3.2.13 Ambient Air Quality – Primary

3.2.13.1 Methodology

Using the HAZ Scanner and Oceanus AQM-09 air quality monitoring system, the ambient air quality of the study region was monitored at ten locations. The monitoring parameters were PM₁₀, PM_{2.5}, SO₂, NO₂, CO, Pb, O₃, and NH₃.

3.2.13.2 Selection of Sampling Locations

The air quality monitoring locations were selected considering the meteorological conditions, topography, sensitive receptors, future development plans, representativeness of regional background air quality, and likely impact areas. Details of the monitoring locations are presented in Table 3-14. A map of the air quality monitoring locations and photographs is presented in Appendix A (Volume III).

Table 3-14: Ambient Air Quality Monitoring Locations

Sampling Code	Sampling Locations	Sampling Date	Geographical Coordinates
AAQ-1	Near BADC sluice gate, Char Chandia, Sonagazi, Feni	12/12/2023	22°47'36.148"N 91°23'34.199"E
AAQ-2	Near 7 no. Sonagazi Union Parishad, Sonagazi, Feni	11/12/2023	22°51'02.332"N 91°24'14.888"E
AAQ-3	East side of the road, Bishumiyarhat, Zorarjong, Mirsharai	07/12/2023	22°51'35.380"N 91°30'31.534"E
AAQ-4	Near BEZA Administrative Building, NSEZ	14/12/2023	22°45'37.566"N 91°28'05.761"E
AAQ-5	South Maghadia, Mirsharai	10/12/2023	22°42'49.566"N 91°31'34.458"E
AAQ-6	Beribadh Road, in front of Unigas Plant, Barabkunda, Sitakunda	08/12/2023	22°33'57.532"N 91°39'12.960"E
AAQ-7	Goll Chatter of Komor Ali Bazar, Mirsharai	9/12/2023	22°41'11.543"N 91°38'08.382"E
AAQ-8	Middle Abu Turab Bazar, Mirsharai, Chattogram	15/12/2023	22°44'52.103"N 91°33'26.088"E
AAQ-9	In front of the Government Technical School & College, Sitakunda	16/12/2023	22°37'39.974"N 91°38'46.504"E
AAQ-10	In front of the Kazi company market, CNG station, Bamansundor, Darogarhat, Mirsharai	13/12/2023	22°47'51.090"N 91°30'47.515"E

Source: EQMS, December 2023

3.2.13.3 Summary of Ambient Air Quality Monitoring Results

The ambient air quality monitoring results are presented in Table 3-15 along with the ambient air quality standard of Bangladesh and IFC/WB/WHO Guidelines. The laboratory test report has been presented in Appendix D (Volume III).

Table 3-15: Ambient Air Quality Analysis Results

Sampling Code	Parameters							
	PM _{2.5}	PM ₁₀	SO ₂	NO ₂	CO	Pb	O ₃	NH ₃
	µg/m ³	µg/m ³	µg/m ³	µg/m ³	mg/m ³	µg/m ³	µg/m ³	µg/m ³
AAQ-1	46.38	79.51	11.63	21.18	0.08	<0.05	27.04	0
AAQ-2	33.41	55.75	25.45	29.24	0.07	<0.05	31.77	0
AAQ-3	20.15	33.90	24.38	31.06	0.12	<0.05	36.19	0
AAQ-4	35.80	59.48	21.55	27.14	0.11	<0.05	29.01	0
AAQ-5	33.19	54.32	15.40	17.91	0.06	<0.05	25.89	0
AAQ-6	10.84	19.49	26.44	19.47	0.10	<0.05	24.83	0
AAQ-7	17.29	31.67	31.52	15.98	0.14	<0.05	21.59	0
AAQ-8	34.89	58.16	22.21	18.59	0.17	<0.05	23.13	0
AAQ-9	15.97	25.65	39.90	33.06	0.22	<0.05	35.42	0
AAQ-10	40.05	71.22	18.62	15.17	0.11	<0.05	20.02	0
Duration (hours)	24	24	24	24	8	24	8	24
Air Pollution (Control) Rules 2022	65	150	80	80	5	0.50	100	400
WBG/WHO Guidelines	15	45	40	25	10	-	100	-

Source: Laboratory Analysis, December 2023

3.2.13.4 Results and Discussion

Concentration of Particulate Matter (PM_{2.5}): PM_{2.5} concentration was recorded in the range of 10.84 µg/m³ to 46.38 µg/m³. All the monitoring locations were within the National Ambient Air Quality Standards (NAAQS) for PM_{2.5}. However, except AAQ-6 (Beribadh Road, in front of Unigas Plant, Barabkunda, Sitakunda), all the monitoring locations' results exceed the stipulated standards for PM_{2.5} mentioned in the IFC/WB Guidelines.

Concentration of Particulate Matter (PM₁₀): PM₁₀ concentration was recorded in the range of 19.49 µg/m³ to 79.51 µg/m³. All the monitoring locations' results were within the NAAQS for PM₁₀. However, monitoring results at AAQ-1 (Near BADC sluice gate, Char Chandia, Sonagazi, Feni), AAQ-2 (Near 7 no. Sonagazi Union parishad, Sonagazi, Feni), AAQ-4 (Near BEZA Administrative Building, NSEZ), AAQ-5 (South Maghadia, Mirsharai), AAQ-8 (Middle Abu Turab Bazar, Mirsharai, Chattogram), and AAQ-10 (In front of the Kazi company market, CNG station, Bamansundor, Darogarhat, Mirsharai) exceed the stipulated standards for PM₁₀ mentioned in the IFC/WB Guidelines.

Concentration of Sulphur Dioxide (SO₂): SO₂ concentration was recorded in the range of 11.63 µg/m³ to 39.9 µg/m³. All the monitoring locations' results were within the NAAQS for SO₂ and the standards for SO₂ mentioned in the IFC/WB Guidelines.

Concentration of Oxides of Nitrogen (NO₂): NO₂ concentration was recorded in the range of 15.17 µg/m³ to 33.06 µg/m³. All the monitoring locations' results were within the NAAQS for NO₂. However, monitoring results at AAQ-2 (Near 7 no. Sonagazi Union parishad, Sonagazi, Feni), AAQ-3 (East side of the road, Bishumiyarhat, Zorarjong, Mirsharai), AAQ-4 (Near BEZA Administrative Building, NSEZ), AAQ-8 (Middle Abu Turab Bazar, Mirsharai, Chattogram), and AAQ-9 (In front of the Government Technical School & College, Sitakunda) exceed the stipulated standards for NO₂ mentioned in the IFC/WB Guidelines.

Concentration of Carbon Monoxide (CO): CO concentration was recorded in the range of 0.06 mg/m³ to 0.22 mg/m³. All the monitoring results were within the NAAQS for CO and IFC/WB Guidelines.

Concentration of Ozone (O₃): O₃ concentration was recorded in the range of 20.02 µg/m³ to 36.19 µg/m³. All the monitoring results were within the NAAQS for O₃ and IFC/WB Guidelines.

3.2.14 Ambient Noise Level – Secondary

To understand the historical ambient noise level baseline condition of the study region, an extensive secondary documentation review was conducted. From the secondary literature review, a total of 26 ambient noise level monitoring results have been identified. A summary of the analysis of the secondary ambient noise level has been provided below, and details of the ambient noise level, including monitoring date, locations, results, etc., have been provided in Appendix A (Volume III).

3.2.14.1 Ambient Noise Level Monitoring Results (Secondary)

A summary of the ambient noise level monitoring results is presented below:

- **Daytime Noise Levels:** daytime noise levels at all the locations range between 52.2 dB(A) to 68.4 dB(A). All the observed values except ANL-5 (Uttar Ishakhali), ANL-6 (Purbo Moghadia), and ANL-24 (Starting of NSEZ Saroni Sheikh Hasina Avenue [Dhaka-Chattogram Highway to EZ Road]) were within the Noise Pollution (Control) Rules 2006 daytime standard.
- **Nighttime Noise Levels:** night-time noise levels at all locations ranged between 39.3 dB(A) to 59.81 dB(A). All the observed values except ANL-1 (Barotakia Bazar), ANL-2 (Dakhin Magadia), ANL-3 (Moddho Moghadia), ANL-5 (Uttar Ishakhali), and ANL-6 (Purbo Moghadia) were within the Noise Pollution (Control) Rules 2006 nighttime standard.

3.2.15 Ambient Noise Level – Primary

3.2.15.1 Noise Sampling Locations

Ambient noise levels were monitored at ten locations considering the different categories of area/receptor, i.e., silent, residential, mixed, commercial, and industrial areas in the study region, using a sound level meter. The ambient noise level monitoring locations were selected considering the location of sensitive receptors, future development plans in the region, representativeness of regional background noise level, and representativeness of likely impact areas. Details of the monitoring locations are presented in Table 3-16. A map of the noise level monitoring locations and photographs is presented in Appendix A (Volume III).

Table 3-16: Ambient Noise Level Monitoring Locations

Sampling Code	Sampling Location	Geographical Coordinates	Monitoring Date	Category of Area/Receptor
ANL-1	In front of the BEZA Administrative Building, NSEZ	22°45'38.607"N 91°28'05.447"E	10/12/2023	Industrial
ANL-2	Beribadh Road, near CP Mor, NSEZ	22°43'52.935"N 91°30'18.620"E	10/12/2023	Mixed
ANL-3	In front of Olikhan Govt, Primary School, Ichakhali, Mirsharai	22°51'38.371"N 91°30'31.029"E	07/12/2023	Silent
ANL-4	Zero Point, Sonagazi municipality, Sonagazi, Feni	22°50'57.149"N 91°23'30.014"E	11/12/2023	Commercial
ANL-5	Junction of 4 roads at Vorer Bazar, Saherkhali, Mirsharai	22°42'39.605"N 91°33'56.550"E	09/12/2023	Commercial

Sampling Code	Sampling Location	Geographical Coordinates	Monitoring Date	Category of Area/Receptor
ANL-6	East Muradpur Deli Bazar, Muradpur Sandwip Ghatghor Road, Mirsharai	22°36'01.149"N 91°38'59.053"E	08/12/2023	Commercial
ANL-7	3 Rastar mor, Brickfield Bazar, Sitakunda, Chattogram	22°38'06.503"N 91°37'03.158"E	13/12/2023	Commercial
ANL-8	Gol Circle of Komor Ali Bazar, Mirsharai	22°41'11.472"N 91°35'08.581"E	09/12/2023	Commercial
ANL-9	Beside Uni Gas Central Jame Mosque, Barabkunda, Sitakunda	22°33'54.628"N 91°39'15.329"E	08/12/2023	Industrial
ANL-10	Junction of 3 Road at Banatoli Vor Bazar, Mirsharai	22°46'01.597"N 91°31'17.428"E	07/12/2023	Commercial

Source: EQMS, December 2023

3.2.15.2 Method of Monitoring

The monitoring was carried out for 24 hours as mentioned in the Noise Pollution (Control) Rules 2006 and IFC guidelines (daytime: 6:00 am to 9:00 pm and nighttime: 9:00 am to 6:00 am) and IFC guidelines (daytime: 07:00 to 22:00 and nighttime: 22:00 to 07:00). The sound level meter was placed at a height of about 1.5 m above the ground on a tripod and was kept 3.5m away from any sound-reflecting surfaces. The noise level data was downloaded to the computer for further analysis.

3.2.15.3 Presentation of Results

The statistical analysis was done for measured noise levels at eight locations during the baseline study. Parameters like Leq_{day} , Leq_{night} , L_{max} , and L_{min} were analyzed. The results of the ambient noise level monitoring are given in Table 3-17. The laboratory test report has been presented in Appendix D (Volume III).

Table 3-17: Ambient Noise Level Analysis Results

Sampling Code	Category of Area/Receptor	Parameters				National Standards		IFC Standards	
		Leq_{day}	Leq_{night}	L_{max}	L_{min}	Day	Night	Day	Night
ANL-1	Industrial	48.0	44.0	66.4	31.6	75	70	70	70
ANL-2	Mixed	62.2	53.5	83.4	40.4	60	50	55	45
ANL-3	Silent	60.6	48.4	88.1	34.0	50	40	55	45
ANL-4	Commercial	69.6	58.4	92.1	43.2	70	60	70	70
ANL-5	Commercial	60.2	39.4	84.7	30.8	70	60	70	70
ANL-6	Commercial	65.0	51.6	86.7	40.0	70	60	70	70
ANL-7	Commercial	61.0	51.9	85.7	30.8	70	60	70	70
ANL-8	Commercial	61.1	57.9	85.3	32.1	70	60	70	70
ANL-9	Industrial	60.7	46.4	88.6	31.6	75	70	70	70
ANL-10	Commercial	56.5	47.0	76.1	31.6	70	60	70	70

Source: Field Survey by EQMS Team, December 2023

3.2.15.4 Results and Discussion

Daytime Noise Levels (Leq_{day}): daytime noise levels at all locations ranged between 48.0 dB(A) to 69.6 dB(A). All the observed values except ANL-2 (Beribadh Road, near CP Mor, NSEZ) and ANL-3 (In front of Olikhan Govt, Primary School, Ichakhali, Mirsharai) were within the Noise Pollution (Control) Rules 2006 daytime standards as well as IFC standards set for the respective zone.

Nighttime Noise Levels (Leq_{night}): night-time noise levels at all locations ranged between 39.4 dB(A) to 58.4 dB(A). All the observed values except ANL-2 (Beribadh Road, near CP Mor, NSEZ) and ANL-3 (In front of Olikhan Govt, Primary School, Ichakhali, Mirsharai) were within the Noise Pollution (Control) Rules 2006 nighttime standards as well as IFC standards set for the respective zone.

3.2.16 Inland Surface Water Quality – Secondary

To understand the historical inland surface water quality baseline condition of the study region, an extensive secondary documentation review was conducted. From the secondary literature review, a total of 33 inland surface water quality monitoring results have been identified. A summary of the analysis of the secondary inland surface water quality has been provided below, and details of the inland surface water quality, including monitoring date, locations, results, etc., have been provided in Appendix A (Volume III).

- **pH:** values ranged between 6.8 to 8.5. All samples complied with Schedule 2(Ka-1) of the Environment Conservation Rules (ECR) 2023 standard.
- **Dissolved Oxygen:** observed to be in the range of 4.18 to 9.5 mg/l. All samples complied with Schedule 2(Ka-1) of ECR 2023.
- **Biochemical Oxygen Demand:** observed to be in the range of 0.4 to 129.6 mg/l. BOD concentrations in all samples except SWQ-2, SWQ-12, SWQ-25, SWQ-26, SWQ-27, SWQ-328, and SWQ-329 were less than 12 mg/l.
- **Nitrate:** concentrations of all samples ranged between 0.04 to 4.22 mg/l, which were compliant with Schedule 2(Ka-1) of ECR 2023.
- **Ammonia:** concentrations of all samples ranged between 0.18 to 1.48 mg/l, which were compliant with Schedule 2(Ka-1) of ECR 2023.
- **Phosphate:** concentrations of all samples ranged between 0.0253 to 6.48 mg/l. Phosphate concentrations in samples SWQ-9, SWQ-10, SWQ-30, and SWQ-33 were more than 2 mg/l, which were not compliant with Schedule 2(Ka-1) of ECR 2023.
- **Total Chromium:** concentrations of all samples ranged between 0.02 to 0.04 mg/l, which were compliant with Schedule 2(Ka-1) of ECR 2023.
- **Lead:** concentrations of all samples ranged between 0.015 to 0.025 mg/l, which were compliant with Schedule 2(Ka-1) of ECR 2023.
- **Total Coliform:** concentrations of all samples ranged between 38 to 26,000 CFU/100 mg, which were compliant with Schedule 2(Ka-1) of ECR 2023.
- **Total Dissolved Solids:** concentrations of all samples ranged between 0.402 to 20,844 mg/l. TDS concentrations in samples SWQ-1, SWQ-2, SWQ-3, SWQ-4, SWQ-7, SWQ-9, SWQ-12, SWQ-30, SWQ-31, SWQ-32, and SWQ-33 were more than 1,000 mg/l, which was not compliant with the Schedule 2(Ka-1) of ECR 2023.
- **Chemical Oxygen Demand:** concentrations of all samples ranged between 2 to 122 mg/l. COD concentrations in samples SWQ-1 and SWQ-2 were more than 100 mg/l, which were not compliant with Schedule 2(ka-1) of ECR 2023.

3.2.17 Inland Surface Water Quality – Primary

Six inland surface water samples were collected and analyzed during the baseline survey from the study area. Surface water samples were collected from different rivers and khals, including Ichakhali,

Bamansundar, Hoania, Saherkhali, and Domkhali. The surface water quality monitoring locations were selected considering the need for samples upstream of the khals flowing through NSEZ, safe access to sampling locations, location of sensitive receptors, future development plans in the area, representativeness of regional surface water quality, and representativeness of likely impact areas. Details of the monitoring locations are presented in Table 3-18. A map of the surface water sampling locations and photographs is presented in Appendix A (Volume III).

Table 3-18: Surface Water Sampling Locations

Sampling Code	Sampling Locations	Geographical Coordinates	Sampling Date
SWQ-1/1 (U/S)	Close to Ichakhali Khal Sluice Gate in Upstream	22°45'50.064"N 91°28'41.982"E	15/12/2023
SWQ-2/1 (U/S)	Near Bamansundar Khal Sluice gate in Upstream	22°43'57.992"N 91°30'17.918"E	15/12/2023
SWQ-3/1 (U/S)	Near Hoania Khal Sluice gate in Upstream	22°43'10.113"N 91°31'11.309"E	15/12/2023
SWQ-4/1 (U/S)	Near Saherkhali Khal Sluice gate in upstream	22°42'19.117"N 91°32'28.728"E	15/12/2023
SWQ-5/1 (U/S)	Near Domkhali Khal Sluice gate in upstream	22°40'56.512"N 91°33'46.037"E	15/12/2023
SWQ-6/1 (U/S)	Just behind of New Muhuri Bridge, Muhuri Reservoir, Feni	22°50'29.859"N 91°27'19.327"E	15/12/2023

Source: Field Survey by EQMS Team, December 2023

Table 3-19: Inland Surface Water Quality Analysis Results (Internal Khals, River)

Sampling Code	Parameters														
	pH	Salinity	DO	COD	BOD	TSS	Ammonia	Phosphate	Nitrate	Lead	Mercury	TC	FC	Chromium	Oil & Grease
	-	ppt	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	n/100 ml	n/100 ml	mg/l	mg/l
SWQ-1/1 (U/S)	7.11	2.58	5.7	18	3.6	129	0.44	1.3	2.3	<0.01	<0.001	15	7	0.004	0.57
SWQ-2/1 (U/S)	7.60	2.60	6.1	50	3.2	130	2.99	2.7	1.2	<0.01	<0.001	20	12	0.001	1.14
SWQ-3/1 (U/S)	7.92	1.96	7.2	28	2.5	130	0.35	2.5	<0.01	<0.01	<0.001	35	13	0.008	1.42
SWQ-4/1 (U/S)	7.62	3.23	6.8	38	2.8	152	0.27	2.3	0.9	<0.01	<0.001	25	14	0.004	1.28
SWQ-5/1 (U/S)	7.65	2.46	7.2	31	2.4	119	1.61	3.9	3.0	<0.01	<0.001	15	9	0.001	1.71
SWQ-6/1 (U/S)	7.64	0.22	7.6	28	3.1	199	0.92	0.9	2.0	<0.01	<0.001	18	8	0.003	<0.001

ECR 2023 [Schedule 2(Ka-1)]

1. Source of drinking water for supply only after disinfecting	6.5-8.5	-	≥6	10	≤2	-	0.1	0.1	7.0	0.03	0.001	≤100	-	0.02	-
2. Water usable for recreational activity	6.5-8.5	-	≥5	10	≤3	-	0.3	0.5	7.0	0.05	0.001	≤50	-	0.2	-
3. Source of drinking water for supply after conventional treatment	6-9	-	≥5	25	≤3	-	0.3	0.5	7.0	0.03	0.001	≤5000	-	0.02	-
4. Water usable by fisheries	6-9	-	≥5	50	≤6	-	0.3	0.5	7.0	0.1	0.004	≤5000	-	0.05	-
5. Water usable by various process and cooling industries	6.5-8.5	-	≥1	100	12	-	2.7	-	-	0.1	0.05	-	-	0.1	-
6. Water usable for irrigation	6.5-8.5	-	-	100	≤12	-	1.5	2.0	5.0	0.1	0.002	≤50000	-	0.1	-

Note: DO = Dissolved Oxygen, COD = Chemical Oxygen Demand, BOD = Biochemical Oxygen Demand, TSS = Total Suspended Solids, TC = Total Coliform, FC = Fecal Coliform
Source: Laboratory Analysis

3.2.17.1 Result Discussion

The results for the surface water samples of khals were compliant with the use for different purposes as per the standards of ECR 2023, Schedule 2(A): Standards for Surface Water (Inland Surface Water). The laboratory test report has been presented in Appendix D (Volume III).

- **pH:** concentrations were in the range of 7.11 - 7.92. All the sampling results were within the permissible limit of the ECR, 2023 standard.
- **Salinity:** concentrations were in the range of 0.22 - 3.23 ppt. There are no standards in ECR 2023 for inland surface water salinity.
- **Dissolved Oxygen:** concentrations were in the range of 5.7 - 7.6 mg/l. All the sampling results met the permissible limit of the ECR 2023 standard.
- **Chemical Oxygen Demand:** concentrations were in the range of 18 - 50 mg/l. All the sampling results are not suitable as a source of drinking water for supply, only after disinfecting, and the water is usable for recreational activity. However, others are usable for different purposes (fisheries, cooling, irrigation, etc.) based on the concentration of COD.
- **Biochemical Oxygen Demand:** concentrations were in the range of 2.4 - 3.6 mg/l. All the sampling results are not suitable as a source of drinking water for supply, only after disinfecting. However, others are usable for different purposes (recreational, drinking after conventional treatment, fisheries, cooling, irrigation, etc.) based on the concentration of BOD.
- **Total Suspended Solids:** concentrations were in the range of 119 - 199 mg/l. There are no standards in ECR 2023 for inland surface water TSS.
- **Ammonia:** concentrations were in the range of 0.27 - 2.99 mg/l. All the sampling results are not suitable as a source of drinking water for supply, only after disinfecting. However, others are usable for different purposes (recreational, drinking after conventional treatment, fisheries, cooling, irrigation, etc.) based on the concentration of ammonia.
- **Phosphate:** concentrations were in the range of 0.9 - 3.9 mg/l. All the samples exceeded the permissible limit of the ECR 2023 standard. However, water at SWQ-1/1 (U/S) is usable for irrigation.
- **Nitrate:** concentrations were in the range of <0.01 - 3.0 mg/l. All the sampling results were within the permissible limit of the ECR, 2023 standard.
- **Lead:** concentrations were observed as <0.01 mg/l. All the sampling results were within the permissible limit of the ECR, 2023 standard.
- **Mercury:** concentrations were observed as <0.001 mg/l. All the sampling results were within the permissible limit of the ECR, 2023 standard.

- **Total Coliform:** concentrations were in the range of 15 - 35 n/100 ml. All the sampling results were within the permissible limit of the ECR, 2023 standard.
- **Fecal Coliform:** concentrations were in the range of 7 - 14 n/100 ml. There are no standards in ECR 2023 for inland surface water.
- **Chromium:** concentrations were in the range of 0.001 - 0.008 mg/l. All the sampling results were within the permissible limit of the ECR, 2023 standard.
- **Oil and Grease:** concentrations were in the range of <0.001- 1.71 mg/l. There are no standards in ECR 2023 for inland surface water oil and grease.

3.2.18 Marine Water Quality – Secondary

To understand the historical marine water quality baseline condition of the study region, an extensive secondary documentation review was conducted. From the secondary literature review, a total of 8 marine water quality monitoring results have been identified. A summary of the analysis of the secondary marine water quality has been provided below, and details of the marine water quality, including monitoring date, locations, results, etc., have been provided in Appendix A (Volume III).

- **pH:** values ranged between 6.7 to 7.47. All samples complied with Schedule 2(Ka-2) of the Environment Conservation Rules (ECR) 2023 standard.
- **Dissolved Oxygen:** observed to be in the range of 4.88 to 7.45 mg/l. All samples complied with Schedule 2(Ka-2) of ECR 2023.
- **Biochemical Oxygen Demand:** observed to be in the range of 1 to 17 mg/l. No standards for BOD in Schedule 2(Ka-2) of ECR 2023.
- **Nitrate:** concentrations of all samples ranged between 0.03 to 1 mg/l, which were compliant with Schedule 2(Ka-2) of ECR 2023.
- **Ammonia:** concentrations of all samples ranged between 0.13 to 0.68 mg/l. No standards for Ammonia in Schedule 2(Ka-2) of ECR 2023.
- **Phosphate:** concentrations of all samples ranged between 0.86 to 1.77 mg/l. Phosphate concentrations in all samples are not compliant with Schedule 2(Ka-2) of ECR 2023.
- **Total Chromium:** concentrations of all samples ranged between 0.01 to 0.03 mg/l, which were compliant with Schedule 2(Ka-2) of ECR 2023.
- **Lead:** concentrations of all samples ranged between 0.012 to 0.07 mg/l, except SWQ-4, all samples were compliant with Schedule 2(Ka-2) of ECR 2023.
- **Total Dissolved Solids:** concentrations of all samples ranged between 32.7 to 10,100 mg/l. No standards for TDS in Schedule 2(Ka-2) of ECR 2023.
- **Chemical Oxygen Demand:** concentrations of all samples ranged between 2.87 to 72 mg/l, except SWQ-7, all samples were compliant with Schedule 2(Ka-2) of ECR 2023.

3.2.19 Marine Water Quality – Primary

Ten coastal/marine water samples were collected and analyzed during the baseline survey from the study area. Coastal/Marine water samples were collected from the Feni River, Sandwip Channel, and downstream of different khals. The coastal/marine water quality monitoring locations were selected considering the need for samples downstream of the khals flowing through NSEZ, the location of sensitive receptors such as fish, marine mammals, birds, and invertebrates in the marine environment, future development plans, and the representativeness of likely impact areas. Details of the monitoring locations are presented in Table 3-18. A map of the coastal/marine water quality sampling locations and photographs is presented in Appendix A (Volume III).

Table 3-20: Coastal/Marine Water Sampling Locations

Sampling Code	Sampling Locations	Geographical Coordinates	Sampling Date
SWQ-1/2 (D/S)	Near Ichakhali Khal Sluice gate in downstream	22°44'52.65"N 91°26'27.95"E	15/12/2023
SWQ-1/3 (D/S)	Close to Daborkhali Khal Sluice gate in downstream	22°43'27.576"N 91°27'28.481"E	15/12/2023
SWQ-2/2 (D/S)	Near Bamansundar Khal Sluice gate in downstream	22°42'54.626"N 91°28'36.85"E	15/12/2023
SWQ-3/2 (D/S)	Near Hoania Khal Sluice gate in downstream	22°42'21.837"N 91°29'48.274"E	15/12/2023
SWQ-4/2 (D/S)	Near Saherkhali Khal Sluice gate in downstream	22°41'23.281"N 91°31'32.998"E	15/12/2023
SWQ-5/2 (D/S)	Near Domkhali Khal Sluice gate in Downstream	22°40'26.007"N 91°32'59.339"E	15/12/2023
SWQ-6/2 (D/S)	Feni River (Muhuri Reservoir)	22°45'25.711"N 91°25'14.407"E	30/11/2023
SWQ-7/1 (U/S)	Sandwip Channel	22°43'3.094"N 91°26'17.988"E	30/11/2023
SWQ-7/2 (D/S)	Sandwip Channel	22°38'34.304"N 91°33'11.849"E	30/11/2023

Source: Field Survey by EQMS Team, December 2023

Table 3-21: Coastal/Marine Water Quality Analysis Results

Sampling Code	Parameters															
	pH	Salinity	DO	COD	BOD	TSS	Ammonia	Phosphate	Nitrate	Lead	Mercury	TC	FC	Chromium	Cadmium	Oil and Grease
	-	ppt	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	n/100 ml	n/100 ml	mg/l	mg/l	mg/l
SWQ-1/2 (D/S)	7.18	2.90	6.2	135	5.8	125	0.65	0.4	0.2	<0.01	<0.001	20	11	0.001	<0.001	0.85
SWQ-1/3 (D/S)	7.91	2.86	6.3	78	4.5	144	0.30	1.0	4.3	<0.01	<0.001	35	14	0.008	<0.001	1.14
SWQ-2/2 (D/S)	7.46	2.42	6.8	48	4.0	175	1.86	2.6	0.3	<0.01	<0.001	25	11	0.001	<0.001	1.20
SWQ-3/2 (D/S)	7.64	2.61	7.0	31	3.0	163	<0.01	3.5	0.3	<0.01	<0.001	40	27	0.009	<0.001	1.48
SWQ-4/2 (D/S)	7.65	4.21	7.4	42	2.1	202	0.02	2.1	0.2	<0.01	<0.001	15	7	0.007	<0.001	1.48
SWQ-5/2 (D/S)	7.61	1.51	7.7	42	2.7	167	1.11	1.2	1.0	<0.01	<0.001	10	4	0.007	<0.001	2.00
SWQ-6/2 (D/S)	7.12	15.7	6.6	31	2.5	208	<0.01	0.8	2.0	<0.01	<0.001	21	10	0.001	<0.001	1.28
SWQ-7/1 (U/S)	6.87	16.8	6.0	37	2.3	130	0.11	2.3	0.6	<0.01	<0.001	24	9	0.001	<0.001	2.28
SWQ-7/2 (D/S)	7.05	16.3	6.3	44	2.4	132	0.21	2.0	0.6	<0.01	<0.001	28	4	0.002	<0.001	3.14
ECR 2023 [Schedule 2(Ka-2)]																
Coral Community	7.5-8.5	-	≥5	2	-	2	-	0.04	0.2	0.05	0.0001	1000	200	0.05	0.005	0.01
Natural Area ⁴	6.5-8.5	-	≥5	8	-	25	-	0.05	0.3	0.05	0.0001	1000	200	0.05	0.005	0.01
Recreation - direct contact ⁵	6.5-8.5	-	-	-	-	5	-	0.08	0.8	-	-	1000	200	-	-	-
Recreation - indirect contact ⁶	6.5-8.5	-	-	-	-	10	-	0.08	0.8	-	-	5000	1000	-	-	-
Aquaculture and Shellfish Culture	6.5-8.5	-	≥5	5	-	50	-	0.08	0.8	0.05	0.0001	1000	200	0.5	0.005	0.14
Industries and Others	6.5-9.0	-	≥4	5	-	100	-	0.1	1.0	-	0.0001	-	-	0.1	0.005	5.00

Note: DO = Dissolved Oxygen, COD = Chemical Oxygen Demand, BOD = Biochemical Oxygen Demand, TSS = Total Suspended Solids, TC = Total Coliform, FC = Fecal Coliform
Source: Laboratory Analysis

3.2.19.1 Results and Discussion

- **pH:** concentrations were in the range of 6.87 to 7.91. All the sampling results were within the permissible limit of the ECR 2023 standard for coastal water.
- **Salinity:** concentrations were in the range of 1.51 - 16.8 ppt. There are no standards in ECR 2023 for coastal water salinity.
- **Dissolved Oxygen:** concentrations were in the range of 6.0 - 7.7 mg/l. All the sampling results met the permissible limit of the ECR 2023 standard for coastal water.
- **Chemical Oxygen Demand:** concentrations were in the range of 28 - 135 mg/l. Values at all samples exceeded the permissible limit of the ECR 2023 standard for coastal water COD.
- **Biochemical Oxygen Demand:** concentrations were in the range of 2.1 - 5.8 mg/l. There are no standards in ECR 2023 for coastal water BOD.
- **Total Suspended Solids:** concentrations were in the range of 125 - 208 mg/l. Values at all samples exceeded the permissible limit of the ECR 2023 standard for coastal water TSS.
- **Ammonia:** concentrations were in the range of <0.01 - 1.86 mg/l. There are no standards in ECR 2023 for coastal surface water NH₃.
- **Phosphate:** concentrations were in the range of 0.4 - 3.5 mg/l. Values at all samples exceeded the permissible limit of the ECR 2023 standard for coastal water phosphate.
- **Nitrate:** concentrations were in the range of 0.2 – 4.3 mg/l. Values at SWQ-1/3 (D/S), SWQ-6/1 (U/S), and SWQ-6/2 (D/S) exceed the ECR 2023 standards for coastal water nitrate.

⁴ Mangrove, sea grass, wildlife habitat and sea spawning, nurshing, and feeding ground.

⁵ Swimming, diving, surfing, etc.

⁶ Boating, fishing, and other activities

- **Lead:** concentrations were observed as <0.01 mg/l. All the sampling results were within the permissible limit of the ECR, 2023 standard for lead.
- **Mercury:** concentrations were observed as <0.001 mg/l. All the sampling results were within the permissible limit of the ECR 2023 standard for mercury.
- **Total Coliform:** concentrations were in the range of 10 - 40 n/100 ml. All the sampling results were within the permissible limit of the ECR 2023 standard for coastal water TC.
- **Fecal Coliform:** concentrations were in the range of 4 - 27 n/100 ml. All the sampling results were within the permissible limit of the ECR 2023 standard for coastal water FC.
- **Chromium:** concentrations were in the range of 0.001 - 0.009 mg/l. All the sampling results were within the permissible limit of the ECR 2023 standard for coastal water chromium.
- **Cadmium:** concentrations were observed as <0.001 mg/l. All the sampling results were within the permissible limit of the ECR 2023 standard for coastal water cadmium.
- **Oil and Grease:** concentrations were in the range of 0.85 - 3.14 mg/l. All the waters are usable only for industries and other purposes and not usable for purposes including coral community, natural areas, aquaculture, and shellfish culture.

3.2.20 Groundwater Water Quality – Secondary

From the secondary literature review, a total of 30 groundwater quality monitoring results have been identified. A summary of the analysis of the secondary groundwater quality has been provided below, and details of the groundwater quality, including monitoring date, locations, results, etc., have been provided in Appendix A (Volume III).

- **Arsenic:** concentrations were in the range between <0.001 mg/l to 0.4 mg/l. Values at GWQ-2 (Dakhin Maghadia) and GWQ-26 (TTW-8 Chunimidhir Tek) exceeded the permissible limit of the ECR 2023 standard of 0.05 mg/l. In addition, values at GWQ-2 (Dakhin Maghadia), GWQ-15 (Sample-2 Muhuri Irrigation Project), and GWQ-26 (TTW-8 Chunimidhir Tek) exceeded the permissible limit of the WHO guideline of 0.01 mg/l.
- **Boron:** concentrations were in the range of 0.2 mg/l to 0.22 mg/l. Boron concentration in all the samples complied with the ECR 2023 standard of 1.0 mg/l and the WHO guideline of 2.4 mg/l.
- **Cadmium:** observed to be <0.001 mg/l. Cd concentration in the samples complied with the ECR 2023 standard of 0.003 mg/l and the WHO standard of 0.003 mg/l.
- **Calcium:** concentrations were in the range of 9 mg/l to 132 mg/l. Ca concentration in all the samples except GWQ-11 (Site 1-Ground Water Quality [EZ]) and GWQ-12 (Site 2-Ground Water Quality [EZ]) complied with the ECR 2023 standard of 75 mg/l.
- **Chloride:** concentrations were in the range of 11 mg/l to 12,275 mg/l. Cl⁻ concentration in the samples at GWQ-8 (Intake Point Osmanpur), GWQ-11 (Site 1-Ground Water Quality [EZ]), GWQ-12 (Site 2-Ground Water Quality [EZ]), GWQ-13 (Site 3- Ground Water Quality [EZ]), GWQ-18 (Musapur Bridge, Little Feni River), GWQ-26 (TTW-8 Chunimidhir Tek), GWQ-27 (TTW-9 NW Side of Cyclone Centre), and GWQ-29 (TTW-DPHE-01) exceeds the permissible limit of ECR 2023 standard of mg/l. High Chloride concentration may be caused by the intrusion of saltwater from the sea due to factors like storm surges, tidal flooding, etc.
- **Chromium:** concentrations were in the range of <0.001 mg/l to 0.108 mg/l. Cr concentration in all the samples except GWQ-17 (Musapur Bridge, Little Feni River) complied with the ECR 2023 standard of 0.05 mg/l and the WHO standard of 0.05 mg/l.
- **Copper:** observed to be 0.006 mg/l at GWQ-17. Cu concentration in the samples complied with the ECR 2023 standard of 1.5 mg/l and the WHO standard of 2.0 mg/l.
- **Fecal Coliform:** observed to be 128 CFU/100 mL at GWQ-18. FC concentration in the sample exceeds the permissible limit of the ECR 2023 standard of 0 CFU/100 ml.
- **Fluoride:** observed to be 0.14 mg/l at GWQ-7. F⁻ concentration in the sample complied with the ECR 2023 standard of 1.0 mg/l and the WHO standard of 1.5 mg/l.

- **Iron:** concentrations were in the range of 0.5 mg/l to 31.02 mg/l. Fe concentration in the samples GWQ-7 (Near Ichakhali Sluice Gate), GWQ-9 (WTP Site NSEZ), GWQ-10 (Mirsharai 2 Economic Zone), GWQ-17 (Musapur Bridge, Little Feni River), and GWQ-22 (TTW-4 Near CP more) complied with the ECR 2023 standard of 0.3-1.0 mg/l. Except that all these samples exceed the permissible limit of the ECR 2023 standard.
- **Lead:** concentrations were in the range of <0.001 mg/l to 0.068 mg/l. Pb concentration in all the samples except GWQ-7 (Near Ichakhali Sluice Gate) complied with the ECR 2023 standard of 0.01 mg/l and the WHO standard of 0.01 mg/l.
- **Magnesium:** concentrations were in the range of 6 mg/l to 789.6 mg/l. Mg concentration in all the samples except GWQ-12 (Site 2- Ground Water Quality (EZ)), GWQ-13 (Site 3- Ground Water Quality (EZ)), and GWQ-18 (Musapur Bridge, Little Feni River) complied with the ECR 2023 standard of 30-35 mg/l.
- **Manganese:** concentrations were in the range of 0.04 mg/l to 0.4 mg/l. Mn concentration in all the samples except GWQ-18 (Musapur Bridge, Little Feni River) complied with the ECR 2023 standard of 0.40 mg/l.
- **Mercury:** concentrations were in the range of <0.001 mg/l to 0.0017 mg/l. Hg concentration in all the samples complied with the ECR 2023 standard of 0.001 mg/l and the WHO standard of 0.006 mg/l.
- **Nitrate:** concentrations were in the range of 0.1 mg/l to 1.5 mg/l. NO₃ concentration in all the samples complied with the ECR 2023 standard of 45 mg/l and the WHO standard of 50 mg/l.
- **pH:** recorded in the range of 6.45 to 8.15. pH values of all samples complied with the Schedule 2B of the ECR 2023 standard of 6.5 - 8.5.
- **Potassium:** concentrations were in the range of 3.3 mg/l to 4.1 mg/l. K concentration in all the samples complied with the ECR 2023 standard of 12 mg/l.
- **Sodium:** concentrations were in the range of 50.6 mg/l to 87.3 mg/l. Na concentration in all the samples complied with the ECR 2023 standard of 200 mg/l.
- **Total Coliform:** observed to be 262 CFU/100 ml. TC concentration in the sample exceeded the permissible limits of the ECR 2023 standard of 0 CFU/100 ml.
- **Zinc:** values were recorded in a range of <0.001 to 0.128 mg/l. Zn concentration in all the samples complied with the ECR, 2023 standard of 5 mg/l.

3.2.21 Groundwater Water Quality – Primary

Five groundwater samples were collected from the study region. The groundwater quality monitoring locations were selected considering the location of sensitive receptors, future development plans in the region, future use of groundwater in different upcoming projects in the region, representativeness of regional groundwater quality, and representativeness of likely impact areas. Details of the groundwater sampling locations are presented in Table 3-22. A map of the groundwater quality monitoring locations and photographs is presented in Appendix A (Volume III).

Table 3-22: Groundwater Sampling Locations

Sampling Code	Sampling Locations	Geographical Coordinates	Sampling Date
GWQ-1	Inside of Assistant Engineer Office, DPHE, NSEZ	22°45'48.471"N 91°28'33.781"E	16/12/2023
GWQ-2	In front of the cyclone center, Takerhat Bazar, Jorargong, Mirsharai, Chattogram	22°48'29.496"N 91°28'02.632"E	16/12/2023
GWQ-3	Hamidul Hoque Mistry House, Mia Para, Maghadia, Mirsharai, Chattogram	22°44'44.213"N 91°32'36.254"E	16/12/2023

Sampling Code	Sampling Locations	Geographical Coordinates	Sampling Date
GWQ-4	New house of Abul Khayar, North-West Saidpur, Sitakunda, Chattogram	22°38'05.053"N 91°37'01.750"E	16/12/2023
GWQ-5	In front of Madina Supermarket (20 meters away from East Saherkhali Govt. Primary School), Saherkhali Bazar Circle, Mirsharai, Chattogram	22°42'39.819"N 91°33'56.480"E	16/12/2023

Source: Field Survey by EQMS Team, December 2023

The results for the groundwater samples analyzed are presented in Table 3-23.

Table 3-23: Groundwater Quality Analysis Results

Parameters	Unit	Sampling Code					Standards	
		GWQ-1	GWQ-2	GWQ-3	GWQ-4	GWQ-5	ECR '23	WHO
Aluminum	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	0.2	-
Ammonia	mg/l	0.03	0.21	0.08	0.13	0.14	1.5	-
Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	0.01
Boron	mg/l	<0.2	0.67	1.03	<0.2	<0.5	1	-
Cadmium	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	0.003
Calcium	mg/l	51	57	47	45	48	75	-
Chloride	mg/l	9	60	150	24	6	250	-
Chromium	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	0.05	0.05
Copper	mg/l	0.02	0.09	0.09	0.16	0.05	1.5	2
FC	n/100 ml	0	0	0	0	0	0	0
TC	n/100 ml	0	0	0	0	0	0	0
Fluoride	ppm	0.02	0.06	0.04	0.04	0.06	1	1.5
Hardness	mg/l	148	176	169	90	64	500	-
Iron	mg/l	0.7	2.31	0.27	0.14	0.11	0.3-1.0	-
Lead	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01
Magnesium	mg/l	32	35	37	26	21	30-35	-
Manganese	mg/l	0.2	0.4	0.2	0.1	0.1	0.4	-
Mercury	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.001
Nickel	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	0.02
Nitrate	mg/l	0.8	35	9.5	1	3.8	45	50
Nitrite	mg/l	<0.01	0.09	0.05	<0.01	0.08	1	3
pH	-	8.41	8.4	8.5	8.48	8.46	6.5-8.5	6.5-8.5
Potassium	mg/l	10.1	9.5	8.6	7.7	6.8	12	-
Salinity	ppt	0.27	0.83	1.53	0.56	0.39	-	-

Parameters	Unit	Sampling Code					Standards	
		GWQ-1	GWQ-2	GWQ-3	GWQ-4	GWQ-5	ECR '23	WHO
Sodium	mg/l	74.2	240	171	248	176	200	-
TDS	mg/l	290	850	1590	600	410	1000	-
Turbidity	NTU	1.8	4.4	0.6	0.4	0.1	5	-
Zinc	mg/l	0.2	0.4	0.3	0.2	0.5	5	-

Source: Laboratory Analysis

3.2.21.1 Result Discussion

The results were compared with the standards of ECR 2023, Schedule-2 (Kha) (Standards for Drinking Water) and WHO standards. The laboratory test report has been presented in Appendix D (Volume III).

- **Aluminum:** concentrations were observed as <0.01 mg/l. All the sampling results were within the permissible limit of the ECR 2023 standard of 0.2 mg/l.
- **Ammonia:** concentrations were in the range between 0.03 - 0.21 mg/l. All the sampling results were within the permissible limit of the ECR 2023 standard of 1.5 mg/l.
- **Arsenic:** concentrations were observed as <0.01 mg/l. All the sampling results were within the permissible limit of the ECR 2023 standard of 0.05 mg/l and the WHO Guidelines of 0.01 mg/l.
- **Boron:** concentrations were in the range between <0.2 - 1.03 mg/l. Values at GWQ-3 (Hamidul Hoque Mistry House, Mia Para, Maghadia, Mirsharai, Chattogram) exceeded the permissible limit of the EC, 2023 standard of 1 mg/l.
- **Cadmium:** concentrations were observed as <0.001 mg/l. All the sampling results were within the permissible limit of ECR 2023 standard of 0.003 mg/l and the WHO Guidelines of 0.01 mg/l.
- **Calcium:** concentrations were in the range between 45 - 57 mg/l. All the sampling results were within the permissible limit of the ECR 2023 standard of 75 mg/l for Ca.
- **Chloride:** concentrations were in the range between 6 - 150 mg/l. All the sampling results were within the permissible limit of the ECR 2023 standard of 250 mg/l for Cl-.
- **Chromium:** concentrations were observed as <0.005 mg/l. All the sampling results were within the permissible limit of ECR 2023 standard of 0.05 mg/l and the WHO Guidelines of 0.05 mg/l.
- **Copper:** concentrations were in the range of 0.02 - 0.16 mg/l. All the sampling results were within the permissible limit of ECR 2023 standard of 1.5 mg/l and WHO Guidelines of 2 mg/l.
- **Fecal Coliform:** Fecal Coliform was absent in all the groundwater samples.
- **Total Coliform:** Total Coliform was absent in all the groundwater samples.
- **Fluoride:** concentrations were in the range of 0.02 - 0.06 ppm. All the sampling results were within the permissible limit of the ECR 2023 standard of 1 ppm and the WHO Guidelines of 1.5 ppm.
- **Hardness:** concentrations were in the range between 64 - 176 mg/l. All the sampling results were within the permissible limit of the ECR 2023 standard of 500 mg/l.
- **Iron:** concentrations were in the range of 0.11 - 2.31 mg/l. Values at GWQ-2 (In front of the cyclone center, Takerhat Bazar, Jorargong, Mirsharai, Chattogram) exceeded the permissible limit of the ECR 2023 standard of 0.3-1.0 mg/l.
- **Lead:** concentrations were observed as <0.01 mg/l. All the sampling results were within the permissible limit of the ECR 2023 standard of 0.01 mg/l and the WHO Guidelines of 0.01 mg/l.
- **Magnesium:** concentrations were in the range of 21 - 37 mg/l. Values at GWQ-1 (Inside of Assistant Engineer Office, DPHE, NSEZ), GWQ-2 (In front of the cyclone center, Takerhat

Bazar, Jorargong, Mirsharai), and GWQ-3 (Hamidul Hoque Mistry House, Mia Para, Maghadia, Mirsharai) exceeded the permissible limit of the ECR 2023 standard of 30-35 mg/l.

- **Manganese:** concentrations were in the range of 0.1 - 0.4 mg/l. All the sampling results were within the permissible limit of the ECR 2023 standard of 0.4 mg/l.
- **Mercury:** concentrations were observed as <0.001 mg/l. All the sampling results were within the permissible limit of ECR 2023 standard of 0.001 mg/l and WHO Guidelines of 0.001 mg/l.
- **Nickel:** concentrations were observed as <0.01 mg/l. All the sampling results were within the permissible limit of the ECR 2023 standard of 0.05 mg/l and the WHO Guidelines of 0.02 mg/l.
- **Nitrate:** concentrations were in the range between 0.8 - 35 mg/l. All the sampling results were within the permissible limit of ECR 2023 standard of 45 mg/l and WHO Guidelines of 50 mg/l.
- **Nitrite:** concentrations were in the range between <0.01 - 0.09 mg/l. All the sampling results were within the permissible limit of ECR 2023 standard of 1 mg/l and WHO Guidelines of 3 mg/l.
- **pH:** concentrations were in the range between 8.4 - 8.5. All the sampling results were within the permissible limit of the ECR 2023 standard of 6.5-8.5 and the WHO Guidelines of 6.5-8.5.
- **Potassium:** concentrations were in the range between 6.8 - 10.1 mg/l. All the sampling results were within the permissible limit of the ECR 2023 standard of 12 mg/l.
- **Salinity:** concentrations were in the range between 0.27 - 1.53 ppt. There are no standards for salinity in ECR 2023 and the WHO Guidelines.
- **Sodium:** concentrations were in the range between 74.2 - 248 mg/l. Values at GWQ-2 and GWQ-4 exceeded the permissible limit of the ECR 2023 standard of 200 mg/l.
- **Total Dissolved Solids:** concentrations were in the range between 290 - 1,590 mg/l. Values at GWQ-3 exceeded the permissible limit of the ECR 2023 standard of 1,000 mg/l.
- **Zinc:** concentrations were in the range between 0.2 - 0.5 mg/l. All the sampling results were within the permissible limit of the ECR 2023 standard of 5 mg/l.

3.2.22 Soil Quality – Secondary

From the secondary literature review, a total of 10 soil quality monitoring results have been identified. A summary of the analysis of the secondary soil quality has been provided below, and details of the soil quality, including monitoring date, locations, results, etc., have been provided in Appendix A (Volume III).

- **pH:** ranges from 5.9 to 8.2.
- **Electrical conductivity:** observed in the range of 4.6 to 25 mg/kg.
- **Total Nitrogen:** observed in the range of 0.035 to 31 mg/kg.
- **Phosphorus:** observed in the range of 1.9 to 8.2 mg/kg.
- **Potassium:** observed in the range of 0.31 to 1.54 mg/kg.
- **Calcium:** observed in the range of 2.71 to 750 mg/kg.
- **Magnesium:** observed in the range of 6.02 to 138 mg/kg. Magnesium concentration in the soil samples complied with the USEPA standard of 5,000 mg/kg (average concentration).
- **Sulphur:** observed in the range of 20.81 to 76.58 mg/kg.
- **Lead:** observed to be 18.41 mg/kg. Lead concentration in the soil sample was not in compliance with the USEPA standard of 10 mg/kg (average concentration).
- **Cadmium:** observed to be 1.09 mg/kg. Cadmium concentration in the soil sample was not in compliance with the USEPA standard of 0.06 mg/kg (average concentration).
- **Chromium:** observed to be 53.57 mg/kg. Chromium concentration in the soil sample complied with the USEPA standard of 100 mg/kg (average concentration).
- **Nickel:** observed to be 36.94 mg/kg. Nickel concentration in the soil sample complied with the USEPA standard of 40 mg/kg (average concentration).
- **Sulphate:** observed in the range of 269.78 to 289.64 mg/kg.

- **Chloride:** observed in the range of 440 to 476 mg/kg.

3.2.23 Soil Quality - Primary

Two soil samples were collected from the study area during the baseline data collection. The soil sampling locations were selected considering future development plans and possible impacted areas, representativeness of regional soil quality, and representativeness of likely impact areas. Details of the sampling locations are presented in Table 3-24. A map of the soil quality sampling locations and photographs is presented in Appendix A (Volume III).

Table 3-24: Soil Sampling Locations

Sampling Code	Sampling Locations	Geographical Coordinates	Sampling Date
SQ-1	Precincts A - Residential development in NSEZ	22°47'24.855"N 91°24'38.209"E	12/12/2023
SQ-2	Precincts I - Heavy Industrial Development in NSEZ	22°39'28.004"N 91°34'39.565"E	09/12/2023

Source: Field Survey by EQMS Team, December 2023

The analysis results of the physico-chemical parameters of soil samples are presented in Table 3-25. The laboratory test report has been presented in Appendix D (Volume III).

Table 3-25: Soil Quality Analysis Results

Sampling Code	Parameters																	
	pH	Electrical Conductivity	Total Nitrogen	Potassium	Calcium	Magnesium	Chloride	Phosphorus	Copper	Zinc	Lead	Cadmium	Nickel	Chromium	Salinity	Sulfate	Organic Matter	Texture
	-	dS/m	ppm	ppm	meq/100g	meq/100g	mg/kg	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppt	ppm	%	-
SQ-1	7.31	0.75	2.0	2.1	4.83	5.61	1083	1.2	4.22	0.68	21.00	0.20	44.39	30.82	0.48	137.48	0.647	Silty Clay Loam
SQ-2	7.28	0.85	2.4	3.0	4.47	6.16	1855	1.4	6.74	0.92	26.61	0.26	53.00	43.46	0.544	90.95	0.651	Silty Clay
USEPA Standards																		
Common Range	-	-	-	-	-	600-6000	-	-	2-100	100-300	2-200	0.01-0.7	5-500	1-1000	-	-	-	-
Average Concentration	-	-	-	-	-	5000	-	-	30	50	10	0.06	40	100	-	-	-	-

Source: Laboratory Analysis

3.2.23.1 Result Discussion

The results for the soil samples were compared with the USEPA standards.

- **pH:** concentrations were in the range between 7.28 - 7.31. There are no standards for salinity in the USEPA standards.
- **Electrical Conductivity:** concentrations were in the range between 0.75 - 0.85 dS/m. There are no standards for EC in USEPA standards.
- **Total Nitrogen:** concentrations were in the range between 2.0 - 2.4 ppm. There are no standards for N in USEPA standards.
- **Potassium:** concentrations were in the range between 2.1 - 3.0 ppm. There are no standards for K in USEPA standards.
- **Calcium:** concentrations were in the range between 4.47 - 4.83 meq/100g. There are no standards for Ca in the USEPA standards.
- **Magnesium:** concentrations were in the range between 5.61 - 6.16 meq/100g. All the results were within the permissible limit of USEPA standards – common range (600-6000 meq/100g), as well as average concentration (5000 meq/100g).
- **Chloride:** concentrations were in the range between 1083 - 1855 mg/kg. There are no standards for Cl- in USEPA standards.
- **Phosphorus:** concentrations were in the range between 1.2 - 1.4 ppm. There are no standards for P in USEPA standards.
- **Copper:** concentrations were in the range between 4.22 - 6.74 ppm. All the results were within the permissible limit of USEPA standards – common range (2-100 ppm), as well as average concentration (30 ppm).
- **Zinc:** concentrations were in the range between 0.68 ppm to 0.92 ppm. All the results were within the permissible limit of USEPA standards – common range (100-300 ppm), as well as average concentration (50 ppm).
- **Lead:** concentrations were in the range between 21 - 26.61 ppm. All the results exceeded the permissible limit of USEPA standards – common range (2-200 ppm), as well as average concentration (10 ppm).
- **Cadmium:** concentrations were in the range between 0.20 ppm to 0.26 ppm. All the results exceeded the permissible limit of USEPA standards – common range (0.01-0.7 ppm), as well as average concentration (0.06 ppm).
- **Nickel:** concentrations were in the range of 44.39 - 53 ppm. All the results exceeded the permissible limit of USEPA standards – common range (5-500 ppm), as well as average concentration (10 ppm).
- **Chromium:** concentrations were in the range of 30.82 - 43.46 ppm. All the results were within the permissible limit of USEPA standards – common range (1-1000 ppm), as well as average concentration (100 ppm).
- **Salinity:** concentrations were in the range between 0.48 - 0.544 ppt. There are no standards for Salinity in USEPA standards.
- **Sulfate:** concentrations were in the range of 90.95 - 137.48 ppm. There are no standards for Sulfate in USEPA standards.
- **Organic Matter:** concentrations were in the range between 0.647% to 0.651%. There are no standards for organic matter in the USEPA standards.
- **Texture:** the texture of the soil samples was silty clay loam and silty loam.

3.2.24 Sediment Quality - Primary

Eight sediment samples were collected from the Feni River, Little Feni River, and Sandwip Channel during the baseline data collection. The sediment sampling locations were selected considering a minimum distance of 1.5 km from the super dike, confluence zone of freshwater and brackish water, erosion-deposition area as per the existing bathymetry data and remote sensing analysis from the hydrological model, proposed jetty in the Sandwip Channel and future impacts due to capital and maintenance dredging and vessel movement, discharge point from CETP in the Sandwip Channel, representativeness of regional sediment quality, and representativeness of likely impact areas. Details of the sampling locations are presented in Table 3-26. A map of the sediment quality sampling locations and photographs is presented in Appendix A (Volume III).

Table 3-26: Sediment Sampling Locations

Sampling Code	Sampling Locations	Geographical Coordinates	Sampling Date
SeQ-1	Confluence of Ichakhali Khal	22°43'24.344"N 91°26'12.443"E	14/12/2023
SeQ-2	Sandwip channel	22°40'57.553"N 91°27'23.013"E	14/12/2023
SeQ-3	Confluence of Domkhali Khal/ Sandwip channel	22°38'05.206"N 91°30'36.946"E	14/12/2023
SeQ-4	Downstream of Fakirhat ghat, Saidpur/ Sandwip channel	22°37'19.419"N 91°33'21.117"E	14/12/2023
SeQ-5	Char in the Sandwip Channel (near Urirchar)	22°43'52.743"N 91°24'36.693"E	14/12/2023
SeQ-6	Confluence of Feni and Little Feni River	22°44'53.326"N 91°24'13.206"E	14/12/2023
SeQ-7	Near to Musapur Closure (Feni EZ)	22°45'56.389"N 91°22'53.920"E	14/12/2023
SeQ-8	Feni River	22°48'01.864"N 91°25'52.325"E	14/12/2023

Source: Field Survey by EQMS Team, December 2023

The analysis results of the physico-chemical parameters of sediment samples are presented in Table 3-27. The laboratory test report has been presented in Appendix D (Volume III).

Table 3-27: Sediment Quality Analysis Results

Sampling Code	Parameters																
	pH	EC	Total Nitrogen	Potassium	Calcium	Magnesium	Chloride	Phosphorus	Copper	Zinc	Lead	Cadmium	Nickel	Chromium	Sulfate	Organic Matter	Texture
	-	dS/m	ppm	ppm	meq/100g	meq/100g	mg/kg	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	-
SeQ-1	7.17	1.40	1.2	2.1	5.67	7.46	6008	0.8	5.91	0.58	22.51	0.20	46.42	37.23	95.76	2.18	Silty Clay Loam
SeQ-2	7.21	2.28	1.8	2.4	4.97	6.94	7034	1.0	5.28	0.68	22.94	0.27	44.88	34.80	101.2	2.32	Silty Clay
SeQ-3	7.60	2.18	1.1	2.3	6.39	8.67	6040	1.2	5.75	0.55	23.59	0.27	43.10	32.45	84.08	2.064	Silty Clay
SeQ-4	7.42	1.38	2.1	2.4	6.39	8.34	7271	1.4	5.92	0.71	23.80	0.25	38.47	30.54	94.30	2.32	Silty Clay
SeQ-5	7.47	2.35	2.3	2.1	6.54	7.92	6824	0.9	5.76	0.58	23.81	0.29	41.70	30.54	100.16	2.32	Silty Clay
SeQ-6	7.38	2.25	2.2	2.2	6.73	8.01	6368	1.2	5.59	0.45	23.82	0.20	42.80	32.73	127.20	2.18	Silty Clay
SeQ-7	7.21	2.40	2.4	2.0	6.65	7.94	5973	1.1	6.06	0.43	23.15	0.27	47.31	34.17	90.15	2.44	Silty Clay
SeQ-8	7.31	1.44	1.3	2.4	5.01	9.47	6105	1.2	6.15	0.52	28.33	0.28	46.22	35.37	105.86	2.064	Clay
USEPA Standards																	
<i>Not Polluted</i>	-	-	-	-	-	-	-	-	<25	<90	<40	-	<20	<25	-	-	-
<i>Moderately Polluted</i>	-	-	-	-	-	-	-	-	25-50	90-200	40-60	-	20-50	25-75	-	-	-
<i>Heavily Polluted</i>	-	-	-	-	-	-	-	-	>50	>200	>60	>6	>50	>75	-	-	-

Source: Laboratory Analysis

3.2.24.1 Result Discussion

The results for the sediment samples were compared with the USEPA standards.

- **pH:** concentrations were in the range between 7.17 - 7.60. There are no standards for pH in the USEPA standards.
- **Electrical Conductivity:** concentrations were in the range between 1.38 - 2.40 dS/m. There are no standards for EC in USEPA standards.
- **Total Nitrogen:** concentrations were in the range between 1.1 - 2.4 ppm. There are no standards for N in USEPA standards.
- **Potassium:** concentrations were in the range of 2 - 2.4 ppm. There are no standards for K in USEPA standards.
- **Calcium:** concentrations were in the range between 4.97 - 6.73 meq/100g. There are no standards for Ca in the USEPA standards.
- **Magnesium:** concentrations were in the range between 6.94 - 9.47 meq/100g. There are no standards for Mg in USEPA standards.
- **Chloride:** concentrations were in the range of 5973 - 7271 mg/kg. There are no standards for Cl- in USEPA standards.
- **Phosphorus:** concentrations were in the range of 0.8 - 1.4 ppm. There are no standards for P in USEPA standards.
- **Copper:** concentrations were in the range between 5.28 - 6.15 ppm. Cu concentration in all the sediment samples complied with the USEPA standard of <25 ppm (not polluted).
- **Zinc:** concentrations were in the range between 0.43 - 0.71 ppm. Zn concentration in all the sediment samples complied with the USEPA standard of <90 ppm (not polluted).
- **Lead:** concentrations were in the range between 22.51 - 28.33 ppm. Pb concentration in all the sediment samples complied with the USEPA standard of <40 ppm (not polluted).
- **Cadmium:** concentrations were in the range of 0.2 - 0.29 ppm. Cd concentration in all the sediment samples complied with the USEPA standard of >6 ppm (not polluted).
- **Nickel:** concentrations were in the range of 38.47 - 47.31 ppm. Ni concentration in all the sediment samples exceeded the USEPA standard of <20 ppm (not polluted) and was found between 20-50 ppm (moderately polluted).
- **Chromium:** concentrations were in the range of 30.54 - 37.23 ppm. Cr concentration in all the sediment samples exceeded the USEPA standard of <20 ppm (not polluted) and was found between 25-75 ppm (moderately polluted).
- **Sulfate:** concentrations were in the range of 84.08 - 127.2 ppm. There are no standards for Sulfate in USEPA standards.
- **Organic Matter:** Organic matter concentrations in the sediment samples were in the range between 2.064% to 2.44%. There are no standards for organic matter in the USEPA standards.
- **Texture:** the texture of the sediment samples was silty clay loam, silty loam, and clay.

3.3 Biological Environment

3.3.1 Ecosystem and Habitat

The NSEZ is located on the coastline of southeastern Bangladesh. The area is home to a diverse range of ecosystems and habitats due to its geographical features and climatic conditions. The NSEZ area encompasses various landforms, including hillocks, plains, rivers, and coastal areas, which contribute to the region's high biological diversity. It's important to note that the ecosystems and habitats of the study region are subject to human activities, such as deforestation, pollution, industrialization, and urbanization.

- **Terrestrial Ecosystem and Habitat:** terrestrial ecosystem of the study region encompasses a diverse range of flora and fauna, supported by various landforms, including coastal plantations, agricultural lands, homestead plantations, and riparian vegetation. Rich biodiversity characterizes the area, featuring trees, shrubs, grasses, and an array of mammals, birds, reptiles, and insects. However, human activities have significantly altered many natural habitats.
- **Aquatic Ecosystem and Habitat:** The aquatic ecosystem of the study region includes diverse water bodies such as the estuarine and marine habitats of the Sandwip Channel/Bay of Bengal, the Feni River, drainage khals, lentic ponds, and coastal mudflats, each contributing significantly to regional biodiversity.

3.3.2 Flora

Baseline biodiversity study and secondary sources (Forest Department, scientific studies, and previous similar studies in the same region) are used for this study to investigate the biodiversity composition. The NSEZ site is a flat lowland area covered with grey silty clay soil. The site has wetlands and remains inundated with water during monsoons and high tides. This area serves as intertidal mud flats and thus provides a habitat for mud crabs and water birds. These water birds and mud crabs occur in forest areas and other wet areas of the NSEZ site. A large variety of fish and shrimps exists in the Susham Khal/channel passing through the NSEZ site and the Bamon Sundar channel abutting the site. The Mirsharai part of the NSEZ site does not support major vegetation. Some planted trees like Akashmoni (*Acacia auriculiformis*), Jhao Ghas (*Tamarix indica*), Karoi (*Albizia procera*), etc., are seen in this part of the NSEZ. A detailed list of flora represented in both the NSEZ site and study region is enclosed as Appendix B (Volume III).

To investigate the vegetation composition of the study region quadrat sampling method was used. The field data collection was mainly included in the assessment of the different life of floral elements such as trees, herbs, and shrubs. A total of six quadrats have been conducted in the study region, covering various floral aspects (Table 3-28).

Table 3-28: Quadrates Location for Floral Assessment of NSEZ

Land Use Class	Quadrates	Geographical Coordinate	Direction from the NSEZ Boundary
Trees (2 quadrates, each size of 10 x 10 m)	TQ-1	22°43'17.7"N 91°30'39.9"E	Inside the NSEZ. North-East side
	TQ-2	22°40'53.4"N 91°33'57.8"E	Outside the NSEZ. North-East side
Herb (2 quadrates, each size 5 x 5 m)	HQ-1	22°44'39.5"N 91°29'30.8"E	Outside the NSEZ. North-East side
	HQ-2	22°44'59.1"N 91°29'32.6"E	Outside the NSEZ. Northside

Land Use Class	Quadrates	Geographical Coordinate	Direction from the NSEZ Boundary
Shrub (2 Quadrates, each size 1 x 1 m)	SQ-1	22°44'29.1"N 91°30'08.9"E	Outside the NSEZ. Northside
	SQ-2	22°42'40.7"N 91°32'13.0"E	Outside the NSEZ. Northside

Source: EQMS Field Survey, November 2023

3.3.2.1 Floral Species Composition and Diversity

During the field survey, a comprehensive inventory of plant species was conducted within the study region, resulting in the identification of a total of 56 distinct species. These encompassed a diverse array of vegetation, spanning trees, herbs, and shrubs. Upon closer examination of the recorded species, it was revealed that 43 of them belonged to the category of homestead species, indicative of plants commonly found in and around human settlements. Additionally, 10 species were classified as fallow land species, signifying their prevalence in areas that had undergone a period of abandonment or cultivation cessation. Furthermore, the survey identified three species of mangroves.

Shannon Diversity Index (H) is used to characterize species diversity for different quadrats. The biodiversity indices of different quadrats are presented in Table 4-22. The highest value of the Shannon diversity index (H) was found for Quadrat SQ-1 (2.046), followed by Quadrat HQ-2 (1.937), and the lowest value was found for Quadrat HQ-2 (0.932). The value of Evenness (E) was highest in Quadrat HQ-2 (0.932), and the lowest evenness was found in TQ-2 (0.848). The highest species richness was recorded in SQ-1 (n=09) and the lowest in TQ-2 (n=04). The results of the diversity index of the floral study in the study region are given in Table 3-29.

Table 3-29: Results of Diversity Index of Floral Study

Quadrat study for floral composition within the study region						
Parameter	TQ-1	TQ-2	SQ-1	SQ-2	HQ-1	HQ-2
Shannon-Wiener Diversity Index (H)	1.878	1.176	2.046	1.827	1.663	1.937
Evenness (E)	0.903	0.848	0.931	0.939	0.928	0.932
Species Richness (S)	8	4	9	7	6	8
Total Abundance	20	36	21	18	29	18

Source: EQMS Field Survey, November 2023

3.3.2.2 Mangrove Vegetation

The NSEZ site includes the area of planted mangrove vegetation in the NW and SE directions. Three species of mangrove vegetation, including Keora (*Sonneratia apetala*), Sada Bain (*Avicennia alba*), and Gewa (*Excoecaria agallocha*), are found. Apart from these species, other weeds like Pan ghas, Lata shak, Noona Jhao, and Katar were also observed. A list of identified mangrove species in the study region, including photographs, is provided in Appendix B (Volume III).

3.3.3 Faunal Diversity

3.3.3.1 Mammals

Among the recorded species, 11 species were observed in the NSEZ site. Among the identified species, the Rhesus Macaque (*Macaca mulatta*) is categorized as Vulnerable (VU), and the Fishing Cat (*Prionailurus viverrinus*) is listed as Endangered (EN) in the IUCN Red List of Threatened Species of Bangladesh 2015.

All the documented species of the NSEZ site also occurred in the study region of the NSEZ, with an additional seven species exclusively found within the study region. Among the study region species, the Rhesus Macaque (*Macaca mulatta*) is categorized as Vulnerable (VU), and the Fishing Cat (*Prionailurus viverrinus*) is listed as Endangered (EN) in the IUCN Red List of Threatened Species of Bangladesh 2015. On the other hand, the Jungle Cat (*Felis chaus*) and Irrawaddy Dolphin (*Orcaella brevirostris*) are categorized as Near Threatened (NT), and the rest of the 13 species are categorized as Least Concern (LC). A detailed list of mammals, including photographs, is enclosed as Appendix B (Volume III).

3.3.3.2 Avifauna

Based on field surveys and secondary data, a total of 185 bird species belonging to 55 families were recorded in the study region. Out of the documented species, 89 species were recorded from the NSEZ site. Among the recorded birds of the NSEZ site, the Black-headed Ibis (*Threskiornis melanocephalus*) is categorized as Vulnerable (VU), while all other species are categorized as Least Concern (LC) as per the IUCN Red List of Threatened Species.

All the bird species found in the NSEZ site were also present in the study region. However, there are 96 species exclusively identified within the study region that are not present in the NSEZ site. Among the recorded birds of the study region, the Black-headed Ibis (*Threskiornis melanocephalus*) is categorized as Vulnerable (VU), while the Grey-headed Fish Eagle (*Ichthyophaga ichthyaetus*) is categorized as Near Threatened (NT) according to the IUCN Red List of Threatened Species of Bangladesh 2015. A list of avifauna species, including photographs, is given in Appendix B (Volume III).

Migratory Bird

The aquatic habitat and mudflats of the study area are regarded as an important area for migratory birds due to their location along the migratory routes of many bird species. The vast wetlands, marshes, and mudflats of this area provide suitable habitats for many migratory bird species, offering them a place to rest and feed during their long journeys. The survey conducted in the study region recorded a total of 65 migratory bird species. Among the recorded species, 21 species were found in the NSEZ site. Notable migratory species observed in the sites were Common Sandpiper (*Actitis hypoleucos*), Common Snipe (*Gallinago gallinago*), Lesser Whistling Duck (*Dendrocygna javanica*), Black-headed Ibis (*Threskiornis melanocephalus*), Eurasian Curlew (*Numenius arquata*), Green Sandpiper (*Tringa ochropus*), Spotted Redshank (*Tringa erythropus*), Wood Sandpiper (*Tringa glareola*), etc. In the NSEZ site, the Black-headed Ibis (*Threskiornis melanocephalus*) is the only species that holds conservation significance as the species is categorized as Vulnerable (VU) (IUCN, 2015).

All the recorded species were also found in the study region of the NSEZ. However, 30 species were exclusively identified within the study region. Notable migratory birds recorded from the study region were the Common Sandpiper (*Actitis hypoleucos*), Green Sandpiper (*Tringa ochropus*), White Wagtail (*Motacilla alba*), Pied Avocet (*Recurvirostra avosetta*), Grey-headed lapwing (*Vanellus cinereus*), Pacific golden plover (*Pluvialis fulva*), Black-tailed godwit (*Limosa limosa*), Common snipe (*Gallinago gallinago*), Grey heron (*Ardea cinerea*), Eurasian curlew (*Numenius arquata*), Ruddy Shallduck (*Tadorna ferruginea*), Gadwall (*Mareca strepera*), Northern pintail (*Anas acuta*), Northern Shoveller (*Anas clypeata*), Eurasian Teal (*Anas crecca*), Baikal teal (*Sibirionetta formosa*), Marbled duck (*Marmaronetta angustirostris*), Eurasian wigeon (*Mareca penelope*), Long-toed stint (*Calidris subminuta*), Black-headed Ibis (*Threskiornis melanocephalus*), Sooty tern (*Onychoprion fuscatus*), Black-naped tern (*Sterna sumatrana*), etc. Some of these birds start visiting the site in October and return in April. The early migrants are the Common Sandpiper (*Actitis hypoleucos*), White Wagtail (*Motacilla alba*), Lesser Sandplover (*Charadrius mongolus*), Common Whimbrel (*Numenius phaeopus*), Brown-headed Gull (*Chroicocephalus brunnicephalus*), etc. Among the migratory birds of the study region, the Black-headed Ibis (*Threskiornis melanocephalus*) is categorized as Vulnerable (VU), and all other species don't hold any conservation significance as per the IUCN Red List of Threatened Species

of Bangladesh 2015. An overview of the migratory status of recorded birds is shown in Appendix B (Volume III).

3.3.3.3 Herpetofauna

A total of twenty-eight species of reptilian fauna, belonging to nine families, were documented in the study region through a combination of primary and secondary data sources. Out of the documented species, 12 species were observed in the NSEZ site. As per the IUCN Red List of Threatened Species of Bangladesh 2015, the NSEZ site doesn't hold any species of conservation significance.

Among the recorded species, 16 species are exclusively found in the study region of the NSEZ. Among the recorded species, the Asian water monitor (*Varanus salvator*) is categorized as Vulnerable (VU), while the Bengal Monitor (*Varanus bengalensis*), Yellow Monitor (*Varanus flavecens*), Monocled Cobra (*Naja kaouthia*), Red-necked Keelback (*Rhabdophis subminiatus*), and Spectacled Cobra (*Naja naja*) are classified as Near Threatened (NT) according to the IUCN Red List of Threatened Species of Bangladesh 2015.

The baseline herpetofauna survey, along with supplementary data, revealed a collective presence of nine amphibian species from five distinct families within the study region. Out of the documented species, five species are observed in the NSEZ site. However, all the recorded species of the NSEZ site are regarded as Least Concern (LC) as per the IUCN Red List of Threatened Species of Bangladesh 2015.

On the other hand, study regions of the NSEZ hold all the recorded species that are also found in the NSEZ site. However, four species are exclusively found within the study region. Among these species, the Cascade Frog (*Amolops marmoratus*) is categorized as Vulnerable (VU) according to the IUCN Red List of Threatened Species of Bangladesh 2015, while the remaining species are classified as Least Concern (LC) in terms of conservation significance. A detailed list of herpetofauna species, including photographs, is shown in Appendix B (Volume III).

3.3.4 Aquatic Biodiversity

3.3.4.1 Ichthyofauna

The primary goal of the fisheries study was to assess the comprehensive status of fisheries, encompassing both captured and cultured fish species, within the study region. To determine the composition of fish species, methods such as fish market surveys, consultations with residents, focus group discussions with fishermen, and key informant interviews with the Upazila Fisheries Officers were employed.

Coastal Fisheries Diversity: in Sonagazi, Mirsharai, Sitakunda, and Sandwip coasts that fall within the study region, the baseline fisheries survey revealed a total of 30 species, comprising 22 species of finfish, 2 species of crab, and 6 species of shrimp. The recorded 30 species are distributed across 24 families. The highest number of species belongs to the family Penaeidae, while Portunidae, Engraulidae, and Plynemidae each hold two species separately. The remaining 20 families each hold one species separately. A detailed list of coastal fisheries diversity in the study region is provided in Appendix B (Volume III).

Fish Farming: a total of fourteen species of fish and two species of crustaceans are mostly cultured by the fish farmers of the study region. Among the cultured species, farming of Nile tilapia (*Oreochromis niloticus*), Catla (*Catla catla*), Rui (*Labeo rohita*), Mrigal (*Cirrhinus cirrhosus*), Silver Carp (*Hypophthalmichthys molitrix*), Grass Carp (*Ctenopharyngodon idella*), Bighead Carp (*Hypophthalmichthys nobilis*), Pabda (*Ompok pabda*), Thai Pangus (*Pangasianodon hypophthalmus*), and Koi (*Anabas testudineus*) holds great potential for high productivity. Bagda Chingri (*Penaeus monodon*) and Golda Chingri (*Macrobrachium rosenbergii*) are also cultured along with the carp species in the same pond. A detailed list of cultured fish and crustacean species in the study region is provided in Appendix B (Volume III).

3.3.4.2 Plankton and Benthos

Samples of plankton and benthos were collected from each predetermined sampling location near the confluence of the Feni River and the Sandwip Channel, in proximity to the NSEZ. The sampling points for the plankton and benthos are detailed in Table 3-30.

Table 3-30: Sampling Points for Plankton and Benthos

Sampling Code	Geographical Coordinates	Location Details
PZ-1/PB-1	22°46'30.46"N, 91°26'18.02"E	Downstream of Feni River
PZ-2/PB-2	22°45'20.40"N, 91°25'17.46"E	Confluence of Feni River and Sandwip Channel
PZ-3/PB-3	22°44'3.60"N, 91°25'25.43"E	Upstream of the proposed Basundhara Jetty Area
PZ-4/PB-4	22°43'25.94"N, 91°26'24.79"E	Upstream of the proposed Basundhara Jetty Area
PZ-5/PB-5	22°42'58.97"N, 91°27'27.43"E	Upstream of the proposed Basundhara Jetty Area (Outlet of Daurkhali Khal)
PZ-6/PB-6	22°42'38.78"N, 91°27'44.29"E	Proposed Basundhara Jetty Area (Sandwip Channel)
PZ-7/PB-7	22°42'14.50"N, 91°28'30.24"E	Downstream of the proposed Basundhara Jetty Area (Outlet of Bamonsundor Khal)
PZ-8/PB-8	22°42'0.74"N, 91°29'21.16"E	Downstream of the proposed Basundhara Jetty Area (Sandwip Channel)
PZ-9/PB-9	22°41'28.72"N, 91°30'22.45"E	Downstream of the proposed Basundhara Jetty Area (Sandwip Channel)
PZ-10/PB-10	22°40'55.75"N, 91°31'13.80"E	Downstream of the proposed Basundhara Jetty Area (Outlet of Saherkhali Khal)

Source: EQMS Field Study, November 2023

Phytoplankton: a total of nineteen species of phytoplankton were identified by sample analysis from ten predefined sample collection locations. The phytoplankton in the study region was represented by twelve groups, and the dominant phytoplankton group was the Bacillariophyceae. In the case of species, *Melosira* sp. was dominant under Bacillariophyceae. Details of the species composition and numbers of phytoplankton per liter have been presented in Appendix B (Volume III).

Shannon-Wiener index (H) diversity of Phytoplankton is higher in PZ-6 (H=2.042) and lower in the sampling point PZ-7 (H=0.713). Evenness is higher in the sampling point PZ-6 (E=0.982) and Lower in PZ-7 (E=0.649). The higher Evenness value of PZ-6 indicates that the number of phytoplankton classes is more evenly distributed, followed by PZ-5, PZ-4, PZ-10, PZ-2, PZ-9, PZ-3, PZ-1, PZ-8, and PZ-7, respectively.

Zooplankton: a total of fourteen species of zooplankton were identified by sample analysis from predefined sample collection locations of the Sandwip Channel, downstream of Feni River and its confluences adjacent to the NSEZ. *Moina* sp. was the highest-abundant zooplankton species in the study region. Details of species composition and the number of zooplankton per liter have been presented in Appendix B (Volume III).

Shannon-Wiener index (H) was higher in the PZ-1 (H=1.479) sampling location and lower in PZ-6 (H=0.691). The evenness value is higher in the sampling points PZ-9 (E=1) and Lower in PZ-5 (E=0.592). A higher Evenness value of PZ-9 indicates that the number of Zooplankton classes is more evenly distributed among the other sampling points, followed by PZ-6, PZ-10, PZ-4, PZ-1, PZ-7, PZ-3, PZ-8, PZ-2, and PZ-5, respectively.

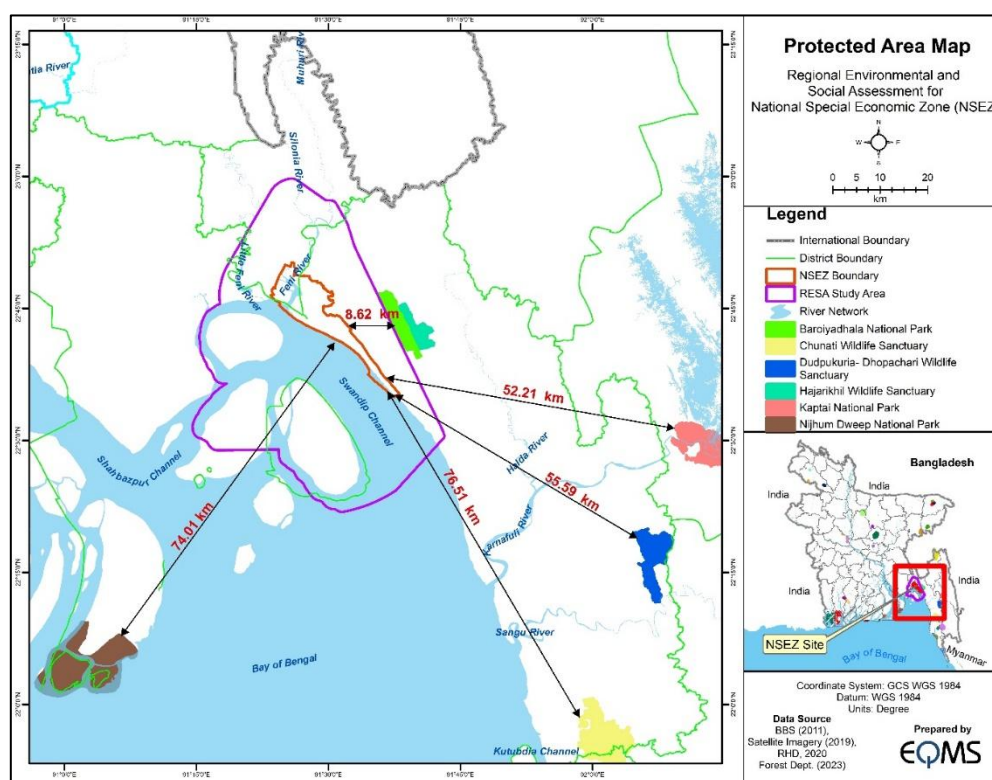
Benthos: a total of sixteen species were identified from ten sampling locations. These genera belong to Crustaceans, Insecta, Polychaeta, Gastropoda, Bivalvia, etc. According to the analysis, three Species of Polychaeta, six species of Gastropoda, five species of Bivalvia, one species of Insecta, and one species of Crustacea were found in the study region. Benthos abundance varied between 755 to 33 individuals per square meter (individuals/m²) in the present study for the Sandwip Channel and its adjacent areas. Details are presented in Appendix B (Volume III).

The Shannon-Wiener diversity indices showed that macrobenthos diversity is higher in PB-9 ($H=1.877$) and lower in the sampling point PB-4 ($H=0.934$). The evenness value is higher in the sampling point PB-5 ($E=0.969$) and lower in PB-1 ($E=0.769$). A higher Evenness value of PB-5 indicates that the number of Benthos classes is more evenly distributed among the other sampling points.

3.3.5 Protected Areas/Marine Protected Areas/Marine Reserves

According to the Wildlife (Conservation and Security) Act 2012, types of protected areas are national parks, sanctuaries, eco-parks, botanical gardens, community conservation areas, safari parks, Kunjaban, etc. The NSEZ site as well as the study area doesn't hold any protected area. Baroiyadhala National Park is the closest protected area to the NSEZ, which is approximately 8.62 km far from the NSEZ boundary. In addition, there are no marine protected areas and marine reserves in the NSEZ boundary, as well as the study area boundary. A map of the protected areas is presented in Figure 3-10.

Figure 3-10: Protected Areas in the Study Region



Source: Data from the Forest Department and map prepared by EQMS

3.3.6 Ecologically Critical Areas

The MOEFCC has declared 13 ECAs to date. No ECAs are located in the study area. The nearest ECA from the NSEZ is Sonadia Island, which has a distance of approximately 95 km away.

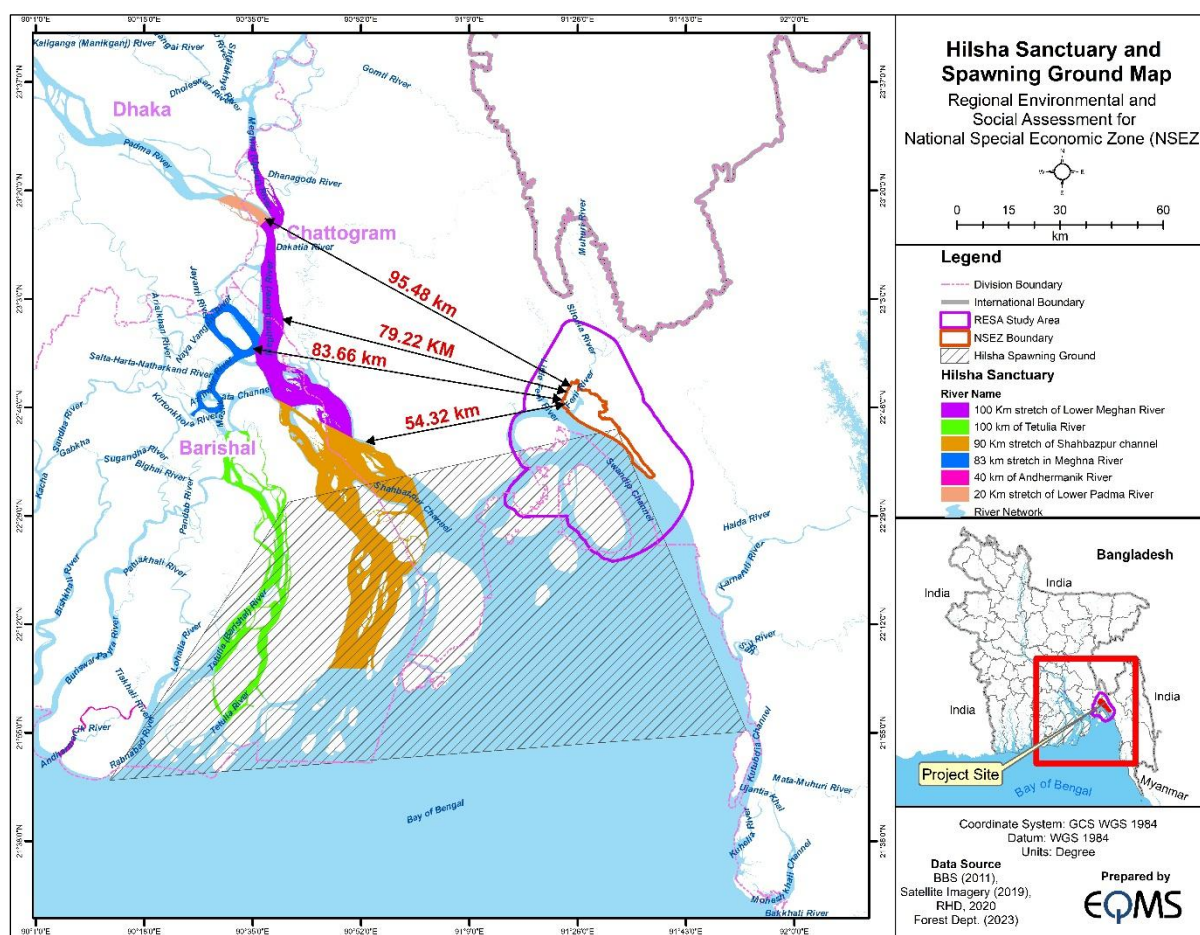
3.3.7 Hilsha Sanctuary and Spawning Ground

Six Hilsha sanctuaries have been established under the 'Protection and Conservation of Fish Act 1950' for the effective conservation of Jatka and brood Hilsha in the major nursery and spawning areas. There

are no hilsa sanctuaries within the study region. However, the nearest sanctuary, Char Ilsha to Char Pail of Bhola district (90 km stretch of Shahbazpur channel, a tributary of Meghna River) is located more than 21 km away from the study region.

Hilsha spawning ground boundary point is located within the study region, namely Mayani Point, Mirsharai, Chattogram (91°32.15'E and 22°42.59'N). The peak spawning period is three days before and seven days after the full moon, including the day of the full moon, that is, a total of eleven days of the moon, which will first appear in the Bengali month of *Ashwin* each year. A map of the Hilsha sanctuaries and the spawning ground is shown in Figure 3-11.

Figure 3-11: Hilsha Sanctuary and Spawning Ground in the Study Area



Source: Data from DOF and map prepared by EQMS

3.3.8 Important Bird and Biodiversity Areas

According to Birdlife International, there are twenty Important Bird and Biodiversity Areas (IBAs) in Bangladesh. In the study region, a total of two IBAs have been found, namely the Ganges-Brahmaputra-Meghna delta and the Muhuri Dam. In the Ganges-Brahmaputra-Meghna delta, IUCN Red List species, including Eurasian Curlew (NT), Spoon-billed Sandpiper (CR), Spotted Greenshank (EN), and Indian Skimmer (EN) are found (BirdLife International 2023a). Similarly, in Muhuri Dam, IUCN Red List species, including *Ferruginous Duck* (NT), and *Anas crecca* (NR) are found (BirdLife International 2023b).

3.3.9 RAMSAR Sites

Two Ramsar sites, namely Sundarbans Reserved Forest and Tanguar Haor, are located in Bangladesh, however, far away from the NSEZ site.

3.4 Socio-economic Profile

The region of the NSEZ area covers part of the three upazilas of the Chattogram and Feni Districts under the Chattogram Division. The upazilas are Mirsharai, Sitakunda under the Chattogram district, and Sonagazi Upazila under the Feni district.

3.4.1 Approach and Methodology

To establish the socio-economic baseline for the NSEZ and undertake the regional social impact assessment of the NSEZ, a phased participatory approach was adopted. Through this approach, an attempt was made to integrate the local understanding and perspective into the assessment process and identification of the mitigation measures. The purpose of such an approach was to allow for:

- The triangulation of the information available from secondary sources through the information made available by the local community, both qualitative and quantitative.
- Formulation of the socio-economic baseline based on a combination of primary and secondary qualitative and quantitative data.
- An understanding was developed of the local community's perception of the NSEZ and its activities, the possible impacts of the same, and the desirable mitigation measures.

3.4.2 Population and Demography of the Study Area

As per the Population and Housing Census 2022, National Report (Volume I), the total population of the Chattogram division is 3,32,02,326 with 7,528,333 households. Table 3-31 presents the demographic data for the Chattogram division. It is perceived that the region will be impacted by the NSEZ. The potentially impacted populations are in the Chattogram and Feni districts. In the Chattogram division, population density is 979 persons per square kilometer, with the total population of the division being 33,202,326.

Table 3-31: Demographic Data of the Division

Division	Total Population	Male	Female	Hijra	Sex Ratio	Population Density/ km ²
Chattogram	33,202,357	16,035,140	17,165,884	1,333	93.41	979

Source: Population and Housing Census 2022, National Report (Volume I)

At the Upazila level, Mirsharai Upazila shares the highest population (472,777), followed by Sitakunda Upazila (4,57,368) while Sonagazi shares the lowest population size (67,320) with the lowest sex ratio among all three upazilas (Table 3-32).

Table 3-32: Population Distribution by Upazila

District	Upazila	Total HHs	Total Population	Sex Ratio	Avg. HH size
Chattogram	Mirsharai	111,009	472,777	0.93	4.19
	Sitakunda	105,258	457,368	1.04	4.30
Feni	Sonagazi	67,320	290,664	0.86	4.28
Total		283,587	1,220,809	0.95	4.25

Source: Population and Housing Census 2022, National Report (Volume I)

Table 3-33 shows that 1.25% of the population are people with disability in the Chattogram Division. Additionally, the dependency ratio is 59.95% in the area. The total number of households in the division is 73,93,636 with an average household size of 4.35.

Table 3-33: Dependency Ratio, Literacy Rate, Disability Data of Chattogram Division

Division	Dependency Ratio	Literacy	Disability	Number of HH	Average size of HH
Chattogram	59.95	75.72	1.25	73,93,636	4.35

Source: Population and Housing Census 2022, National Report (Volume I)

As per the primary socio-economic survey conducted during the study period, it was identified that 402 households with a population of 1,573, with an average household size of 3.91, a sex ratio of 0.89, disability rate is 1.03%, and a literacy rate of 79.85%. The findings are consistent with regional data found from secondary sources. Table 3-34 depicts the dependency ratio, literacy rate, and disability status of the surveyed population.

Table 3-34: Dependency Ratio, Literacy Rate, Disability Data of Surveyed Population

Number of Households	Total Population	Average HH Size	Sex Ratio	Disability	Literacy
402	1,573	3.91	0.89	1.03	79.85%

Source: Household Survey conducted by EQMS 2023

More than half of the population is married, and 42.28% are unmarried. The number of widows/widowers is low (2.42%).

3.4.3 Gender

According to the Population and Housing Census 2022, the sex ratio of the Chattogram division is 93.41. The regional population comprises 48% males and 52% females.

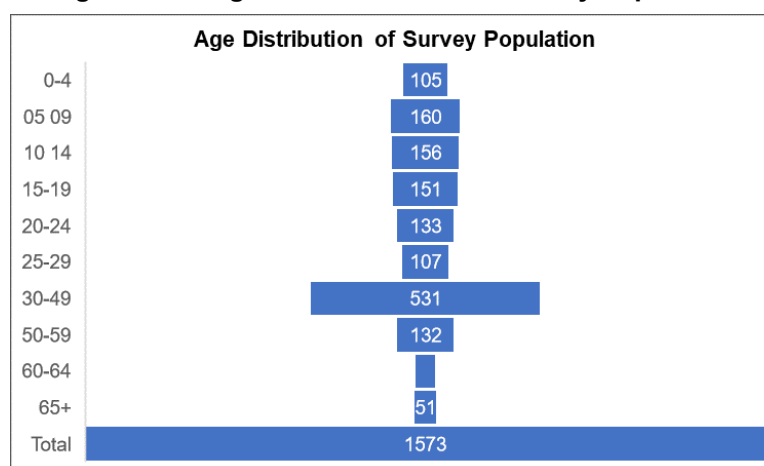
As per the Bangladesh Demographic and Health Survey 2018, around 43% of married women in the Chattogram division are observed to be able to control financial decisions, while 49.75% reported to have jointly control, and the rest 7.2% have no control over the same. Around 15.1% of women have bank accounts (BDHS 2018).

3.5 Age Composition

More than one-third (>35%) of the total population was identified as children and adolescents. The majority (~40%) of the population was aged between 20-49 years, which also means that the majority of the studied population is in their productive age (BBS, 2011).

A population pyramid of the survey population is shown in Figure 3-12. Data shows the availability of a large working-age population. Around 30% of the population is between 30-49 years of age. Around one-fourth of the population is children below 15 years of age. About 5 % of the population is elderly. According to the 2022 preliminary census report, Bangladesh's working-age population, between 15 and 64 years, increased by 4.88% from 2011 to 2022, hitting 65.5% or 10.82 crore of the total population, according to the latest census data⁷.

⁷ <https://businesspostbd.com/front/working-age-population-rises-2022-07-31>

Figure 3-12: Age Distribution of the Survey Population

Source: Household Survey conducted by EQMS 2023

3.6 Ethnic Composition

The primary socio-economic survey reveals no ethnic minority group in the NSEZ area.

3.7 Community Structure

According to the Population and Housing Census 2011, there are 72 playgrounds and 78 Eid-Gah (Designated open spaces where Eid Prayers of the Muslim community are held annually) places in those three upazila of the NSEZ area, which are mostly owned by the community and supported by the government.

According to the primary socio-economic survey findings (Table 3-35), there are playgrounds, graveyards, and crematoriums in the community. Nearly half of the respondents (50%) reported that they have playgrounds and graveyards in their locality.

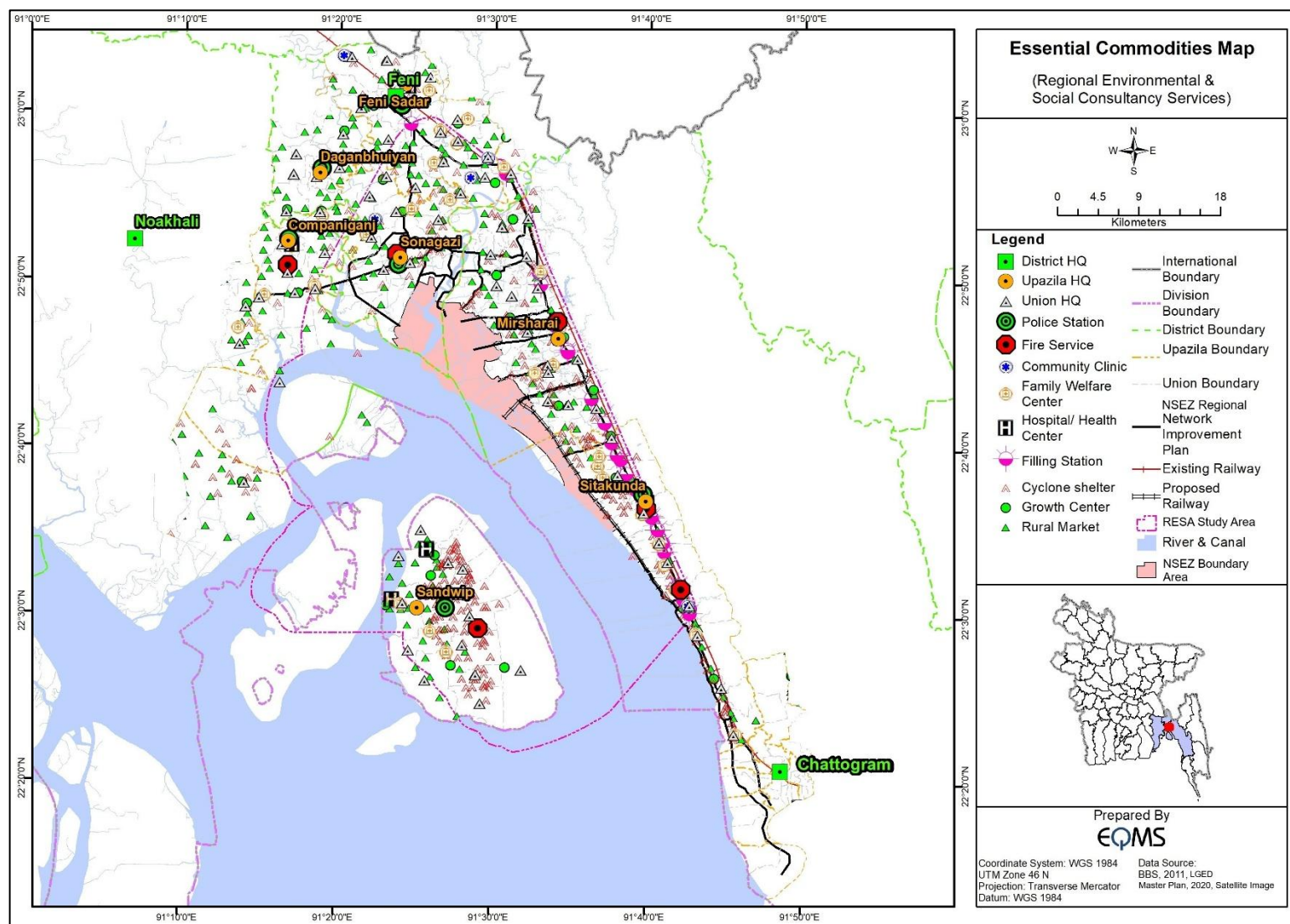
Table 3-35: Community Structures

Type of Community Structure	Percent of Cases
Playground	84.9%
Graveyard	93.2%
Crematorium	3.1%
Temple	6.0%

Source: Household Survey conducted by EQMS 2023

Figure 3-13 shows the locations of community structures like markets, growth centers, community clinics, union health centers, fire services stations, cyclone shelters, and union parishads.

Figure 3-13: Map of Community Structure and Essential Commodities

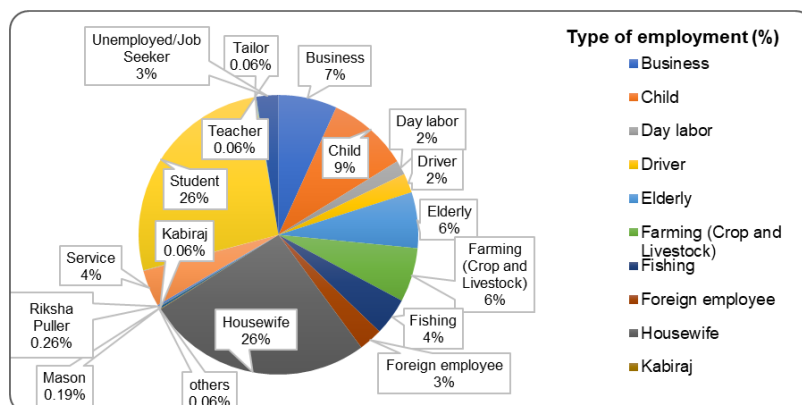


Source: EQMS

3.8 Employment

Agriculture, comprising crop cultivation, fisheries, direct farming, sharecropping, agricultural laborers, and so on, is the most common source of employment in the study area. Regarding the source of employment, primary socio-economic survey findings (Figure 3-14) show that major sources of employment are farming 6%, fishing 4%, day labor 2%, business 7%, service 4%, and working abroad 3% (of the respondents in nearby areas). At present, 3% of the respondents are looking for employment. Nearly 25% are students, 26% are housewives, and 6% are elderly, and they are not employed in any sector. Other sectors of employment include teaching, rickshaw pulling, tailoring, masonry, etc. (less than 1%).

Figure 3-14: Type of Employment in Nearby Area Population



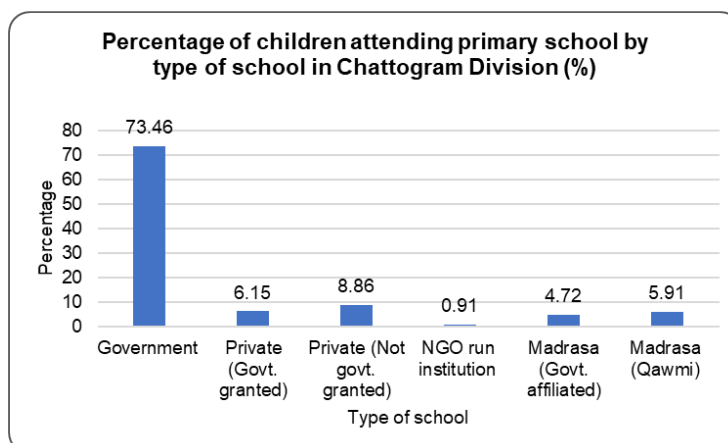
Source: Household Survey conducted by EQMS 2023

3.9 Access to Financial Products

According to the Institute of Microfinance data, the majority of households (75.62%) have access to any financial market in the Chattogram division. Around 40.75% have access to the formal market, while 38.54% have access to the Microfinance Market (National Convention on Inclusive Finance in Bangladesh 2015). According to the Household survey in 2023, more than half of the households (64%) have an account in a bank, and two-thirds of the households (66%) have taken loans from various sources. Additionally, the majority (79%) of the respondents (those who have a loan) received loans from NGOs, around 6% have taken loans from banks, and 15% have taken loans from the informal sector.

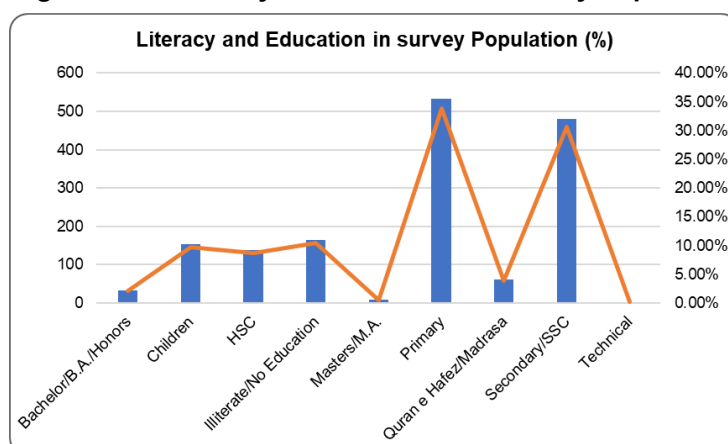
3.9.1 Education and Skills

The Household Income and Expenditure Survey 2022 data (Figure 3-15) illustrates that the majority of the students are enrolled in government primary schools (73.46%). Private (non-government) schools accounted for 8.86%, NGO-run schools accounted for 0.91%, government-recognized Madrasah accounted for 4.72%, and Kawmi/Qawmi Madrasah accounted for 5.91% of primary school students in the Chattogram division.

Figure 3-15: Percentage of Children Attending Primary School by Type of School

Source: Household income and expenditure Survey 2022

According to the primary survey, 9.37% are children who are too young to attend school, and 8.7% are illiterate. One-third of the population completed primary education, whereas 30.58% completed secondary education, and nearly 9% of the population passed higher secondary school (Figure 3-16). Nearly 5% of the population studied in a madrasa.

Figure 3-16: Literacy and Education in Survey Population

Source: Household Survey conducted by EQMS 2023

Most of the survey respondents (90%) expressed their interest in receiving skill development training. Additionally, primary survey data also reveals that half of the population expressed their interest in receiving technical skill development training in computer/MS Office packages, and 40% are willing to receive mechanical and tailoring skill development training. Figure 3-17 shows detailed data on the preference of community people in receiving skill development training.

Figure 3-17: Expected Training/Skill Development Trades by Community

Source: Household Survey conducted by EQMS 2023

3.9.2 Knowledge and Perception of the NSEZ

The knowledge about the proposed NSEZ of the community people was administered during the primary socio-economic survey. Around 96% of the respondents had prior knowledge about NSEZ. The community people obtained knowledge about NSEZ from their peers, local union parishad members, NGOs, and media. Around 82% of the respondents, including day laborers, landowners, farmers, business owners, and other people, perceive this NSEZ as favorable for the community.

According to the survey response data, the NSEZ will create more job opportunities for the local population, which would result in social development and would also help in improving road communication, economic conditions, and utility services in the area.

3.10 Housing Pattern

According to the primary survey, about 64% of the houses in the core area are tin sheds, 23.6% of the houses are semi-pucca, and 12 % of the houses are buildings. Less than 1 % of households are reported to be Jhupri/kacha.

3.11 Access to Utilities and Services

Electricity is an important indicator for measuring the quality of life in the study area. In the NSEZ area, most of the surveyed households (88%) have grid electricity connections. Primary survey findings show that the majority of households in all unions, except Muradpur, have access to electricity.

The study shows that around half of households use wood (19.40%) and a mix of wood/cow dung (35%) as cooking fuel sources, and 42% use a mix of wood, cow dung, and Liquefied Petroleum Gas (LPG). About 2.5% of households use LPG for their cooking. The rest of the households use mixed electric, cylinder, and other energy sources for cooking.

In the NSEZ area, the major source of drinking water is tube-well where about 59.45% of the population uses tube-well water. About 28.36% of people collect water from both tubewell and deep tubewell. Another 12.19% of people have access to deep tube wells.

In the study area, survey results find that nearly 90% of the households have access to electricity for lighting and fanning purposes. Around 10.45% of households utilize solar panels for lighting. Less than 1% of households use kerosine lamps as a source of light in day-to-day activities.

In the study area, households that use water-sealed sanitary latrines and non-water-sealed sanitary latrine facilities are 31% and 69% respectively, which indicates almost the entire survey population has access to sanitary latrines.

During the primary survey, it was found that around 12.44% of the total households have healthcare facilities within 1 km of their houses, while 32% have healthcare services between 1 to 3 km distance. However, a significant number of HHs (55.47%) have to travel more than 3 km to get to healthcare facilities. More than half of the survey population has a market (60.20%) and a primary school (65.42%) within 1 km of their household.

The primary survey reveals that waste collection services and drainage networks are not available to the households in the NSEZ area, according to most (100% and 94% respectively) of the respondents.

3.12 Religious Profile

According to the findings of the socio-economic survey, about 88% of the population is Muslim while 12% are Hindu by faith. No indigenous community or household was found during the socioeconomic survey.

3.13 Income and Expenditure

According to a socio-economic survey conducted in the area (Table 3-36), the monthly income of the community people living in the studied areas ranges between BDT 10,000 to BDT 60,000, with one exception where the monthly income is reported to be BDT 1500,000.

Table 3-36: Income and Expenditure

Income/Expenditure	Minimum	Maximum	Mean
Monthly Income	3,000	1,500,000	27,043.5323
Monthly Expenditure	9,000	55,000	20,757.4627

Source: Household Survey conducted by EQMS 2023

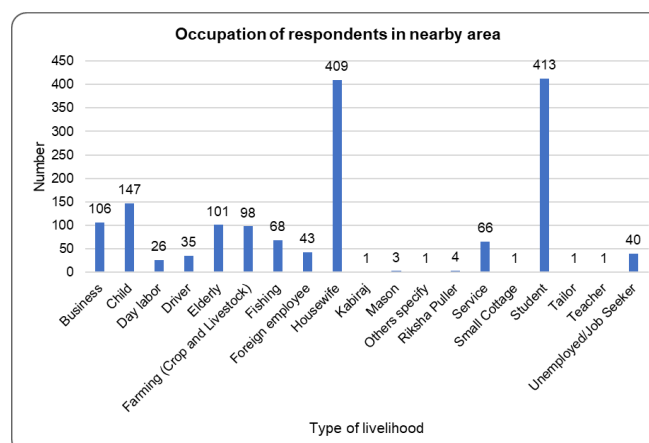
According to the Household Income and Expenditure Survey, around 19.4% of the households in the rural area of the Chittagong division are under the poverty line using the Headcount rate (HCR) by the cost of basic living (HIES, 2016).

3.14 Livelihoods

To assess the livelihood and occupation categories in the studied areas, the consultant team followed both secondary and primary data sources. According to the primary socio-economic survey data, the main source of livelihood is mostly related to agriculture, comprising crop cultivation, fisheries, direct farming, sharecropping, agricultural laborers, etc. A considerable number of fishermen were found in Mirsharai, Sitakunda, and Sonagazi upazila during the stakeholder consultation.

According to the primary survey (Figure 3-18), primary sources of livelihood are farming, fishing, business, service, day labor, driving, etc.

Figure 3-18: Occupation of Respondents in Nearby Area



Source: Household Survey conducted by EQMS 2023

NSEZ is expected to create thousands of employment opportunities in various sectors such as business, service, production, residence/housing, market and commodities, transportation, tourism, etc.

Buffalo Grazing, Fishing, and Fisheries Landing Site: The vast areas of Saherkhali, Ichhakhali, Sonagazi, Char Chandia, and Muradpur Union are used for buffalo, cow, and sheep grazing. Typically, an individual farmer owns up to one hundred buffaloes or 150 sheep on average. Buffalo and cows provide both milk and meat, while sheep are for meat only. There is an established dairy value chain in the area.

There are five major fisheries landing sites/ghats in the area: 1) Saherkhali Ghat, 2) Domkhali Ghat, 3) Bamonsundor Ghat, 4) Muhuri Project Mukh Ghat, and 5) Mithachora Ghat.

3.14.1 Common Property Resources

Common Property Resources have been largely described in the community structure part. The number of specific CPRs in the NSEZ area has been identified through site visits and consultation. The list of CPR identified through consultations is mentioned in Table 3-37.

Table 3-37: Common Property Resources

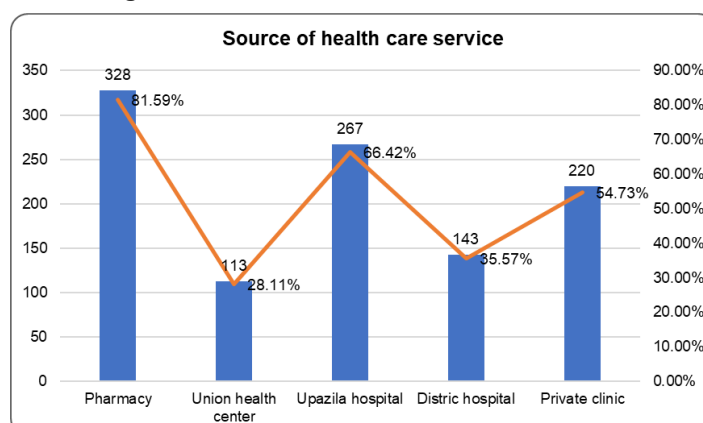
S/N	Common Property Resources	Resources extracted by community/utility
1	Low & wetland, canal & Rivers	Buffalo grazing, Fishing & crab hunting
2	Government khas land	Cow and sheep grazing
3	Mangroves and coastal forests	Fuel wood, fish, and crabs
4	Sea beaches and Sandwip channel	Fish, fish drying space, tourism

Source: Household Survey conducted by EQMS 2023

3.15 Health Care Facilities

Consultation findings and secondary review indicate that the generation of emissions, effluents, waste, and increased vehicular movements may have an overall adverse impact on the health of the people in the area. Moreover, the future influx of population, the number of beds, necessary logistics, and resources in the Upazila-level hospitals need to meet the future demands. According to the findings of the consultation, it has been recommended to increase additional healthcare facilities with well-trained medical practitioners and staff. Medical facilities need to increase gradually, considering the rise in population size in the areas, particularly in Saherkhali, Ichhakhali, Saidpur, Muradpur, and other NSEZ surrounding areas. Figure 3-19 supports the qualitative findings with 81.6 % of the survey population seeking treatment from the pharmacy as a first source of treatment, while 66% seek treatment from Upazila Hospital if the treatment from the pharmacy is not sufficient.

Figure 3-19: Source of Healthcare Service



Source: Household Survey conducted by EQMS 2023

3.16 Disadvantages and Vulnerable Groups

According to the Household Income and Expenditure Survey 2016 and Poverty Maps of Bangladesh 2016, around 18.43% of the total population of the Chattogram division lives below the poverty line. Stakeholder consultation further revealed the existence of an artisanal fisherman Community called 'Jaldas' (translated as servant of water). They are from a minority Hindu community and are found vulnerable in terms of their level of income and living conditions. Those communities expressed great concern, assuming any potential risk of interruption in their access to traditional fishing. Additionally, people living near the shoreline are vulnerable to natural disasters like cyclones, as the majority of the house structures are made of tin sheds (64%).

Allowances and Social Safety Net Program: According to the Household Income and Expenditure Survey 2016⁸, 21.1% of HHs are under the coverage of social safety net programs in the rural areas of the Chattogram division. Education and other stipends, old age allowance, widow deserted and destitute woman allowance, Freedom Fighter honorarium, VGF, VGD, GRA-General relief activities, etc., are the major categories of safety net coverage.

Department of Social Services and Disaster Management Directorate have multiple social safety nets including the above-mentioned VGF, VGD, GRA, and different allowances. Additionally, there are employment generation programs for the hard-core poor, and food/cash-for-work programs are implemented by different government departments. NGOs also implement IGA, microcredit, and other programs for vulnerable communities. BRAC has a Targeting Ultra Poor (TUP) program for poor households in the area.

3.17 Status of Gender-Based Violence

The primary survey reveals that about 9.20% of the population moderately believes violence against women is a social issue. While 58.46% of the population perceived violence against women as a non-major social issue. Additionally, a total of 32.34% of the respondents do not consider the prevalence of violence against women as a social issue.

According to BDHS 2022, the prevalence of child marriage is 64.3% in the rural areas of the Chittagong division. 19.5% of females get married before reaching the age of sixteen, and 44.8% of females get married before 18 years of age⁹.

According to the primary survey, about 64% of the respondents assert that the prevalence of child marriage is low in the area, while 17% of the respondents reported perceiving the prevalence of child marriage as a major social issue. Around 19% percent of the respondents do not perceive child marriage as a social issue.

3.17.1 Archaeological, Heritage, and Cultural Structure

Bangladesh possesses three world heritage sites namely the Historic Mosque City of Bagerhat, the Ruins of the Buddhist Vihara at Paharpur, and Sundarbans. None of the existing world heritage sites are located within or around the study area.

In addition, there is an archaeological site which is called Shamsher Gazir Kella, also known as Shamsher Gazir Tila, situated in Raipur, Mirsharai. This site is located around 20 km from the boundary of the NSEZ. A few archaeological sites are also situated in different areas of the Feni district, such as Mohammad Ali Chowdhuri Mosque, Sharshadi Shai Mosque, etc., which are located around 30 km away from the NSEZ boundary.

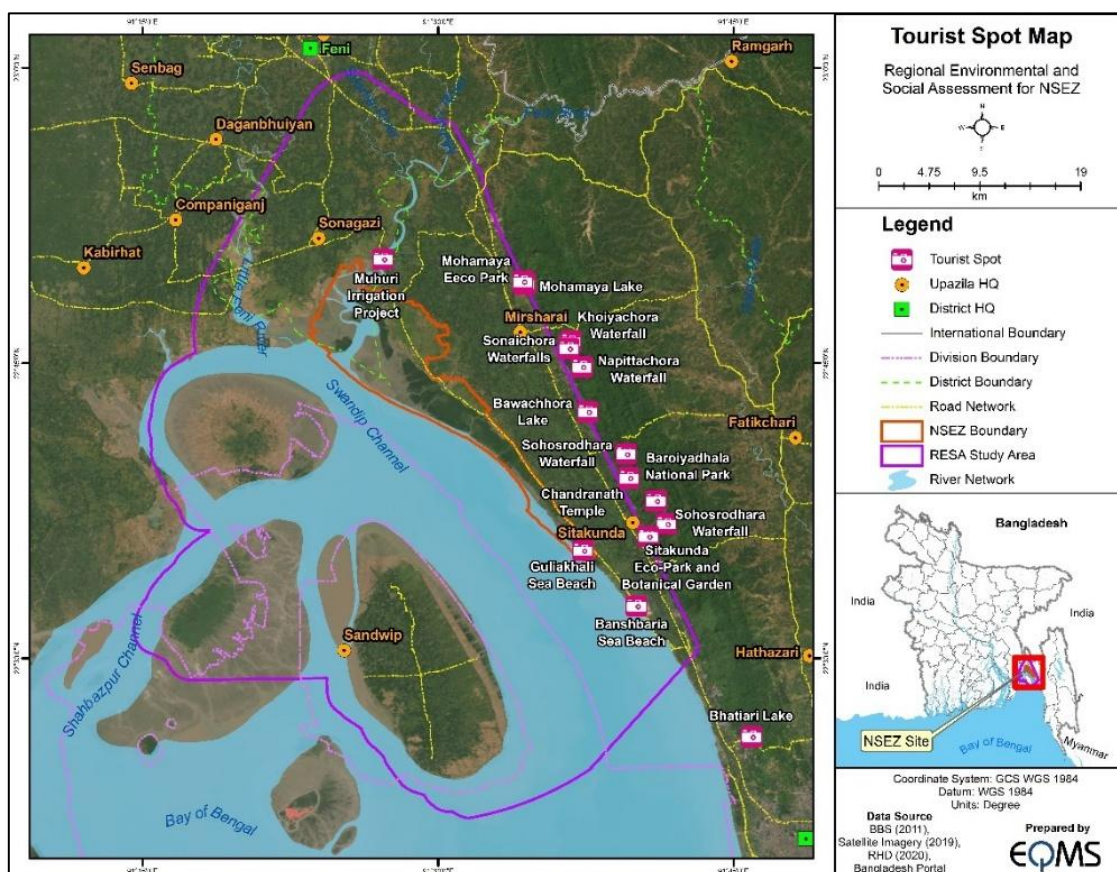
⁸ Household Income and Expenditure Survey -HIES 2016, BBS

⁹ Bangladesh Demographic and Health Survey-2022 (BDHS 2022)

3.17.2 Tourist Spots/Tourism

Rangamati, Khagrachari, Bandarban, and Cox's Bazar districts are the main tourist hubs of the country and are in the Chattogram Division. Any future influx of population in the NSEZ area will create opportunities in the adjacent tourist hubs as well as for the local tourist spots. Primary and secondary data reveal the presence of multiple tourist spots in the three upazilas in which the NSEZ is located. A list of the tourist spots is provided in Appendix A (Volume III), and a map showing the tourist spots in the study area is presented in Figure 3-20.

Figure 3-20: Tourist Spots in the Study Area



Source: EQMS, December 2023

4 STAKEHOLDER MAPPING AND PUBLIC CONSULTATION

4.1 Background

Stakeholder engagement is a continuous process of sharing information, seeking to understand the concerns of community stakeholders, and building relationships based on collaboration. It is an inclusive and culturally appropriate process that provides stakeholders with opportunities to express their concerns, views, observations, and feedback. It begins as early as possible in a project preparation because early identification of and consultation with both the affected and interested parties allow stakeholders' views and concerns to be considered in the project design, implementation, operation, and decommissioning.

4.2 Objectives

The main objectives of the stakeholder engagement are to:

- Adopt long-term relationships with the stakeholders, establish a positive community existence, and manage expectations and possible misconceptions.
- Identify and prioritize stakeholders as well as vulnerable groups within the NSEZ region.
- Generate a good understanding of the NSEZ amongst stakeholders, including NSEZ updates, E&S assessments, mitigation measures and management plans, and monitoring plans.
- Receive feedback from stakeholders regarding environmental and social risks and impacts associated with the NSEZ, along with proposed measures and actions to address them.
- Demonstrate a commitment to all stakeholders concerning E&S issues.
- Prepare a list of corrective actions/procedures suggested by stakeholders and include them in the planning and implementation.
- Demonstrate the ability to comply with standards and expectations that may arise in the future.
- Fulfill the national as well as the World Bank's requirements concerning public access to information and public involvement in the decision-making process.

4.3 Stakeholder Identification

Aligning with the requirement of WB ESS10, stakeholders have been categorized into two groups:

- **Project Affected Parties:** those who are or are likely to be affected by the NSEZ activities.
- **Other Interested Parties:** those who have an interest in NSEZ.

In addition to the above two main categories, the following group has also been identified as stakeholders for this NSEZ, considering different socioeconomic vulnerabilities and disadvantages:

- **Disadvantaged/Vulnerable Individuals or Groups:** these groups may include the elderly (especially those living alone), Individuals with chronic diseases and pre-existing medical conditions, Ethnic minority groups, Female-headed households, Disaster-affected populations, Poor households, including homeless and landless families, and Persons with disabilities.

Table 4-1 lists the identified stakeholders and states their effect on the NSEZ.

Table 4-1: Stakeholder Identification

Categories of Stakeholders	Stakeholder Groups
Project Affected Parties	• Affected Persons who are living in or beside the planned IMD land. • Communities in the vicinity of the NSEZ's planned activities. • The local population and local communities, including ethnic communities. • Disadvantaged/vulnerable individuals or groups.

Categories of Stakeholders	Stakeholder Groups
	- Local health, education, and like services would have to provide basic support to the EZ staff, workers, and their families, including school-going children, like basic healthcare, schooling, etc. - Residence, business entities, and individual entrepreneurs around NSEZ. - Local laborers and their families, and followers. - Suppliers and service providers, contractors, subcontractors. - Transport owners & workers.
Other Interested Parties (International Level: Investors)	- Environmental and societal NGOs (including those working on labor, human rights, environment, gender, and GBV matters). - Foreign investors & companies, development partners (at national and international levels), etc. - Multinational or foreign companies - Donor agency
Other Interested Parties (National Level: Government, investors, political groups)	- Bangladesh Garment Manufacturers and Exporters Association (BGMEA) - Bangladesh Export Processing Zones Authority (BEPZA), Bangladesh Economic Zone, SBG EZ - Local investors - Business and workers' organizations - Academic institutions (e.g., universities, think tanks, schools, colleges) - Training service providers - Urban Development Directorate (UDD), Roads and Highway Department (RHD), Chattogram Water and Sewerage Authority (CWASA), Bangladesh Railway (BR), Urban Development Directorate (UDD), Bangladesh Telecommunication Company Limited (BTCL), Bangladesh Industrial Technical Assistance Center (BITAC), Karnaphuli Gas Distribution Company Limited (KGDCL), Gas Transmission Company Limited (GTCL), Cyclone Preparedness Programme (CPP), Ministry of Social Welfare (MOSW), Export Competitiveness for Jobs (EC4J) Project. - Civil Society Organization (CSO)/Community-Based Organization (CBO)/Non-Government Organization (NGO)/Other NGOs. - GOB officials (Deputy Commissioner, Upazila Nirbahi Officer), permitting and regulatory agencies at the national and regional levels, including environmental, technical, social protection, and labor authorities. - GOB officials at the district level and below including the Department of Environment (DOE), Upazila Health and Family Planning Officers (UHFPO)/Upazila Health Complex (UHC), Bangladesh Rural Electrification Board (BREB), Fire Service and Civil Defense, Department of Youth Development, Department of Public Health Engineering (DPHE), Department of Narcotics Control, Forest Department (FD), Department of Agriculture (DA), Department of Fisheries (DOF), Bangladesh Water Development Board (BWDB), Bangladesh Inland Water Transport Authority (BIWTA), Power Grid Company of Bangladesh (PGCB), Power Division (PD), Bangladesh Meteorological Department (BMD), Upazila Education Office (UEO). - Local Government, including Union Parishad, Upazila Parishad in the NSEZ area, village administrations, elected representatives such as Member of Parliament (MP), and Major Political Representatives. - Business owners and providers of services, goods, and materials that will be involved in NSEZ's wider supply chain & transportation business. - Feni and Chattogram Chamber of Commerce and Industry.

Categories of Stakeholders	Stakeholder Groups
	Mass media and associated interested groups, including district and local press clubs, local, regional, and national print and broadcasting media, digital/web-based entities, and their associations.

4.4 Stakeholder Engagement Process

The engagement of stakeholders is an evolving process that commences from the inception phase and continues throughout the RESA report preparation. Each stage and phase has its specific objectives of engagement and results in specific outputs to be integrated into the RESA. A summary of the stakeholder engagement process for the RESA has been given in Figure 4-1.

Figure 4-1: Stakeholder Engagement Process during the RESA



Source: EQMS, April 2024

4.5 Stakeholder Engagement Methods

Various techniques were employed through stakeholder engagement exercises which included different participatory methods such as key informant interviews, focus group discussions, household questionnaire surveys, and validation workshops. Photographs, attendance sheets, and minutes of the meetings/consultations have been provided in Appendix C (Volume III).

- Key Informant Interviews (KIIs):** KIIs were carried out with stakeholders based on pre-set questionnaires to focus on the NSEZ objectives. Stakeholders include government departments 'representatives, local government institutions, staff, investors, community leaders, local and regional stakeholders, non-governmental organizations, business community, news media representatives, and other stakeholders. Their opinion, issues, concerns, and suggestions were recorded considering the study objectives.
- Focus Group Discussions (FGDs):** FGDs were carried out with local communities, fishermen, farmers, buffalo owners/grazers, workers, disadvantaged/vulnerable communities, women groups, youth, students, and other stakeholders. To carry out the discussion more effectively and efficiently, the team involved ranged from 6 to 12 participants at a time during the discussion. FGDs were carried out throughout the study as per the requirement to know the issues, concerns, and suggestions of the local communities and other stakeholders.

- **Validation Workshops:** a total of eight validation workshops (Union, Upazila, District, Regional, and National level) were carried out to disclose the draft RESA report among the public and stakeholders as per the requirements of the provided TOR.

4.6 Summary of Stakeholder Consultation

A total of 130 consultations were conducted with various stakeholders including BEZA, NSEZ officials, investors, utility providers, permitting and regulatory government authorities, government departments, community leaders, non-governmental organizations, business community, students, journalists, teachers, religious leaders, raw materials supplier, women, disadvantage/vulnerable groups, and local communities that include different occupational groups i.e., farmers, buffalo grazers, fishermen, workers, drivers, etc. Sample photographs of the stakeholder consultations are given in Figure 4-2. Details of the consultation, including photographs, attendance sheet, and minutes of the consultation, have been provided in Appendix C (Volume III).

Figure 4-2: Photographs of the Stakeholder Consultations



Consultation with Upazila
Nirbahi Officer, Mirsharai



Consultation with Female
Participants at Domkhali



Consultation with Fishermen at
Saidpur, Sitakunda

Source: EQMS, 2024

The key findings of the stakeholder consultations are given in Table 4-2.

Table 4-2: Key Findings of the Stakeholder Consultations

Aspects/Issues	Response/Findings/Observations
Knowledge and perception about NSEZ	• Most of the stakeholders have mentioned that they know about the NSEZ in Mirsharai, Sitakunda, and Sonagazi Upazila. • A considerable extent of consulted stakeholders perceived that the NSEZ would be a significant intervention for the development of the region for various reasons, such as increased access to communication, information, and utility services. • Institutional stakeholders, including government officials, local government institutions, and civil society organizations' representatives, opined that the NSEZ would be a 'game changer' not only for local development but also for the country's economic development.
Land Acquisition, Compensation, and Resettlement	• Most of the NSEZ's land was reclaimed from the sea. • Land acquisition was done by the Deputy Commissioner's office, and affected people opined that they were receiving their compensation. • Compensation for squatters has been provided. A group of squatters has already been relocated to the "Gucchha Gram" NSEZ area developed by the GOB. • Stakeholders also strongly suggested that compensation and rehabilitation must be ensured prior to starting construction work, following national legislation for any further land acquisition and resettlement in the region.

Aspects/Issues	Response/Findings/Observations
Ambient Air Quality	- Dust generation from the movement of vehicles on the access roads has increased. It may impact the local community health if dust control measures are not followed. The study should consider assessing ambient air quality in the NSEZ and the surrounding area. - The government should assess the pollution load resulting from any industrial facilities that will be established because there are agricultural lands and vegetation surrounding the NSEZ.
Water Resources	- Stakeholders emphasized groundwater availability as it is the main water supply source for the local community in the NSEZ region. - Currently, there is a groundwater crisis for domestic uses as well as irrigation during the dry season. The extraction of groundwater for the development and operation of NSEZ may cause a groundwater crisis and conflict with the surrounding community. Requested to reduce or stop the use of groundwater specifically for operational purposes and find out alternative sources of water, such as surface water extraction from the Meghna River. - In case of unavailability of water in NSEZ, investors may not be interested in investing. - Future impacts on water resources, water quality, and groundwater issues in the region should be considered in the study. - Request to consider rainwater harvesting systems in individual industries.
Ambient Noise Level	- Ambient noise levels in the NSEZ area increased due to the movement of vehicles. - Construction activities associated with the NSEZ generate noise that is also likely to affect wildlife. - Proper mitigation should be followed to avoid noise pollution during construction works; otherwise, it would harm community health. - BEZA needs to encourage its investors to adopt environmentally friendly equipment and technology to avoid noise pollution.
Livelihoods	- Most of the people's livelihoods in the NSEZ adjacent areas depend on agriculture, fishing, livestock, small businesses, etc. Participants of the consultations opined that the NSEZ would bring both positive and negative impacts on their existing livelihood patterns. Potential impacts would include the scope of new works, occupational shifting, increase of wages, migration, increased access to the service facilities, etc., while negative impacts are assumed to be made for some particular type of occupations such as fishing, agriculture, buffalo grazing, etc. - The development of access roads will reduce travel time to reach Chattogram and Feni towns. - Fishermen communities and buffalo owners/grazers are identified to be one of the most impacted groups as they are expected to lose their access to the fishing ground and grazing land, respectively. - Fishermen have raised their concerns as they are encountering interruptions to fishing in the Sandwip Channel due to the increased navigation of ships and vessels. They are often getting their net harmed by the bulk carriers and other cargo ships, which requires additional time and money to repair the nets. Such nets are costly, with prices reaching up to 50,000 BDT per net. Fishermen also mentioned that such interruption and damage are gradually increasing their costs for fishing in the Sandwip Channel. - Buffalo grazers have already experienced a reduction in grazing areas due to the intervention under the NSEZ. - Day laborers expressed their hope to get more work opportunities with increased wages at different activities like development works. At the same

Aspects/Issues	Response/Findings/Observations
	time, they have raised a concern about not being able to utilize the opportunities if require any particular skill that they do not have currently. • Proper mitigation measures such as alternative livelihoods/employment opportunities, skill-development training, increased communication and business opportunities, and other facilities could contribute to reducing the impact on the livelihoods of different occupational groups.
Employment Generation	• Local people are expecting that the NSEZ will create a lot of work opportunities for them. Young people are hoping to be directly employed in different activities during the construction and operation phases. • Local people with educational qualifications are expected to be employed in different official and managerial positions. • NSEZ will also contribute indirectly to employment generation in adjacent areas such as small businesses, shopkeeping, and service providers (e.g., legal services, engineering services, etc.) etc. • Department of Youth Development opined that the NSEZ would be a great contributor to the local labor market. They are in the process of enhancing their capacities by providing skill development training on time-demanding trades. They hope that future large-scale training programs will contribute to preparing the local youth as a potential labor force for NSEZ. • Skills development and capacity-building training/initiatives will improve opportunities for future employment in local communities.
Land and Other Resources	• Land value has increased in the adjacent areas of NSEZ. Landowners expressed satisfaction as they are getting increased value. • There are different types of fishing nets used by the Jaldas community to catch fish. “Ton”, “Binti”, and ‘Chandi” are the most common types of fishing nets used by the fishermen in Saherkhali. Boats are typically light-fiber boats with diesel engines. A boat costs between BDT 200,000 to BDT 400,000, depending on the size and condition of the boat.
Fish Production/ Fish Landing Stations/Ghats	• The number of registered fishermen in the Mirsharai Upazila is around 2,557. Fisherman mostly catches fish in the Sandwip channel using light fiber boats with diesel engines. Few fishermen catch fish in the deep sea. • According to the local fisherman community, there are four fish ghats/landing stations, i.e., Domkhali, Mithachora, Saherkhali, Ichakhali, and Bamansundor. • Fish yield varies by season and depends on other factors like rainfall, salinity, marine traffic, etc. In recent times, fish have become scarce. On average, 15-20 kg of fish are caught by every boat per day. As their current practice, they usually sell the fish immediately after landing at the ghat and do not preserve it. Usually, the “Bepari” (vendor) or the middleman buys those fish from the fisherman and supplies them to the market. • Consultation with the Jaldash community/traditional fishermen and fishery office found that fishing could be impacted in some ways, such as the fish catching rate could be reduced if fishermen face difficulties netting in the seas due to navigation; if fishermen encounter difficulties accessing boats due to relocation of Ghats or boat parking stations, etc. • No facilities (resting, drinking water, sewage, etc.) at the shifted ghats and no berthing facility during cyclone emergencies.
Community Health and Safety	• Currently, local people are getting healthcare services from Upazila hospitals, private clinics, and Chattogram Medical College, which is both time-consuming and expensive for the community people. Mostly, they are dependent on private clinics.

Aspects/Issues	Response/Findings/Observations
	- Local people are looking forward to enjoying their access to increased health services and safety as a positive result of the NSEZ in their areas. The establishment and operation of health centers in NSEZ will contribute to community health greatly. - Many opined that they will require more community clinics, specialized hospitals, and medical colleges in the area. - Local health practitioners including UHFPO emphasized enhancing their resources and capacities proportionately with the increased population and service demand in the area. They also gave importance to increasing ambulance services, medical practitioners, support staff, infrastructure, and training on handling occupational diseases and health hazards.
Flora and Fauna	- Stakeholders emphasized plantation, protection of wildlife, and biodiversity to keep the ecosystem balanced. Some opined that biodiversity and natural resources such as wildlife and forest areas are the unique features of the areas, which should not be harmed. - Wildlife residing NSEZ site is suggested to be rehabilitated in alternative forest areas.
Law Enforcement and Security	- Currently, there are three police stations surrounding the NSEZ, namely Mirsharai, Sitakunda, and Sonagazi. The common crimes are theft, kidnapping, sexual harassment/gender-based violence, robbery, drug dealing, fraud, etc. Crimes like murder and rape are also reported occasionally in the area. - Despite all the dedication and effort from the police department, it is also claimed that there is scope for improvement in terms of equipment and logistics of police stations. - Due to rapid urbanization and industrialization, incidents related to crime may increase, as it is a general trend in society. - Rapid influx of workers may decrease social cohesion, which may lead to an increased number of crimes in society, as outsiders have less integration in the local community and lack empathy for the community and surroundings. - The prevalence of GBV, including false marriage, women and child trafficking, sexual harassment, etc., may increase with the influx of workers, industrialization, and urbanization. - Since the industries are starting their operation and labor influx is being observed gradually, local people emphasized establishing a dedicated police station. Local police also suggested increasing security personnel in and around the NSEZ area.
Local Culture	People of different sociocultural backgrounds are living in the NSEZ adjacent areas with community harmony and their traditional norms and values. There are a mentionable number of artisanal fishermen who have practiced fishing over the generations as their hereditary occupation.
Tourist Spots and Tourism Development	- There is a great scope for developing and promoting potential tourist places i.e., Chandranath Hill and Temple, Sohosrodhara waterfalls, Shuptodhara waterfalls, Sitakunda Botanical Garden and Eco-Park, Guliakhali Sea Beach, Mohamaya lake, etc. It is also suggested that the government can develop tourist zones in the area. - There would be a demand for recreational facilities and tourism if a city developed at NSEZ. - Proper management plans are required to manage waste generated in tourist spots and ensure accommodation for tourists and their security.
Social Infrastructure/Ca	The capacity of the local government offices needs to be enhanced to handle the potential population influx in the future.

Aspects/Issues	Response/Findings/Observations
capacity and preparation of regional/local service providers	• Accommodation and housing: stakeholders highlighted the future demand for housing facilities in NSEZ's surrounding areas, particularly in the Mirsharai area. They opined that the Upazilas are not yet ready to provide housing facilities for the large number of newcomers. They suggested some potential places for developing the residential and market facilities for the upcoming population, i.e., UP no. 6, 7, 8 of Sonagazi Upazila; Dakshin Edilpur and Shibpur areas of Sitakunda Paurashava; and Mahasimpur of Mirsharai Upazila. • The National Housing Authority is also searching for a potential location near Ichakhali Union and Muhuri Reservoir for future housing development. • Stakeholders also raised concerns regarding the increase in house rent in the future. • A separate township could be developed to manage the population influx, considering the provision of schools, hospitals, markets, graveyards, mosques, playgrounds, sports complexes, recreational facilities, etc. Separate accommodation facilities for the workers and investors should be developed. • A dedicated development authority, such as RAJUK, can be established to regulate unplanned building construction and ensure planned development in the region. • Currently, houses, shops, and markets are being constructed beside the existing roads. Further expansion of existing roads will be required in the region. In that case, such types of structures will be a problem during land acquisition for road improvement. • Educational institutes: schools and other educational institutes are able to provide services with their current resources. Capacity enhancement, including academic building, teachers, supporting staff, etc., of the existing educational infrastructure will be required to meet the future demand. A demand for the establishment of additional educational institutes, such as colleges, universities, and engineering institutes in the region was raised by the stakeholders. The quota for local students in the NSEZ's educational facilities is expected by the local people. • Healthcare facilities: additional healthcare facilities with well-trained medical practitioners and staff are required. According to the consultation, medical facilities need to be increased gradually, considering the rise of population in the NSEZ surrounding area, including Saherkhali, Ichakhali, Saidpur, Muradpur, and other areas. A demand for a Medical Institute/Medical College establishment in the Sonagazi area arises from the stakeholder consultation. • Electricity supply: increased demand for electricity in the future is being anticipated. It is anticipated that the community-level demand will also increase in the future, considering the township development in the region. Therefore, the sourcing and distribution of electricity need to be considered in the development planning. • Roads and communication: the current roads and transportation system in the NSEZ surrounding area is inadequate to meet future demand. RHD has already prepared a DPP for the development of infrastructure targeting the increasing demand. The improved road network in the Sonagazi area will reduce the travel time from Dhaka to NSEZ and facilitate the movement to the nearby districts. Mirsharai Upazila Development Plan (MUDP) prepared by the Urban Development Directorate suggested considering regional roads such as Sitakunda to Sonaimuri (Noakhali) via Domkhali to facilitate the movement in this direction. Stakeholders also suggested developing road

Aspects/Issues	Response/Findings/Observations
	networks from Sonagazi to the NSEZ to facilitate communication from the NSEZ to the different locations of the region. The roads such as Muhuri Project to NSEZ (7.8 km); Jorarganj to Sonapur Road; Badamtali - Raghunathpur (this road will connect NSEZ to Dhaka-Chattogram Highway (via Koshka). - Considering the need for workers' movement from different locations of the region (Baroirhat and Sitakunda) to NSEZ, Bangladesh Road Transport Corporation (BRTC) has introduced a bus service. Stakeholders recommended increasing the number of trips, considering the demand of workers. - According to the Department of Fire Service and Civil Defense, currently, it is not practically possible to timely respond to any emergency in the EZ region due to narrow and undeveloped roads. Considering the future plan, the EZ will require 2.5-inch hose connection facilities for fire service, dedicated fire hydrants, wider roads, and six new fire stations. A master fire safety plan is essential. - Embankment and super dyke: Bangladesh Water Development Board has constructed a super dyke that spans 22.5 km at the Mirsharai portion, with plans to extend it by an additional 12.5 km towards Sitakunda. - Jetty and others: BIWTA has planned to establish a permanent jetty in the Sandwip Channel. Raw materials suppliers demanded access to the Jetty facilities so that they could timely deliver their goods and materials to facilitate the construction activities in the NSEZ.
Waste Management	- Generation and management of waste in NSEZ will be a critical task. Currently, there is no mentionable waste management system in the region. Even the local municipal authority has a lack of ability to handle waste in the region. - UDD suggested a waste treatment plant in the Domkhali for the community. Paurashava authority demanded for establishment of waste management systems in their areas to meet future demand. - The establishment and function of WTPs, CSTPs, and CETPs need to be ensured to protect the environment in the region. - The cost and technology of CETPs and CSTPs must be investment-friendly. If the cost of CETPs and CSTPs is higher, then the investor may not be interested in establishing and using them.
Emergency Response	Fire Services and Civil Defense provide emergency responses to any fire outbreak or accident in the region. Although there are three fire service stations in Mirsharai, Sitakunda, and Sonagazi. However, stakeholders are emphasized in establishing dedicated fire service stations for the NSEZ.
Drainage	- The rainwater naturally drains out through the khals. Stakeholders suggested considering drainage facilities parallel to the road network and keeping existing khals functional at any cost. - Currently, the local community in the NSEZ surrounding area is constructing their housing without considering adequate provision for stormwater drainage; therefore, it can accelerate the waterlogging/flooding in the region in the future.
Foreseen Risk	- Social risks such as theft, divorce, false marriage, an increase in living costs, competition over common property/resources, integration of migrants/outsiders due to language and culture, a decrease in social cohesion, and social conflict among the insiders and outsiders. - The risk of fire outbreaks/accidents, such as community-level incidents, may increase due to the increased population in the areas.

Aspects/Issues	Response/Findings/Observations
	- Environmental risks, such as an increasing population, will produce an increased extent of waste and pollution, which will contribute to environmental hazards in the future. - The NSEZ site is vulnerable to different disasters; therefore, adequate mitigation and management plans need to be considered.

4.7 Summary of Validation Workshops

According to the TOR, eight validation workshops were carried out (one for each Union - Sonagazi and Maghadia, one for each Upazila - Mirsharai, Sitakunda, and Sonagazi, one District level at Feni, one regional level at Chattogram, and one national level at Dhaka). Sample photographs of the validation workshops are given in Figure 4-3. Details of the workshops, including photographs, attendance sheet, and minutes of the workshop, have been provided in Appendix C (Volume III).

Figure 4-3: Photographs of the Validation Workshops



District Level Workshop at Feni District



Regional Workshop at Chattogram



National Workshop at Dhaka

Source: EQMS, 2024

Table 4-3 presents a summary of the key findings of the validation workshops.

Table 4-3: Key Findings of the Validation Workshops

Aspects/Issues	Comments/Concerns/Expectations/Recommendation
Water Resources	- Measures should be undertaken to prevent groundwater extraction in Mirsharai and Sitakunda to address the existing water crisis. - Utilize rainfall runoff by reserving it in internal khals for construction activities. - Focus on surface water collection from the Meghna River and establish a 150 km pipeline to supply water, considering the competition for PPP service providers for effective management. - Introduce rainwater harvesting, recycling, and artificial recharge of groundwater aquifers. - UDD has developed a master plan considering the entire Mirsharai Upazila. As per the report, water scarcity will emanate from the rapid urbanization of Mirsharai triggered by the development of NSEZ. Annual water demand in the next 20 years will be 233 MCM. Currently, the volume of available water is 105 MCM, and the shortage amount will be 128 MCM. - During the operation of the EZ, the groundwater level will be depleted in the area.
Agricultural Land and Productivity	Ensure no agricultural land is acquired in the future to protect national food security. To save agricultural land, UDD prepares master plans. Single-cropped land is discouraged for other uses (industrial and residential). In addition, double and triple-cropped land avoidance is preferred.

Aspects/Issues	Comments/Concerns/Expectations/Recommendation
	- Address the lack of water availability to prevent hampered agricultural production in Mirsharai and Sitakunda. - Agriculture-based entrepreneurship should be created and encouraged.
Land Acquisition and Involuntary Resettlement	- Ensure fair market value or replacement cost compensation and timely disbursement. - Set compensation rates for land, structures, crops, and lost livelihoods, ensuring they meet national legislation and international standards. - One of the positive sides of this EZ is the availability of vast government barren land, and people's displacement is less.
Livelihood Restoration	- Develop and implement a comprehensive livelihood restoration plan for communities dependent on fishing and livestock affected by the NSEZ. - Some local investors and entrepreneurs were affected, and they should also be covered by livelihood restoration. - Char Khandakar under Sonagazi Upazila and Kumira in Sitakunda Upazila area are two major fishermen living areas. Mainly, they depend on the fish captured from the seashore area. Access rights for the artisanal fisherman should be ensured, as mentioned in SDG target 14B. - Fish processing industries should be promoted in the NSEZ. - Necessary skill set under the skill development program for the NSEZ workforce, as per the demand and availability of the trading opportunities in and around the NSEZ.
Employment Opportunities	- Provide training for residents to enhance their job readiness for industries in EZ. - Ensure job opportunities are available for affected individuals and maintain quotas for residents of Mirsharai, Sonagazi, and Sitakunda. - Take the initiative for the skill development of the local affected communities. - Inclusion of women, youth, and differently challenged people should be ensured.
Social Infrastructure	- Current educational, health, and recreational facilities are inadequate for the growing population. Road infrastructure is also insufficient to support increased traffic from EZ operations. - Invest in the development of educational and healthcare facilities, including schools, playgrounds, clinics, and hospitals, in the EZ area. - Develop bridges, roads, and railways for the smooth communication and transportation of goods. - Technical institutes or vocational training centers should be developed to enhance the number of skilled workers for local industries. - Growth centers should be developed with improved communication facilities. - Housing and accommodation for workers and followers should be created. - Unplanned housing should not be allowed. It will create hurdles in the future, specifically for road and drainage improvement. - Increase security and protection of the boats and resources in the relocated fish landing stations. Boats are vulnerable during cyclones or storms in the newly shifted boat parking area.
Labor Accommodation/ Housing, Transportation, etc.	- NHA is willing to support BEZA if they are invited to work jointly to solve the housing for the workers and build a planned city in the EZ area. - If any government authority does not come forward for the development of a planned city, then the haphazard development will take place around EZ. Slumification will take place, which will impact local environmental and social conditions.

Aspects/Issues	Comments/Concerns/Expectations/Recommendation
	- There is an acute scarcity of labor in the National Special Economic Zone compared to other economic zones in Bangladesh. - Low-cost transportation is required for the workers' movement. BRTC and other bus services from different points can be introduced as low-cost transportation.
Social Dynamics and Discrimination	- Social and cultural dynamics will be changed in the EZ area and the surrounding area due to the population influx for jobs, education, etc., purposes. - Women, children, and youth groups will be impacted.
Transportation and Communication	- Increase transportation facilities to support the labor movement for the industries and locals. There is a gap between the need and existing facilities in terms of transportation services. - BRTC has already launched a service, but it is insufficient in terms of frequency of services, number of buses, etc. - Transport cost for labor is also high. Steps need to be taken to reduce it otherwise it will demotivate the workers to work in NSEZ. - Alternative roads to NSEZ could be developed to reduce pressure on NSEZ Saroni. - Foot overbridges at relevant spots (e.g., near Nurul Absar school) need to be considered to reduce the accident risk for students and villagers. - A designated access route at the entry point of the three major approach roads of the NSEZ should be considered to avoid the growing traffic congestion prior to the full-fledged operation of the EZ.
Flora and Fauna/Wildlife/Biodiversity	- Implementation of EZ is likely to disrupt local wildlife habitats. Rehabilitation efforts and conservation measures are needed to protect biodiversity. - Establish wildlife rehabilitation initiatives to relocate affected species to suitable habitats. - Encourage the development of wildlife parks and ecotourism ventures in the EZ area to foster conservation and community engagement. - Implement reforestation programs, including roadside plantations, to restore local vegetation. - Biodiversity conservation - nature-based solutions and ecosystem-based approaches should be introduced. - Biodiversity conservation as well as climate change adaptation should be considered not only in the NSEZ but also in the township development area. - Approximately 16,000,000 trees have been cut or removed from the EZ site. - Habitat of sea birds, shore birds, migratory birds, etc., has already been lost due to the implementation of the EZ. 22% of the area of the NSEZ will be a green zone, with trees and lakes. - EZ area is a suitable breeding and feeding ground for marine and coastal fisheries, including Kain Magur (<i>Plotosus canius</i>), Nona Tengra (<i>Mystus gulio</i>), Pangas (<i>Pangasius</i>), Bhetki (<i>Lates calcarifer</i>), etc.
Environmental Quality Monitoring (air, water, noise)/impacts and risks	- DOE is responsible for ambient air quality monitoring, and Continuous Air Monitoring Stations (CAMS) can be established under the PRIDE project. - Except for noise from vehicle operations, industrial noise inside the NSEZ should follow the WHO standards as well as occupational safety and hazard issues should be considered. - Stormwater retention ponds, rainwater gardening, permeable footpaths, and many other nature-based solutions for efficient water resource management in NSEZ should be addressed.

Aspects/Issues	Comments/Concerns/Expectations/Recommendation
	• A regional water quality monitoring process must be developed and implemented to control water pollution. • A comprehensive monitoring framework should be prepared under the leadership of BEZA to monitor long-term E&S impacts in the region. • Significant changes in land use and cover will occur due to EZ development, impacting air, water, soil, and local wildlife. Increased traffic could lead to congestion and pollution. • Provision of the environmental and social impacts of EZ development to ensure that negative effects on local resources are minimized. • Green industry should be introduced in the NSEZ to reduce environmental pollution.
Resources Efficiency	• A phasing plan should be incorporated into the NSEZ development practices, and unused/undeveloped land will be allocated for renewable energy generation. • Energy efficiency technology should be used in industrial development as well as township development. • Fossil fuel can be used only for the first phase of development, and renewable energy (specifically rooftop/floating solar panels) should be prioritized for the second and third phases of development.
Disasters/Hazards	• The NSEZ region is prone to cyclones and tidal surges, flash floods, necessitating effective disaster management strategies and infrastructure improvements to safeguard the area. • Complete the construction of the super dyke and develop green belts to protect coastal areas from cyclones and tidal surges. Super dyke should be monitored strongly to protect the site during cyclones and storm surges. • Assess and incorporate existing local khals into flood management strategies. • Chattogram region is situated in a high-risk zone for earthquake disasters.
Stormwater Drainage	• Existing drainage systems are insufficient, leading to flooding risks in the surrounding areas. Design and implement comprehensive drainage systems to manage stormwater effectively and reduce flooding. • Enhance the drainage system by maintaining the existing khals of the EZ area.
Waste Management	• CETPs must function properly to treat industrial waste. Implementation of CETPs to treat industrial wastewater, ensuring no hazardous materials enter the environment. • Zero Discharge Plans should be considered to reduce pressure on water resources. Promote and adopt practices based on Reduce, Reuse, and Recycle to minimize waste generation and encourage sustainable waste management. • CSTPs, CETPs, and waste management are the responsibility of entrepreneurs, producers, and investors.
Tourist Spots and Tourism Development	• Ensure that land acquisition processes avoid disrupting existing tourist attractions such as Guliakhali Sea Beach and sensitive areas. • Develop plans for enhancing tourist facilities and promoting ecotourism in the region while ensuring the preservation of sensitive areas.

Aspects/Issues	Comments/Concerns/Expectations/Recommendation
Law Enforcement and Security	- Security measures need to be established to maintain law and order in the EZ area, particularly as the labor influx increases. - Create an industrial police unit to ensure security in EZ and a separate Thana Police unit for law enforcement in the surrounding area. - Improve the capacity of the Bangladesh Coast Guard to ensure effective patrolling and response in coastal areas.
Utility Requirement	- After the full completion of the EZ, the power demand will be 3,248 MW per day, and the gas demand will be 700 MMCFD per day. - Approximately 1,033 MLD of water will be required. Currently, a water treatment plant and water supply pipeline with a capacity of 100 MLD are under construction. BEZA is collaborating with CWASA through a public-private partnership (PPP) to meet the water demand.
Development Authority	- Currently, there is no development authority in the NSEZ area, and it falls outside of the jurisdiction of the Chattogram Development Authority. - The Chattogram regional office of the UDD has recently received approval, and this office will look after the issues in the EZ area.
Coordination and Cooperation among Various Entities/Stakeholders	- Effective coordination among governmental entities is essential for the successful implementation of the NSEZ and to address local community concerns. - A multi-stakeholder steering committee under the leadership of BEZA should be established to oversee the implementation activities of the NSEZ as well as other projects/activities in the region.
Miscellaneous	- Issues such as unauthorized sand extraction and land grabbing pose significant challenges to local communities. - Currently, there is no gas supply in the Sonagazi area. Therefore, the gas supply should be ensured not only for the NSEZ but also for the local community. - UDD has prepared a DPP for the preparation of the master plan for the Sitakunda and Sonagazi Upazilas and submitted it to the planning commission for approval.

4.7.1 Participation of Women and Vulnerable People

Focus group discussions and group interviews with women groups, elderly people, landless and economically vulnerable, and other vulnerable community members were carried out in different areas of the NSEZ adjacent community to obtain their opinions and suggestions. Key findings from the consultation with women and vulnerable people are as follows:

- Local women welcomed the NSEZ and considered as a very positive intervention to contribute to their local economy.
- Local women expressed their willingness to get employed in different industries in NSEZ. They also demanded training for women's development and empowerment.
- Women from the fishermen's community raised concerns regarding the impact on fishing activities. They demanded livelihood training and support for alternative occupations.
- Elderly people emphasize increasing service facilities regarding law enforcement, healthcare services, etc.
- Elderly people who are covered by government allowance or safety net programs demand increasing amounts and scope of allowance, considering the potential price hike in the area due to the future population influx to their communities.

- Parents of disabled children suggested creating education and healthcare opportunities for people with disability. Currently, there are no mentionable educational facilities for special children in the Mirsharai, Sitakunda, and Sonagazi areas.
- Economically vulnerable people lacking any skills for industry work demanded cash support to start businesses.

5 POTENTIAL ES RISKS AND IMPACTS

This chapter presents the identification and appraisal of various potential environmental and social risks and impacts from the development and operation of the EZ in the surrounding environment. It is to be noted that the total required land for the economic zone has not yet been acquired, and some lands have been allocated to investors, it is more complicated to accurately phase the site according to best practices. Considering the above facts, the master plan area has been divided into three phases. Development activities of different components and subcomponents of the economic zone are expected to continue in the region up to 2040, parallel to the operation of established industries inside the economic zone. Therefore, the consultant has conducted the impact assessment considering the full-fledged development due to the implementation of the master plan in the region by dividing the impacts considering the development of the EZ and operation phase activities.

5.1 Methods of Impact Significance

The nature of the impact was primarily defined as positive or negative. Then, the following criteria (nature, geographical extent, duration, intensity/severity, irreplaceable loss, and probability) (Table 5-1) were used to evaluate the impact magnitude. Later, significance was rated by multiplying the impact magnitude and probability of occurrence (i.e., $\text{Magnitude} \times \text{Probability} = \text{Significance}$). The maximum value that can be obtained is 100 significance points. Table 5-2 shows the impact Significance score and definition.

Table 5-1: Ranking Criteria to Evaluate the Impact Magnitude

Nature	Geographical Extent	Duration	Intensity/Severity	Irreplaceable Loss	Probability
Direct Impacts will be generated directly from the NSEZ activities, which are directly linked to the NSEZ. (e.g., discharge of untreated wastewater from construction camps into a nearby water body may lead to a decline in water quality).	5 – Transboundary Impact is considered not only at the national level but also within the neighboring country. Impact is considered at a global level.	5 – Permanent (no mitigation) Impact will remain after the operational life of the NSEZ. No mitigation measures will reduce the impact after implementation.	5 – Very high Natural, cultural, and social functions and processes permanently cease, and valued, important, sensitive, or vulnerable systems or communities are substantially affected. Negative impacts cannot be reversed.	5 – High Impact replaces a particular/vulnerable resource.	5 – Definite Impact will occur regardless of any prevention measures.
Indirect Impacts will be generated from secondary sources, which are induced by the NSEZ activities.	4 – National Impact areas are considered at a national level.	4 – Permanent (mitigated) Impact will remain after the operational life of the NSEZ, but appropriate mitigation measures will reduce the impact.	4 – High Cultural and social functions and processes are distorted/disturbed/impacted. Potentially ceasing to Environmental function temporarily. Negative impacts cannot be fully reversed.	3 – Medium Irreplaceable/unique resources can be replaced with mitigation measures/efforts, and will be replaced after a certain period of time.	4 – High Most likely that the impact will occur.
Induced Impacts will be generated (which are not part of the NSEZ) due to the effect/consequence/outcome of the NSEZ.	3 – Regional Impacts' area extends to the immediate surrounding areas along with adjacent areas.	3 – Long term Impact duration will continue for more than 10 years or the entire operational life of the NSEZ.	3 – Medium Environment is remarkably distorted/disturbed/impacted, still functions, if in a modified way. Negative impacts cannot be fully reversed.	1 – Low No irreplaceable/unique resources will be impacted.	3 – Medium Distinct probability of the impact occurring.

Nature	Geographical Extent	Duration	Intensity/Severity	Irreplaceable Loss	Probability
	2 – Local Impacts' area is not only limited to the NSEZ site but also its immediate surrounding areas/receptors.	2 – Medium term Impact duration will continue after the construction period but stop/discontinue/cease within a tenure of 10 years.	2 – Low Natural functioning of the environment is minimally affected. Natural, cultural, and social functions and processes can be reversed to their original state if mitigation measure is taken.		2 – Low Probability of the impact occurring is low due to its design or historical experience.
-	1 – NSEZ site Impacts' area only at or within the NSEZ site/NSEZ boundary.	1 – Short term Impact duration is a very limited time or length of the construction/decommissioning period.	1 – Insignificant Changes due to potential/possible impact are minor, not visible/noticeable, natural functioning of the environment is not affected.	-	1 – Unlikely Under normal conditions, no potential/possible Impact is expected.

Magnitude

The magnitude was calculated as extent + duration + intensity + potential impact on irreplaceable resources.

Magnitude essentially describes the intensity of the change that has the potential to occur in the resource/receptor as a result of the potential impact. The magnitude designations themselves are universally consistent, but the definitions for these designations vary depending on the resource/receptor. In the case of a potential positive impact, no magnitude designation (aside from 'positive') was assigned. It was considered sufficient for RESA to indicate that the NSEZ has the potential to result in a potential positive impact, without characterizing the exact degree of positive change that may occur.

Significance

The significance was rated by multiplying the consequence of the impact and the probability of occurrence (i.e., Magnitude × Probability = Significance).

Table 5-2: Significance of Issues (based on environmental and social parameters)

Significance	Description
Positive Impact	Potential/possible impacts that have a beneficial impact on affected stakeholders
Very Low (4-14)	- No action is required. - Potential/possible impacts that are practically indistinguishable from the ES baseline, with little to no potential impacts to or concerns from affected external stakeholders. - No impact on the public.
Low (15-29)	- Impacts are within the acceptable range. - Potential/possible impacts such as localized or short-term effects on habitat, species, or environmental media. - Potential/possible impacts that are short-term nuisance or inconvenience, potentially affected external stakeholders are concerned, but likely able to adapt with relative ease. - Potential/possible illness or adverse effect with limited or no impacts on the ability to function, and medical treatment is limited or not necessary.
Medium-Low (30-44)	- Impacts are within the acceptable range but should be mitigated to lower significance levels wherever possible. - Potential/possible impacts such as localized, long-term degradation of sensitive habitat or widespread, short-term impacts on habitat, species, or environmental media. - Potential/possible impacts, such as localized or short-term effects, potentially affected stakeholders are concerned but likely able to adapt with relative ease. - Potential/possible illness or adverse effects with mild to moderate functional impairment requiring medical treatment or management.
Medium-High (45-59)	- Potential/possible impacts are significant and require attention. - Mitigation is required to reduce the negative impacts to acceptable levels. - Potential/possible impacts such as localized but irreversible habitat loss or widespread, long-term effects on habitat, species, or environmental media. - Potential/possible impacts such as local-to-regional or medium-term effects; potentially affected stakeholders are concerned and raised the issue as a high priority, but may be able to adapt with some targeted support or assistance. - Potential/possible serious illness or severe adverse health effects requiring a high level of medical treatment or management.
High (60-80)	- Impacts are of great importance, and mitigation is crucial. - Potential impacts such as significant, widespread, and persistent changes in habitat, species, or environmental media. - Potential impacts such as persistent reduction in ecosystem function on a landscape scale or significant disruption of a sensitive species. - Potential/possible impacts, such as local-to-national or long-term effects, potentially affected stakeholders concerned and raised as a high priority, may not be able to adapt without targeted support or assistance to maintain a pre-impact livelihood. - Potential/possible serious illness or chronic exposure of a few resulting in life-shortening effects.
Very High (81-100)	- Impacts are unacceptable. - Potential impacts such as loss of a significant portion of a valued species or the loss of effective ecosystem function on a landscape scale.

Significance	Description
	• Potential/possible impacts such as local-to-global or irreversible long-term effects; potentially affected stakeholders concerned raise the issue as a high priority and are likely not able to adapt without targeted support or assistance. • Potential/possible serious illness or chronic exposure of many resulting in life-shortening effects.

The potential environmental and social risks and impacts in the region are identified based on both the secondary and primary baseline information, as well as extensive stakeholder consultations. Environmental issues are not isolated since they have social implications as well. On the contrary, social issues, too, have environmental implications and are listed together below:

5.2 Potential Positive Impacts

5.2.1 Employment Opportunities

The implementation of the economic zone master plan is expected to provide a large number of employment opportunities in the short and long term during both the development of the economic zone and the operation phases. According to the master plan, it is expected that approximately 1.4 million job opportunities will be created in the economic zone. The NSEZ is envisaged to provide direct employment in different industries in the economic zone as well as indirect employment opportunities in different sectors, including logistics, manufacturing, healthcare, education, retail, transportation, entertainment, financial services, etc., of the study region. Priority will be given to workers from the local communities, where casual work will also be needed. The majority of this number will be low-skilled labor, which will be hired from local communities. This will present a positive but short-term economic benefit for the local youths. As of now, approximately 10,000 workers are engaged in different industrial development and operational activities in the economic zone. Moreover, it is common for the largest proportion, if not all of this labor, to comprise male workers only, but for the equitable benefit and gender equity, able women should also be hired wherever they meet job requirements.

5.2.2 Increased Value of Land

The implementation of the master plan will lead to an increase in demand for residential housing in the region. This will in turn lead to an increase in land and property values in the region benefiting residents owning land and residential properties. During the stakeholder consultations, this issue was also raised by the participants and confirmed that the land value has already increased in the region.

The price of land and property, including rental houses along the access roads, will be raised after road network improvement. This will provide monetary benefits to the owners of the property. This impact will be post-construction and will be long-term. However, it will only benefit the property owners, while tenants and buyers will pay higher prices.

5.2.3 Capacity Building

The economic zone will provide increased capacity building and training during the implementation of the economic zone, ensuring that the locals, project-affected people, and their communities are prioritized. During the development stage, locals and project-affected people will be taught, skills enhanced and impacted which will be utilized even after the economic zone life cycle.

5.2.4 Skill Transfer

The economic zone seeks to attract both national and foreign experts, investors, workers, and consultants for the development, design, construction, and operation of the industries in the economic zone. During these interactions and processes, the locals will have significant benefits through the transfer of relevant technical skills and tools.

5.2.5 Growth of Foreign Exchange Reserves

The economic zone is anticipated to boost national foreign exchange reserves and bring in foreign currency through two major streams. These are a) increased export earnings - growth of the industrial base will help Bangladesh reduce its dependence on foreign imports to meet manufactured product needs, and b) foreign direct investments into the manufacturing industrial sector.

5.2.6 Increase Public Revenue

The economic zone will help restore confidence in foreign investors and promote a good business climate. Economic zones seek to attract foreign and national investment that helps strengthen and decentralize the economy, increase the national treasury through tax payments, and encourage rural and community development.

5.2.7 Economy

The development of the NSEZ is expected to deliver significant national and regional benefits through industrial growth, employment generation, and large-scale investment promotion. With an estimated USD 20 billion in investment proposals and the potential to create 1.4 million jobs, the NSEZ is a transformative project for Bangladesh's economy. The economic zone will promote production and value-added goods and services for the local and foreign markets thus stimulating industrial and commercial growth. It will eventually increase the revenue and profitability of the sector, thereby encouraging mindset change in youth towards the business sector. Banks and financial services will be improved, including automated teller machines (ATMs).

5.2.8 Local Infrastructure Development

The economic zone will be a stimulus towards the development of local infrastructure, notably the transport infrastructure, to support the transport connectivity needs of industries and workers. The economic zone will stimulate the establishment of major infrastructures for both local and foreign needs, considering the region's infrastructure gaps and needs. These infrastructural developments will improve the physical and aesthetic outlook of the region. The economic zone envisages accelerating the infrastructure development in the region (Noakhali, Feni, and Chattogram Districts) and making it the third-largest city in Bangladesh.

5.2.9 Improved Social Amenities

An increase in population attributed to workers in the economic zone will inform the provision of more and better social amenities, including education facilities, health facilities, recreational facilities, and markets, among others. This will ensure improved living conditions for the community members.

5.2.10 Improved Security in the Area

Under the proposed development activities, police stations will be established in the economic zone to ensure public security. The roadside lights along the proposed access roads will increase visibility on the road at night hence reducing crime in the area. This impact will be long-term and will benefit all road users, roadside businesses, and residents.

5.2.11 Increased Number of Tourists Visiting the Area

The surrounding of the proposed economic zone master plan area has numerous tourist attraction sites that include Mahamaya Lake, Khoiyachara Waterfalls, Napittachora Waterfall, Sitakunda Eco Park, Botanical Garden, Sohosrodhara Waterfall, Jharjhari Waterfalls, Bhatiari Lake, Komoldoho Trail, Muhuri project, among others. An increase in population attributed to the number of workers to be engaged in the economic zone will translate to more visitors to these tourist attraction sites. This will, in turn, translate to an increased demand for existing hospitality facilities. In addition, parks and recreational facilities for visitors are also proposed in the economic zone.

5.2.12 Benefit to Local Retail Businesses

The economic zone will have development works ongoing up to 2040, parallel to the operation of industries. The local communities will gain through the sale of items like foodstuffs, drinks, and other consumable products. They will also benefit indirectly from the increased spending of the workforce. The increase in demand for products will lead to increased supply and the creation of a market for products, thereby improving the income and general welfare of the local communities and their families. This will positively impact women (and their households) who would be involved in such businesses.

5.2.13 Increased Market for Local Agricultural Products

An increase in population as a result of economic zone implementation will inform an increase in demand for agricultural products from the region. As such, livestock products from the local community, as well as other agricultural products from the region. During the stakeholder consultation, this issue was raised by the participants, and they also mentioned that currently, excess agricultural products are exported to other parts of the country.

5.2.14 Vibrancy of Area Commercial/Urban Nodes

Notable commercial and urban nodes in the surroundings of the economic zone include Noakhali, Sonagazi, Feni, Mirsharai, Sitakunda, and Chattogram. These urban areas are key commercial nodes that will significantly benefit from the implementation of the master plan due to an increase in the population of workers in different industries in the economic zone. This will be attained through the establishment of various operations in these nodes to support the economic zone operations.

5.2.15 Improved Public Transportation

Public transportation in the economic zone surrounding area is currently limited to CNGs, motorcycles, and bicycles. This can mainly be attributed to the fact that most local roads are in a poor state. The implementation of the master plan will facilitate the provision of more access roads. This will encourage the establishment of public transportation and enhance mobility in the area. During the stakeholder consultation, participants raised the importance of the establishment of a public transportation system in the economic zone surrounding area for the frequent movement of workers. This will mainly benefit residents of Sonagazi, Mirsharai, and Sitakunda, among others, in the vicinity.

5.2.16 Improved Quality of Life

The proposed master plan implementation will improve the livelihoods of the region's residents through the creation of employment opportunities and improved levels of social infrastructure and social provision. This will benefit the host community as well as residents of the economic zone surrounding upazilas and districts.

5.2.17 Income to Material/Equipment Suppliers and Contractors

Construction activities in the economic zone and related facilities will require the supply of various materials and/or equipment. For example, the construction of a road will require gravel and aggregate, etc., some of which can be sourced locally. Other materials are lime, bitumen, water, cement, stones, and steel. Some of these materials required for the NSEZ will be sourced nationally and internationally to ensure that the desired quality is achieved. Procurement of these resources connotes income to suppliers and owners of the land where borrow pits and quarry sites will be located.

Besides the employment of workers, another important type of employment has been observed for some particular groups, such as local contractors, vendors, and raw materials suppliers for construction works. Nearly 30-40 contractors, vendors, and suppliers are involved in the work related to the construction of different industries in the economic zone. These parties also created employment for local people in several positions, like managerial positions, supervisory positions, and labor.

5.3 Potential Negative Impacts

5.3.1 Impacts During Development Phase

5.3.1.1 Impacts on Air Quality

It is important to note that the development of the economic zone takes place in rural areas and on the coastline of the Bay of Bengal, where air quality is usually good and natural. During the development of the EZ, the main pollutant will be the particulate matter, which will be generated during earthwork activities, including vegetation clearing, excavation works, dredging and reclamation, and transportation of construction materials to and from the economic zone sites, especially where trucks will travel on unpaved portions of tracks and roadways. Particulate matter will also be generated from site development activities such as levelling on land, cutting and filling activities to the NSEZ site from various sources, rock breaking, crushing, etc. The particulate matter will thus generate blows along the wind direction. Generally, these particles will settle down within 100m to 200m from the construction site. However, during strong wind conditions, they will blow further. At the economic zone site, the wind direction is mostly from the southwest to the northeast. Since there are habitations in the downwind direction. The impact is likely to be felt during the development of EZ and would be generally confined locally to the construction site itself. However, when the construction activity is near habitation, it might be a cause of concern. In addition, dust will get deposited on the leaves of plants and trees, causing a lessening of photosynthetic activities, leading to loss of pollination and even mortality.

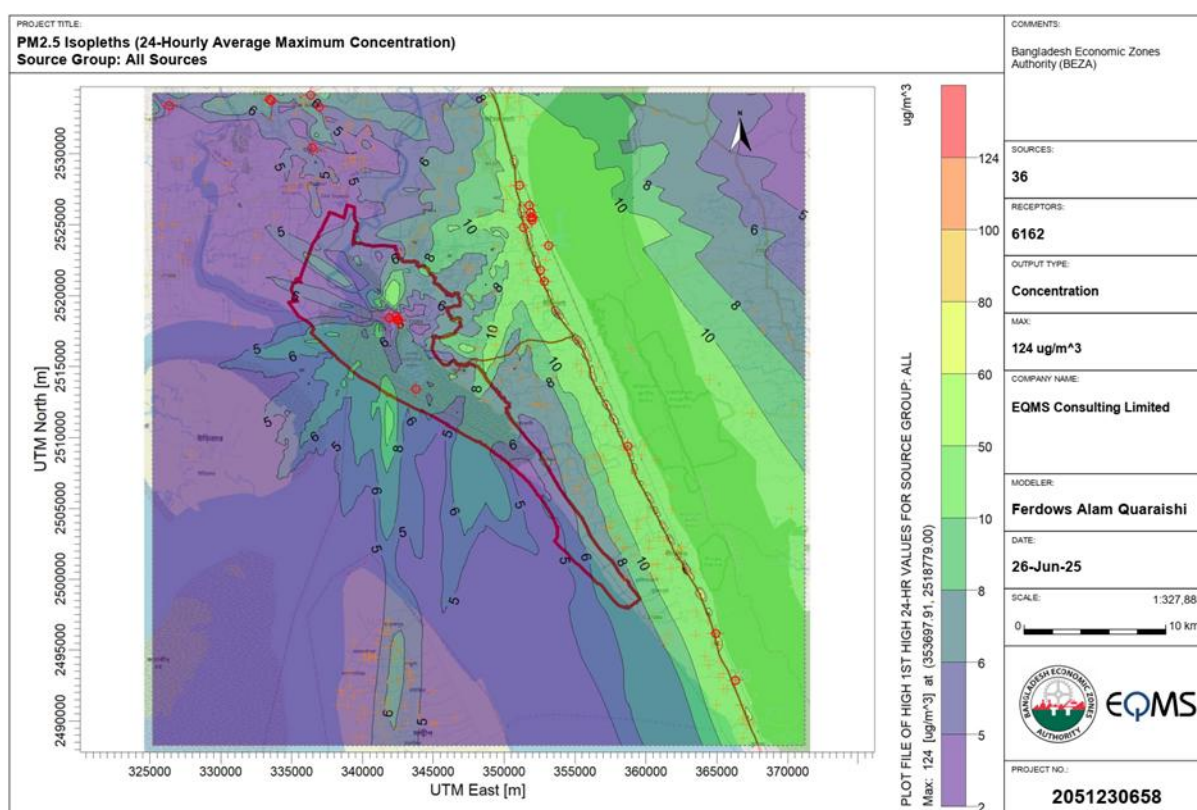
The local ambient air quality around the economic zone will be temporarily impacted during the development of the EZ as a result of air emissions generated by construction activities. In addition, pollutant emissions will occur due to the operation of diesel fuel generators, and exhaust emissions from transport vehicles such as material transport trucks and administrative vehicles. Therefore, the potential impacts of the NSEZ activities on air quality are associated with dust emissions and an increase in the following combustion pollutant concentrations (CO, NO_x, SO₂, PM, etc.). This has the potential to cause temporary impacts on the ambient air quality. As most of the construction equipment will be mobile, the emissions are likely to be fugitive and not concentrated at a single place or source. As the impacts will be localized in nature, the areas outside the economic zone boundary are not likely to face any significant adverse impact with respect to ambient air quality.

Air Quality Modelling Result

Air dispersion has been modelled using the AERMOD dispersion model (Version 13.0.0), which has been developed by the United States Environmental Protection Agency (USEPA). The model is a steady-state Gaussian plume model used to assess pollutant concentrations associated with industrial sources. The model has been designated the regulatory model by the USEPA for modelling emissions from industrial sources in both flat and complex terrain. Resulting Ground Level Concentrations (GLCs) were determined specifically for NO₂-24 hr. and Annual average, and PM -24 hr. and Annual average. Details of the ambient air quality model output have been given in Appendix G (Vol-III).

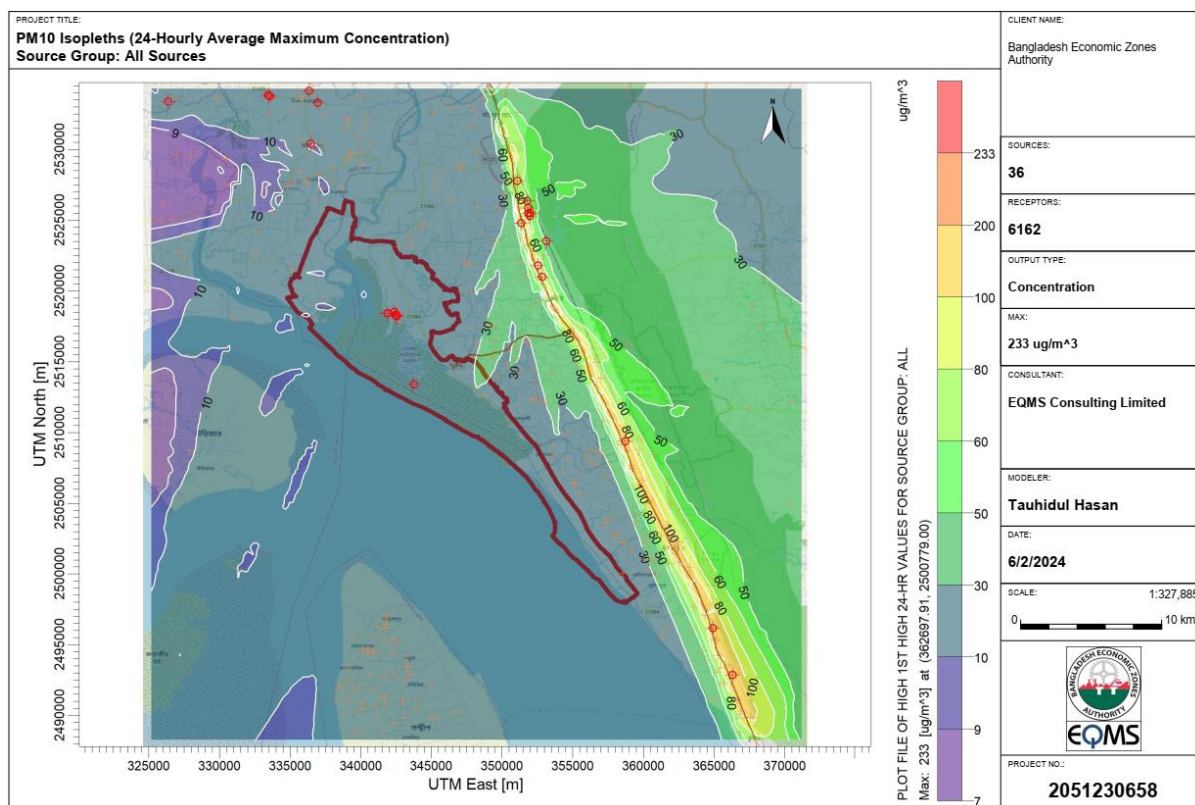
Concentration of Particulate Matter (PM_{2.5})

The contribution of PM_{2.5} from existing industries including power plants, chemical, paint, steel, brick kilns, and glass has been assessed through dispersion modeling. The results indicate that road dust and brick kilns are the dominant contributors to PM_{2.5} concentrations in the study area. Notably, brick kilns operate primarily during the dry season, and their contribution is seasonal. The modeling results indicate a maximum predicted ground-level concentrations (GLCs) of 24.07 µg/m³ at air quality monitoring locations. The 24-hourly maximum GLCs of PM_{2.5}, represented as isopleths, are illustrated in Figure 5-1. Detailed outputs of the ambient air quality modeling are provided in Appendix G (Vol-III).

Figure 5-1: Isopleths of 24-Hourly Maximum PM_{2.5} GLC- All Sources

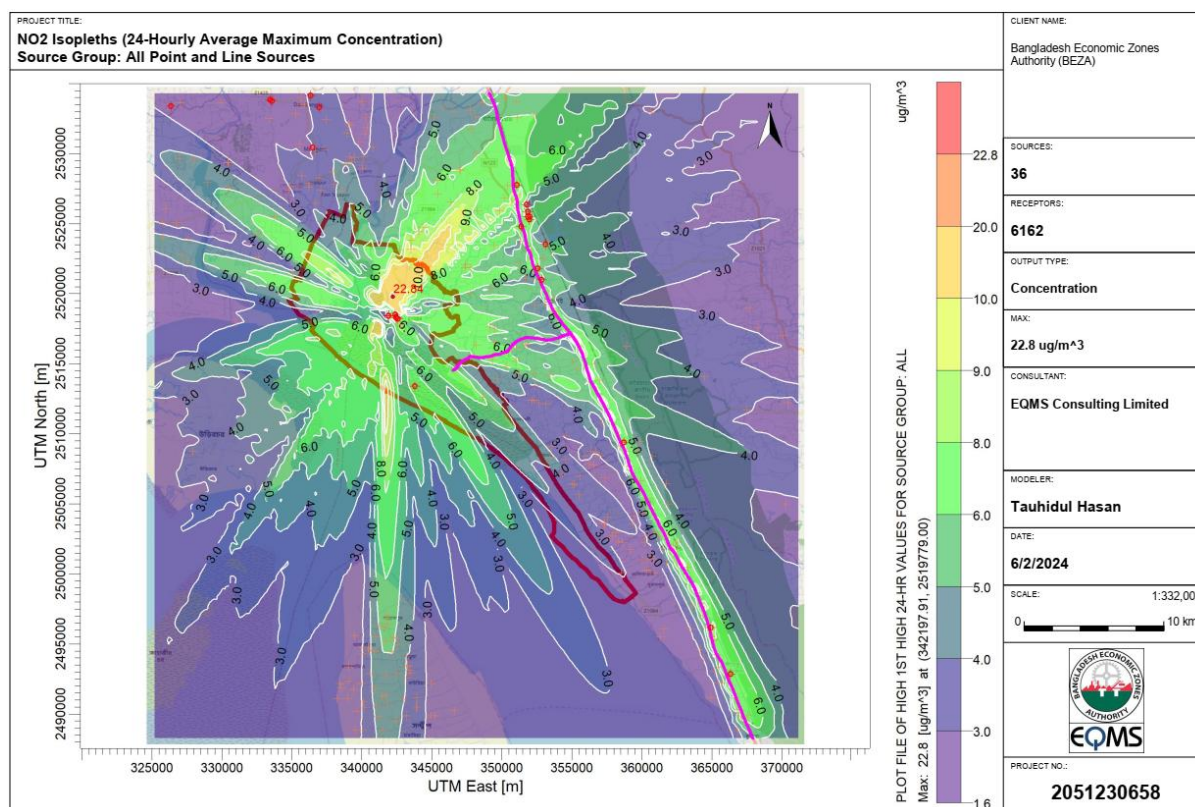
Concentration of Particulate Matter (PM₁₀)

The contribution of PM₁₀ from existing industries including power plants, chemicals, paint, steel, brick, and glass has been predicted through modelling study. The modelling result reveals that brick kiln and road dust will cumulatively result in increased PM₁₀ concentrations in the study area. The model reveals that major PM₁₀ contributors in the study area are road dust and brick kilns. However, the brick kiln only contributes to air pollution during the dry period only. The model shows that the contribution of PM₁₀ from the existing industries in the economic zone on air quality monitoring locations is insignificant. Hence, the contribution of PM₁₀ from existing industries within the economic zone towards concentrations of PM₁₀ in the air shed is assessed to be low. The isopleths representing 24-hourly maximum PM₁₀ GLCs are presented in Figure 5-2. Details of the ambient air quality model output have been given in Appendix G (Vol-III).

Figure 5-2: Isopleths of 24-Hourly Maximum PM₁₀ GLC- All Sources

Concentration of NO₂

The past and present industrial activity will cumulatively impact the condition of the economic zone and the surrounding area airshed. The model shows that the contribution of NO₂ from the power plant inside the economic zone contributes maximum, followed by other industries in the economic zone, road traffic, brick kiln, and industries outside the economic zone. It can be stated that the existing industries in the economic zone will contribute NO₂ significantly to the airshed. The isopleths representing 24-hourly maximum NO₂ GLCs are presented in Figure 5-3. Details of the ambient air quality model output have been given in Appendix G (Vol-III).

Figure 5-3: Isopleths of 24-Hourly Maximum NO₂ GLC- All Sources

Considering the above issues, the impact of the development of EZ on ambient air quality is evaluated to be **Medium Low**.

5.3.1.2 Impacts from Noise

The major sources of noise during the development of the EZ will be vehicular traffic and the operation of heavy construction equipment like dozers, scrapers, concrete mixers, cranes, compressors, generators, pumps, rock drills, pneumatic tools, saws, vibrators, etc. The operation of this equipment will generate noise ranging between 70-85 dB(A). The noise produced during the construction will have a significant impact on the existing ambient noise levels. The construction equipment may have high noise levels, which can affect the personnel operating the machines. However, these impacts will be short-term and intermittent in nature. Additionally, noise will be generated from transportation activities during the construction period. The increased noise level can impact workers' health and safety and reduce performance. Heavy vehicle operators, nearby communities, and residents close to access roads are at higher risk of noise nuisance.

Dredging activities in the Sandwip Channel/Bay of Bengal will generate noise from a variety of sources. The primary sources of equipment noise would include the dredger itself, with its associated pumps and generators, and the tugboats used to position the dredger. Other equipment, such as the crew boats and survey boats, would not contribute substantially to the noise associated with the dredging activities. Additionally, noise will be generated by the onshore plant used to spread the dredged materials and to assemble and periodically relocate pipelines. Generally, a weighted noise intensity from working engines at the noise source shall not exceed a continuous level above approximately 120 dB(A).

Seawater is an efficient medium for sound propagation, particularly low-frequency sound, and therefore, marine life over a wide area could be potentially affected. Underwater noise during the jetty construction will result from the equipment that is used for underwater activities, such as dredging, reclamation, or the construction of the bund wall, piling, and ship movements. The noise generated by underwater activities can potentially be transmitted to considerable distances through the water and hence cause negative impacts on marine mammals and fish resources.

Construction Method and Equipment

There is limited information available on construction methods, plants, and equipment before the works contract is awarded, but based on the anticipated scope of works, it can be assumed that standard construction methods and equipment would be used for the civil works for the construction of industries and other facilities in the economic zone.

The construction equipment expected to be employed for construction has been identified, and Table 5-3 lists the likely construction equipment usage at each of the major work sites.

Table 5-3: Equipment Likely to be Used During Major Construction Activities and Location

Activity	Equipment	Work Site Location
Demolition/ Breaking Up Concrete	Hydraulic hammers, Wheeled Loader, Trucks, Excavators, Breaker	Existing structures (bridges and culverts) and houses are to be demolished
Site Clearance	Milling machine, Wheeled Loader, Trucks, Excavators, Dozers	Across the work site
Earthworks	Excavators, Loaders, Dump trucks, Graders, Dozers, Vibrating rollers, Compactors	Across the work site
Structure Works	Excavators, Drilling Rigs, Concrete Mixer Trucks, Concrete Pumps, Trucks, Cranes, Poker Vibrators, Diesel Generator	At all construction locations
Road Construction Works	Water Tanker, Graders, Road Sweeper, Bitumen Sprayer, Paver, Multi-tyred Rollers	Across the NSEZ site

Ideally, noise data in calculations should be for the specific equipment to be used on site. However, at the assessment stage, the equipment has not been selected, and data is not available. Therefore, for initial predictions, reference noise data from BS 5228-1:2009 has been used.

BS 5228-1:2009 includes reference noise level data for typical construction equipment. These data have been obtained from measurements at construction sites in the United Kingdom on similar types of equipment to those used internationally. These data are used as a guide to establish the construction noise emissions.

Table 5-4 presents the A-weighted sound pressure level at 10 m for the anticipated generic construction equipment, together with an estimate of the length of time the construction equipment has been used.

Table 5-4: Major Noise-Generated Sources During Construction of Industries in the EZ

Source	Noise Level dB(A)
Generators	68
Excavator	77
Backhoe	68
Wheeled loader	80
Dump Truck	79
Lorry	80
Roller	73
Hydraulic Hammer Rig	89
Impact Pile Driver	68
Vibratory Piling Rig	88

Source	Noise Level dB(A)
Large Rotary Bored Piling Rig	83
Crawler-Mounted Rig	80
Concrete Pump	78
Wheeled Mobile Crane	67
Tracked Mobile Crane	70
Wheeled Loader	71
Wheeled Mobile Telescope Crane	78
Tower Crane	77
Cement Mixer Truck	75
Asphalt Paver	75
Breaker (Pneumatic)	87
Grader	83
Milling Machine	82
Multi-tired Roller (asphalt)	82
Poker Vibrator	69
Road Sweeper	76
Water Pump	68
Road Planer	82
Wheeled Loader	76

Source: BS 5228-1:2009

Calculated Noise Emissions

Table 5-5, Table 5-6, Table 5-7, Table 5-8, and Table 5-9 contain a summary of noise emission levels for major construction activities to be undertaken in the EZ site. To calculate the combined noise level for a construction activity, the following equation has been used to combine the noise levels from the individual construction equipment:

$$\text{Combined Noise Level} = 10 \times \log_{10} (10^{(L_1/10)} + 10^{(L_2/10)} + \dots + 10^{(L_n/10)})$$

where: L = individual noise events

Table 5-5: Noise Emission for Demolition/Breaking up Concrete Works

Equipment Type	Noise level at 10 m	Duration of Activity	Correction to	Activity Noise Level
	L _{Aeq} (dB)	as a percentage of 10 h	L _{Aeq} (dB)	L _{Aeq(10)} (dB)
Hydraulic Hammer	93	50	-3.0	90.0
Breaker	87	50	-3.0	84.0
Excavator	80	80	-1.0	79.0
Wheeled Loader	76	80	-1.0	75.0
Truck	79	60	-2.2	76.8

Equipment Type	Noise level at 10 m	Duration of Activity	Correction to	Activity Noise Level
Total Activity				91.5

Table 5-6: Noise Emission for Site Clearance Works

Equipment Type	Noise level at 10 m	Duration of Activity	Correction to	Activity Noise Level
	L _{Aeq} (dB)	as a percentage of 10 h	L _{Aeq} (dB)	L _{Aeq(10)} (dB)
Milling Machine	82	80	-1.0	81.0
Dozer	75	80	-1.0	74.0
Excavator	80	80	-1.0	79.0
Wheeled Loader	76	80	-1.0	75.0
Truck	79	60	-2.2	76.8
Total Activity				84.9

Table 5-7: Noise Emission for Earthworks

Equipment Type	Noise level at 10 m	Duration of Activity	Correction to	Activity Noise Level
	L _{Aeq} (dB)	as a percentage of 10 h	L _{Aeq} (dB)	L _{Aeq(10)} (dB)
Excavator	80	80	-1.0	79.0
Wheeled Loader	76	80	-1.0	75.0
Excavator	80	80	-1.0	79.0
Truck	79	60	-2.2	76.8
Grader	83	80	-1.0	82.0
Dozer	75	80	-1.0	74.0
Vibrating Roller	77	60	-2.2	74.8
Compactor	80	80	-1.0	79.0
Total Activity				87.3

Table 5-8: Noise Emission for Bridge/Structure Works

Equipment Type	Noise level at 10 m	Duration of Activity	Correction to	Activity Noise Level
	L _{Aeq} (dB)	as a percentage of 10 h	L _{Aeq} (dB)	L _{Aeq(10)} (dB)
Excavator	80	80	-1.0	79.0
Drilling Rig	83	80	-1.0	82.0
Concrete Mixer Truck	79	80	-1.0	78.0
Concrete Pump	80	80	-1.0	79.0

Equipment Type	Noise level at 10 m	Duration of Activity	Correction to	Activity Noise Level
Truck	79	60	-2.2	76.8
Crane	76	60	-2.2	73.8
Poker Vibrator	69	80	-1.0	68.0
Diesel Generator	66	100	0.0	66.0
Total Activity				86.7

Table 5-9: Road Pavement Works

Equipment Type	Noise level at 10 m	Duration of Activity	Correction to	Activity Noise Level
	L _{Aeq} (dB)	as a percentage of 10h	L _{Aeq} (dB)	L _{Aeq(10)} (dB)
Water Tanker	79	50	-3.0	76.0
Graders	83	80	-1.0	82.0
Road Sweeper	76	20	-7.0	69.0
Bitumen Sprayer	79	50	-3.0	76.0
Asphalt Paver	75	60	-2.2	72.8
Total Activity				84.2

All noise predictions are for a circumstance where specific or general noise mitigation has not been implemented on-site. Therefore, noise levels from the activity would generally be lower than those shown in Table 5-10. The predicted noise levels in Table 5-11 represent the highest noise level likely to be received from the construction site without any mitigation. It should be noted that noise emissions would vary as construction progresses, and the inherent variability in construction noise makes it very difficult to predict.

Table 5-10: Activity Noise Levels Depended on Distance

Activity	Activity Noise Level				
	at 10 m (dB)	at 20 m (dB)	at 50 m (dB)	at 100 m (dB)	at 200 m (dB)
Demolition	91.5	85.5	77.5	71.5	65.5
Site Clearance	84.9	78.9	70.9	64.9	58.9
Earthworks	87.3	81.3	73.3	67.3	61.3
Bridge/Structure Works	86.7	80.7	72.7	66.7	60.7
Road Pavement Works	84.2	78.2	70.2	64.2	58.2

Noise Modelling Result

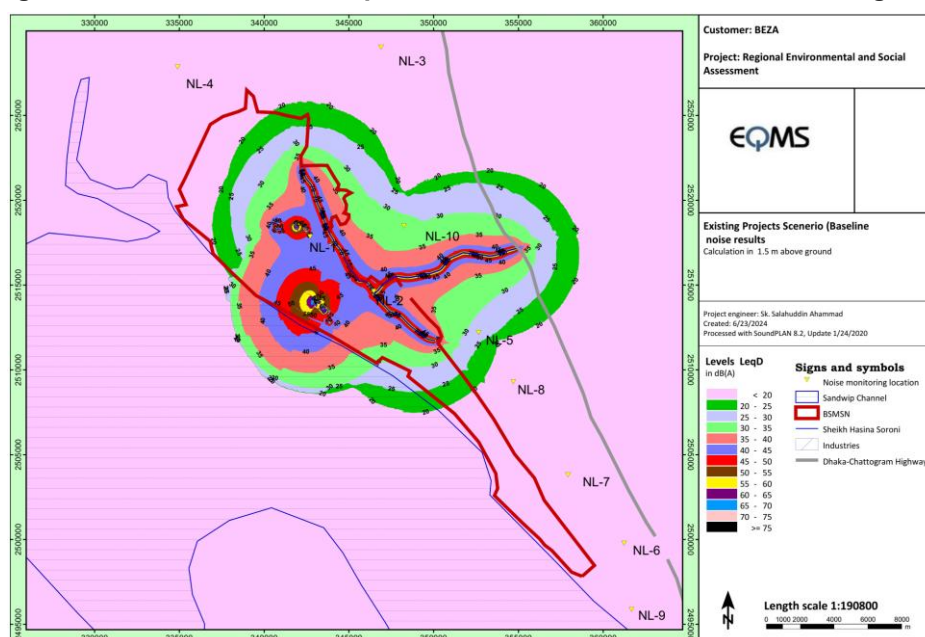
The environmental noise prediction model Sound PLAN 8.2 has been used for modeling noise emissions from the existing construction and operation of industries in the economic zone and noise from other sources in the surrounding area. Based on the noise propagation from the existing projects in the economic zone, a noise contour map has been prepared using the modeling tool. The predicted noise level at different receptor points is shown in Table 5-11, and the noise contour map is shown in Figure 5-4. Details of the ambient noise model have been given in Appendix G (Vol-III).

Table 5-11: Predicted Noise Levels at Receptors for Existing Condition

Receptor	Category of Area/ Receptor	Baseline Sound Pressure Levels at Receptors, Leq (dBA) ¹⁰		Predicted Sound Pressure Levels at Receptors, Leq (dBA)		Total Sound Pressure Level (Baseline + Predicted), Leq (dBA)		Applicable National Standard ¹¹ , dB(A) as per Land use		IFC Guidelines	
		Leqd	Leqn	Leqd	Leqn	Leqd	Leqn	Leqd	Leqn	Leqd	Leqn
ANL-1	Industrial	48.0	44.0	47.5	47.5	50.8	49.1	75	70	70	70
ANL-2	Mixed	62.2	53.5	57.5	57.5	63.5	59.0	60	50	55	45
ANL-3	Silent	60.6	48.4	<20.0	<20.0	60.6	48.4	50	40	55	45
ANL-4	Commercial	69.6	58.4	<20.0	<20.0	69.6	58.4	70	60	70	70
ANL-5	Commercial	60.2	39.4	27.5	27.5	60.2	39.7	70	60	70	70
ANL-6	Commercial	65.0	51.6	<20.0	<20.0	65.0	51.6	70	60	70	70
ANL-7	Commercial	61.0	51.9	<20.0	<20.0	61.0	51.9	70	60	70	70
ANL-8	Commercial	61.1	57.9	<20.0	<20.0	61.1	57.9	70	60	70	70
ANL-9	Industrial	60.7	46.4	<20.0	<20.0	60.7	46.4	75	70	70	70
ANL-10	Commercial	56.5	47.0	32.5	32.5	56.5	47.2	70	60	70	70

Source: EQMS, June 2024

It has been observed that the predicted noise level in all the receptors is within the permissible limit set in the Noise Pollution (Control) Rules 2006, except the ANL-2, which already exceeds the standard due to industrial activities and vehicular movement around the receptors. However, the incremental noise level at ANL-2 is very low.

Figure 5-4: Noise Contour Map of the Economic Zone and Surrounding Area

Source: EQMS, June 2024

Considering the above issues, the impact of the overall development of the EZ on ambient noise level is evaluated to be **Medium Low**.

¹⁰ Ambient noise levels as monitored during the regional baseline survey¹¹ Noise Pollution (Control) Rules, 2006

5.3.1.3 Impacts on Surface Water

During the development of the EZ, water will be required for the construction of structures, sprinkling on roads for dust suppression, and domestic and non-domestic uses of the construction workers. Sources of pollutants that may impact surface water quality during the development of the EZ include domestic wastewater from workers and sediment from runoff, particularly in land development activities where vegetation clearing is needed. The present surface water (internal khals) may be impacted due to non-point discharges of solids from soil loss and sewage generated by the construction workforce stationed at the site. Sewage discharge and runoff during the development of the EZ may lead to contamination of surface water if not managed properly.

Raw sewage can impact surface water quality by promoting the growth of algae and delivering pathogens that may be harmful to human and ecological receptors. Sewage is generally characterized as having a high concentration of suspended solids and dissolved solids, biochemical oxygen demand, chemical oxygen demand, nutrients (nitrogen, ammonia), and fecal coliform counts. Organic substances are decomposed in water, and the decomposition of organic matter will reduce the oxygen content dissolved in water.

During the rainy season (April-September), the surface water quality is likely to be affected due to the development work and loosening of topsoil. This is likely to increase the sediment as a result of increased soil erosion due to earthworks can enter surface waters, causing increased turbidity and hence impacting aquatic fauna and flora by altering the aquatic environment. Improper handling of lubricants, hazardous substances, and hydrocarbons (fuels, gasoline, etc.) may also cause water pollution of surface water.

Marine Water

During dredging, oxygen-demanding compounds, nutrients, and sediments from the seabed will enter the marine water column. Since concentrations of oxygen-demanding compounds are normally much higher in pore water than in the water column, this will cause a depletion in oxygen concentration. Nutrients may stimulate primary production when light and temperatures are sufficient and may cause eutrophication problems when released in favorable conditions. DO levels in bottom sediments, which are usually low, would increase during the dredging period.

Waste disposal from marine vessels into the marine environment may impact on marine water quality. The present surface water in the Sandwip Channel may be impacted due to non-point discharges of solids from soil loss and sewage generated by the construction workforce stationed at the site. In addition, pollutants from the upstream area of rivers and khals may carry and discharge into the marine environment may deteriorate the marine water quality as the river and khals are lined with the Sandwip channel and flow through the EZ.

Considering the above issues, the impact of the development of EZ on surface water quality is evaluated to be **Medium Low**.

5.3.1.4 Impacts on Groundwater

During the development of the EZ, water will be required for the construction of structures, sprinkling on roads for dust suppression, and domestic and non-domestic uses of the construction workers. According to the discussion with BEZA, all the water required during the construction phase is arranged from groundwater sources. According to BEZA, the water requirement for phase 1 is approximately 10 MLD which is sourced from groundwater. Currently the Phase 1 activities of EZ are partially operation stage. For the phase 2 implementation, the cumulative water requirements will be approximately 130 MLD. Among this volume 30 MLD will be sourced from groundwater and rest of the water will be taken from the Feni Reservoir. In this phase additional water will also be required for the township development/influx of people in the Mirsharai Upazila and will impact on the groundwater resources.

According to the MUDP, the projected population in the urban and rural setups in Mirsharai Upazila is 33,960 and 4,52,757 respectively in 2037. The water requirements estimated for these setups are about

4.10 MLD and 27.20 MLD, respectively. The average per capita water requirements are considered 120 LPD and 60 LPD for the urban and rural setups, respectively, following the guidelines provided in the BNBC. Thus, the total water requirement for Mirsharai Upazila in 2037 is about 31.30 MLD, excluding the water demand of the EZ. Considering all sources of water, the total capacity for water supply appears to be 19.20 MLD. Thus, the future water balance scenario appears to be negative, and Mirsharai Upazila may have a water deficit of $31.30 - 19.20 = 12.10$ MLD in 2037. The cumulative water requirement for phase 3 of EZ will be approximately 429 MLD, which will be sources mainly from different surface water sources including Feni reservoir, Meghna River, CETP, desalination plant, and rainwater harvesting and extraction of groundwater will be stopped. However, the increasing population surrounding EZ will create pressure on groundwater resources. Withdrawing groundwater in excess of the rate of recharge may result in the lowering of the water table, land subsidence, and decreased water quality. Therefore, sustainable use of groundwater will require proper utilization and groundwater recharging techniques.

Groundwater, especially shallow tubewells, is the main water supply source for local people in the surrounding communities of the economic zone. From the stakeholder consultation, it was observed that currently, there is a groundwater crisis in the region for domestic uses as well as irrigation during the dry season. The water will be produced from groundwater sources at the site camp and for construction purposes, which may cause a groundwater supply crisis and conflict with the surrounding community.

The Hydro-Geological Survey under Mirsharai Upazila Development Plan (MUDP) 2018 recommends that the aquifer condition in the EZ area is not suitable for the heavy groundwater withdrawal required for the NSEZ. The shallow groundwater in this part of the Upazila is brackish, while the deep groundwater is fresh and occurs in a thin confined aquifer below a thick and soft clay layer. Heavy pumping from that aquifer would cause the compression of the aquitard and result in land subsidence. Besides, there is a high risk of later intrusion of sea water (salinity intrusion) into groundwater from the adjacent sea. In addition to that, according to the IWM study (BEZA 2020b), salinity exists in shallow aquifers in most parts of the project area. Therefore, shallow aquifer (0-70m) needs to be avoided for a large quantity of water supply.

The groundwater quality of observed locations showed that most parameters are within the standard of groundwater for drinking. From the secondary data analysis, the presence of arsenic is identified in the EZ area. From an extensive literature review, it has been found that the arsenic concentration in the EZ (Mirsharai and Sitakunda) area depends on the depth of the aquifer. The shallow aquifer is contaminated with arsenic; on the other hand, the deep aquifer is expected to be safe from arsenic (MUDP, 2018; DPHE, 2015, and Rahman et.al., 2003).

Groundwater can get worse in quality because the proper treatment of generated wastewater is neglected in the economic zone. At this phase, there is a likelihood of having an adverse impact on groundwater quality through sewage disposal from temporary workers' facilities, debris, and solid waste deposits in case of a lack of proper management. Treating toilets and lavatories in labor camps and the other wastewater from various activities of workers by proper treatment units shall prevent groundwater contamination.

Improper handling of lubricants, hazardous substances, and hydrocarbons (fuels, gasoline, etc.) may also cause groundwater pollution. Hydrocarbon pollutants in the event of leakage of petroleum hydrocarbons from heavy vehicles operating in the economic zone site could lead to the local aquifer systems potentially being contaminated. Potential chemicals and improper handling of lubricating slurry, and other toxic substances during construction may cause groundwater pollution, thus through gradual seepage. Dredging may release sediment-associated contaminants directly into groundwater by dewatering or runoff discharges and by seepage. Dewatering liquid from the deposited dredged material contains leachable contaminants from the dredged material, and if inadequately captured and treated, poses a threat to groundwater quality.

Considering the above issues, the impact of the development of the EZ on groundwater quantity and quality is evaluated to be **Medium High**.

5.3.1.5 Impacts on Topography and Soil

The topography during the development of EZ will change due to activities such as soil excavation, land development, embankment/super dyke, internal roads, stormwater drainage, construction of access roads, pipelines, etc. These changes are accounted for as being the adverse impacts of the NSEZ, as these kinds of activities usually cause changes to the natural status of the land.

Construction of the individual industries in the economic zone will involve a large amount of earth movement. Most of the materials obtained from the excavation and dredging in the Sandwip Channel will be used for backfilling the low areas of the NSEZ. The NSEZ area is in the coastal region of Bangladesh. The land elevation on the site varies from the site's lowest point at -3.33m MSL to the highest point at +8.71m MSL¹². According to the consultation with BEZA, the NSEZ site has been partially filled with an elevation of 6.5m, and the rest of the site will be filled with an elevation of 6.5m.

The main impacts on soil will occur due to increased erosion potential as a result of vegetation clearing and earth-moving activities. Construction activities in the EZ will involve leveling, excavation, and removal of existing vegetation will invariably disturb the soil of the area. The impacts on soil during the construction phase shall be mainly due to loss of topsoil in the construction areas and contamination of the soils of the surrounding area due to solid waste generation from site activities, as well as liquid waste such as lubricants, slurry, and accidental spills, and leaks occurring from storage and work areas. The rainfall and surface runoff can cause soil erosion. The disturbances would be more pronounced during the summer and monsoon seasons with strong rains, as the NSEZ site is located near the sea. Accidental spillage of oil from construction vehicles might cause soil contamination.

During the development of EZ, there will be imported materials from outside, especially construction materials like bricks, cement, HDPE pipes, backfill material, sand, clay, etc. These materials will be stored at the site, which is likely to change the characteristics of the soil in the construction area. In addition to that, municipal waste due to construction workers, domestic sewage, and sullage from the construction labor facilities and offices at the NSEZ site, etc., will contribute to changing the soil characteristics.

Considering the above issues, the impact of the development of the EZ on topography and soil quality is evaluated to be **Medium Low**.

5.3.1.6 Impacts of Sediment

Construction activities i.e., piling of building, excavation, concreting work, construction of a jetty at the vicinity of the internal khals, Rivers, and Sandwip Channel, accidental spillage of hazardous chemicals like oil and lubricant from the construction vehicles, improper storage and disposal of construction waste, solid and liquid waste from the worker's facilities may mix with rainfall water and it can accumulate on the adjacent khals, Rivers, and Sandwip Channel through runoff. Besides the above-mentioned sources of impact, there are some additional sources, i.e., runoff and erosion of exposed bare soil, slopes, earth, and stockpiles, the release of cement materials with rain, and washing water of dust suppression sprays and vehicle wheels. The extra sediment loads in the khals, rivers, and marine water also lead to an impact on the aquatic environment.

Sediment quality in the Sandwip Channel was sampled at eight different locations in December 2023, and the result was compared with the USEPA standard. From the results, nickel concentration was found in the range of moderate polluted (20-50 ppm), and chromium concentration was found in the range of moderate polluted (25-75 ppm). It is recommended to confirm the sediment quality/contamination level of the dredge materials prior to dredging that will be used for landfill in the economic zone.

¹² https://NSEZ.gov.bd/?page_id=639

Considering the above issues, the impact of the development of EZ on sediment quality is evaluated to be **Medium Low**.

5.3.1.7 Impact due to Changes in Land Use

The economic zone has a total land area of 33,805 acres or 136.86 square kilometers (mostly reclaimed land) with a 25 km coastline along the Sandwip Channel in the Bay of Bengal. Land use and land cover of the region will be changed due to the implementation of the EZ master plan. Before the development of the economic zone, the site was comprised of barren lands (27.6%), planted mangroves/forest/vegetation (31.65%), water bodies (8.71%), and under development (6.53%)¹³. The existing vegetation and trees will be cleared for the development of the NSEZ and its allied facilities; therefore, the land use of the existing area will be changed to an industrial area, which will result in the loss of existing vegetation. Also, it will have an impact on the existing drainage pattern in the EZ as well as in the adjoining area if the development is not properly planned.

During the development of the EZ, there will be a large number of personnel moving into the economic zone and the surrounding area. The majority will be construction crews with low wages. They will likely depend in part on the locals to provide certain low-cost basic services, such as food, cleaning, transportation, and entertainment or relaxation. Naturally, there will be temporary structures set up to provide such services at the places most convenient for the workers, predictably near the access roads and the entrance to the site. These squatted temporary settlements will take more permanent forms over time, but are not necessarily tidy, safe, or sanitary. It is recommended to provide a designated township for the workers, considering the convenient distance between the accommodation and work/construction sites. In terms of land use, such temporary service activities and structures set up for workers' needs must be planned out and monitored regularly. Relocation may be needed in intervals as appropriate so that eventually most or all services for NSEZ personnel will not be allowed to scatter outside the designated township zone.

Considering the above issues, the impact of the development of the EZ on land use changes is evaluated to be **Medium High**.

5.3.1.8 Impact due to Solid Waste Generation

Solid waste is likely to be generated in significant amounts during the development of the EZ. Construction activities will generate different categories of solid waste. Solid materials such as domestic/canteen waste, food packet wrappers, paper, plastic drums, paints, oil containers, packaging from construction materials, generation from earthwork, debris, excess construction materials, site establishment activities, removal of vegetation/bush/trees, and others will be generated. This may cause environmental degradation at the EZ site as well as its immediate surroundings if adequate measures are not taken.

Hazardous waste, i.e., oil, chemicals, lubricants, paints, compressed gases, varnishes, etc., generated during the development of EZ should be dealt with separately from non-hazardous waste. The dripping of oil from construction vehicles might cause soil contamination. Medical waste will be generated from the first aid facilities on the construction sites.

In order to avoid any solid waste disposal problems, an effective solid waste management system is required by means of the collection of waste in different types of dustbins and transporting the same to the central waste treatment facility. Though EZ will have an integrated waste storage, treatment, and disposal facility, the investors should also develop a waste management plan in tune with the overall waste management system for EZ. Strict adherence to the established solid waste collection and disposal system will ensure a clean environment during the development phase.

Considering the above issues, the impact of solid waste generation and disposal due to the development of the EZ is evaluated to be **Low**.

¹³ https://NSEZ.gov.bd/?page_id=639

5.3.1.9 Impacts from Liquid Waste Generation

During the development of EZ, the primary wastewater issues relate to stormwater events and sanitary wastewater generated by construction activities on site. Stormwater has the potential to run off into areas containing hazardous materials and either leach into the soil or carry these off the site, potentially contaminating other areas, groundwater, or marine waters. Storm events can potentially have adverse impacts on water resources, resulting in large amounts of silt-laden run-off.

Sewage will be generated from the construction workers' facilities and the NSEZ site. Wastewater generation at construction sites includes surface runoff, also, which may contain pollutants and traces of solvents, paints, metal compounds, etc., that may impact the nearby surface water resources if not managed properly. The impact is that until the development phase is completed as infrastructure for the wastewater conveying network and treatment plants will be available.

Considering the above issues, the impact of liquid waste generation and disposal due to the development of the EZ is evaluated to be **Low**.

5.3.1.10 Impacts on Drainage

The implementation of the EZ master plan has the potential to change the topography of the land, which may also disrupt the natural drainage of the region. This is because the construction will involve cutting and filling earthworks. The cut-and-fill work will normally change the natural topography of the land, which will result in a disruption of the natural drainage of the land and the surrounding area.

The township, access roads, and other utility services will be developed while undertaking minimum cutting for making traces for the construction of buildings, while making minimum modifications in the terrain conditions, and implementing appropriate environmental measures.

EZ site is sloping from north-east to south-west. Storm runoff generated from the entire area of the economic zone, and its surroundings, gets drained to the sea through a number of natural drainage channels passing through the EZ, viz. Ichakhali, Daborkhali, Bamansundar, Hoania, Saherkhali, Domkhali, etc. Altogether, there are 13 drainage channels, all getting discharged to the sea, apart from the Feni River, which passes through EZ before conferencing to the sea (Master Plan, 2020). All these rivers and khals are influenced by the tidal effect. In the case of NSEZ development, rivers and khals may be affected by the development activities. Excavation, earthwork, and levelling activities are possible to obstruct the water drainage. The effects might include an increase in sediment or a change in river/khals velocity or direction.

Stormwater from villages upstream is drained through different khals and finally falls to the Sandwip Channel. These khals will not be impacted during the development of economic zones and will be retained in their existing conditions. However, sluice gates are proposed to be developed at different khals at the point of entry of the khal in the EZ site from the seaside to control the flow of water. These sluice gates will control the level of water entering the khals and will be closed only during high tide and high flow times and allowing the water movement in the rest of the time.

The NSEZ site has a good amount of rainfall during the rainy season. To ensure maintenance of existing water bodies and create new water reservoirs, a lake (NSEZ Sarobar) in the economic zone (Precint J - Open Space) has been considered by the NSEZ authority. The area of NSEZ Sarobar is approximately 112 acres. This lake will help not only with drainage of the rainwater but also be used as a rainwater storage system, a recreational center, and for floating solar panels. This lake will also act as an oasis and central hub of the green network across the entire city to serve as the heart of the NSEZ and promote tourist attractions. The proposed stormwater drainage network has been designed in such a way that there will be no disturbance to the natural drainage system.

Considering the above issues, the impact of the development of the EZ on drainage is evaluated to be **Medium Low**.

5.3.1.11 Impacts of Traffic

The development of EZ will generate a significant increase in traffic volume on the local road networks on a long-term basis, as the construction activities will be done in different phases and will continue up to 2040. Construction traffic will include vehicles transporting equipment, materials, and personnel. The main transportation route corridor from the Chattogram Sea Port is the Dhaka-Chattogram Highway. Currently, NSEZ Saroni is the main route to access the EZ from the Dhaka-Chattogram Highway is already improved to a bitumen standard. The length of the road is approximately 10 km. Improving this road is not only beneficial for the EZ but also for the inhabitants of different villages located along the road. Thousands of vehicles per day are moving from the beginning of the development of EZ.

During the development of the EZ, there will be an increase in the traffic volumes on the local road networks in the region day by day. The increased traffic volumes will place an additional burden on the existing roads within the study region. Traffic congestion may occur due to vehicles from the construction site and vehicles entering and exiting the industrial zone. The volume of vehicles involved in transporting raw materials has a lot of potential for traffic accidents and potential injuries to public road users, especially residents living close to the access roads. Therefore, it is essential to regulatory check vehicles and shipping volumes to minimize road accidents on roads. To reduce the risk of accidents, EZ should install signboards along the roads that are most frequently used by NSEZ's vehicles. Investors/contractors should regularly propagate and enhance workers' awareness of obeying traffic laws to minimize risks and accidents when driving vehicles. In addition to the risk of accidents, increased traffic will lead to inconvenience to the public and increase the potential for nuisance in the EZ area.

Since the transport and communication routes will be improved during the development phase, all advantages and disadvantages usually relate to that phase. However, as a long-term impact, its benefits remain. The improvement and development of the local road conditions will enhance various socio-economic activities.

Considering the above issues, the impact of the development of the EZ on traffic is evaluated to be **Medium Low**.

5.3.1.12 Loss of Ecosystem Services

Currently, the local community benefits from a wide range of provisioning, regulating, and supporting ecosystem services in the EZ site and its surrounding area. These services include fishing, abstraction of groundwater for various purposes, medicinal plants, fuel wood, livestock grazing, protection against natural hazards and extreme events, aesthetic value, etc. Based on consultations with the Upazila Fisheries Officers, around 2,557 fishermen are registered in the Mirsharai Upazila, while Sonagazi has about 800 marine fishers. Additionally, 300 seasonal fishers operate during the Hilsa migration, alongside hundreds of informal fishers using casting nets in coastal and riverine areas. Main landing sites Saherkhali, Domkhali, Muhuri, and Bamonsundor Ghats are being relocated due to EZ development, increasing hardships for fishermen by reducing access and safety, especially during cyclones. Fishermen also face challenges from increased maritime traffic, including net damage, habitat disturbance, and disrupted fish migration. Furthermore, buffalo owners relying on EZ land for open grazing may also be affected, as grazing areas shrink, potentially leading to reduced livestock productivity and increased fodder costs. These changes may pose threats to traditional livelihoods and ecosystem-dependent income sources.

Increased construction and infrastructure development may lead to groundwater depletion, affecting the availability of water for various purposes such as drinking, irrigation, and domestic use. This disrupts the provisioning service of freshwater. Changes in water body dynamics due to construction activities can impact fish populations, affecting the livelihoods of local communities who rely on fishing for income. This impacts the provisioning service of the ecosystem.

Habitat destruction and land conversion for the industrial city may lead to the loss of medicinal plant species such as Arjun (*Terminalia arjuna*), Hargoza (*Acanthus ilicifolius*), and Neem (*Azadirachta*

indica). The area hosts mainly planted species with limited medicinal value. This reduces access to traditional healthcare resources, impacting cultural services and potentially increasing reliance on external healthcare systems. Deforestation and land clearing for development purposes may lead to a reduction in the availability of fuelwood, affecting households dependent on it for cooking and heating. Conversion of land for industrial purposes may reduce grazing areas for livestock, thereby impacting the livelihoods of pastoral communities. All these activities affect the provisioning services of the ecosystems.

The alteration of natural landscapes and habitats may diminish their ability to protect against natural hazards and extreme events, increasing vulnerability to disasters like floods and cyclones, and affecting the regulating services of the ecosystem. Changes in the landscape due to industrial development may reduce the aesthetic value of the area. The reduction or elimination of these ecosystem services could result in a loss of income for the local community, particularly for those dependent on natural resource-based livelihoods.

Considering these issues, the impact of the development of EZ on ecosystem services is evaluated to be **Medium Low**.

5.3.1.13 Impacts on Terrestrial and Mangrove Flora

As the development activities involve vegetation clearance, terrain shaping, and soil excavation, several plant species will be lost, as well as planted mangrove species. Major visible trees are Akashmoni, Jhao Ghas, and Karoi, among others, which will also be affected, leading to a reduction in vegetation cover in the area. All the species are very common; their destruction will reduce the vegetation cover in the area. Water from the sea enters the EZ site and the nearby planted mangrove forest during high tides. This area serves as intertidal mud flats and thus provides a habitat for mud crabs, water birds, fish, and shrimps. All these species will be impacted during the removal of trees as well as the land development, dyke construction, and other construction activities. The basic significant impact of construction on terrestrial ecology will be due to the loss of vegetation. According to the BEZA, the NSEZ site, spanning 33,805 acres (mostly reclaimed land), comprises 31.65% (10,699.21 acres) mangrove/forest/vegetation. These mangroves are planted by Bangladesh Forest Department. However, BEZA allocated a total of 40.37% (13,646.28 acres) of land as mangroves, green areas, vegetation, and open spaces which is a significant increase compared to the existing coverage.

Destruction of ecosystems can also be caused indirectly if emissions from EZ development activities reduce the productivity of vegetation. Dust, for instance, will affect plant growth by interrupting physiological processes like transpiration when lodged on leaf surfaces, thereby blocking their stomata. Stack emissions such as sulphur dioxide, nitrogen oxides, carbon monoxide, and heavy metals (such as mercury) may contribute to acid rain, which in turn pollutes and affects plant growth by corrosion of their surfaces, and causes acidification of aquatic ecosystems.

With the expected habitat disturbance during the implementation of the EZ master plan, invasive species may take advantage of the situation and increase in the region. Clearing of natural vegetation opens gaps that are immediately occupied by opportunistic invasive and weedy species when conditions become favorable. Movement of trucks and soil from one point to another might spread seeds of these species along the communication and travel paths that are under persistent disturbances. Exotic species might also be introduced in the region either passively, as people dispose of fruit seeds in the environment, or by design during landscaping activities.

Considering these issues, the impact of the development of the EZ on terrestrial flora is evaluated to be **Medium High**.

5.3.1.14 Impacts on Terrestrial Mammals

Clearing of vegetation, soil excavation, and construction of facilities may alter the habitat for mammals in the area. The population of trees and other plant species will also be reduced through the clearing of

vegetation for the EZ structures. It is expected that the removal of vegetation will alter the ecological function of the area. As a result, wildlife ranging, foraging, and roosting areas will be adversely affected.

From the primary baseline survey and secondary literature review, 11 species of terrestrial mammals were observed in the EZ site. Among the identified species in the EZ site, the Rhesus Macaque (*Macaca mulatta*) is categorized as Vulnerable, and Jungle Cat (*Felis chaus*) is categorized as Near Threatened in the IUCN Red List of Threatened Species of Bangladesh 2015. In the study region, all the documented species of the EZ site and an additional 7 species were exclusively found. Among the study region species, the Fishing Cat (*Prionailurus viverrinus*) is listed as Endangered in the IUCN Red List of Threatened Species of Bangladesh 2015. Therefore, considering the presence of these species, there will be some obvious impacts on mammalian species during the development of EZ.

Vegetation removal will diminish food resources available for herbivorous mammals like spotted deer, impacting their foraging success and potentially leading to population decline. Loss of habitat complexity due to clearing can also negatively affect prey availability for carnivorous mammals like the Jungle Cat and Fishing Cat.

Spatial occupation of the area by NSEZ facilities and people will displace mammals that currently forage in the EZ site and study region, and could create a barrier effect, which may alter their dispersal patterns. Displacement of mammals due to habitat loss and construction activity could increase human-wildlife conflict, as animals may seek food and shelter in nearby human settlements.

Mammal species are sensitive to human occupation. Disturbances include flood lights, vehicle lights, and noise from machinery and vehicles. Road kills of nocturnal animals are expected due to the movement of vehicles through the approach roads for the transport of construction material during dawn and dusk periods. Occupation of the area by NSEZ facilities will render the site inaccessible to mammals. This will reduce faunal foraging options by barring the site as a foraging ground. Noise and vibrations from heavy machinery may interfere with the foraging, ranging, breeding, and nesting behavior of mammals in the ecosystem within the NSEZ site and those in the larger ecosystem.

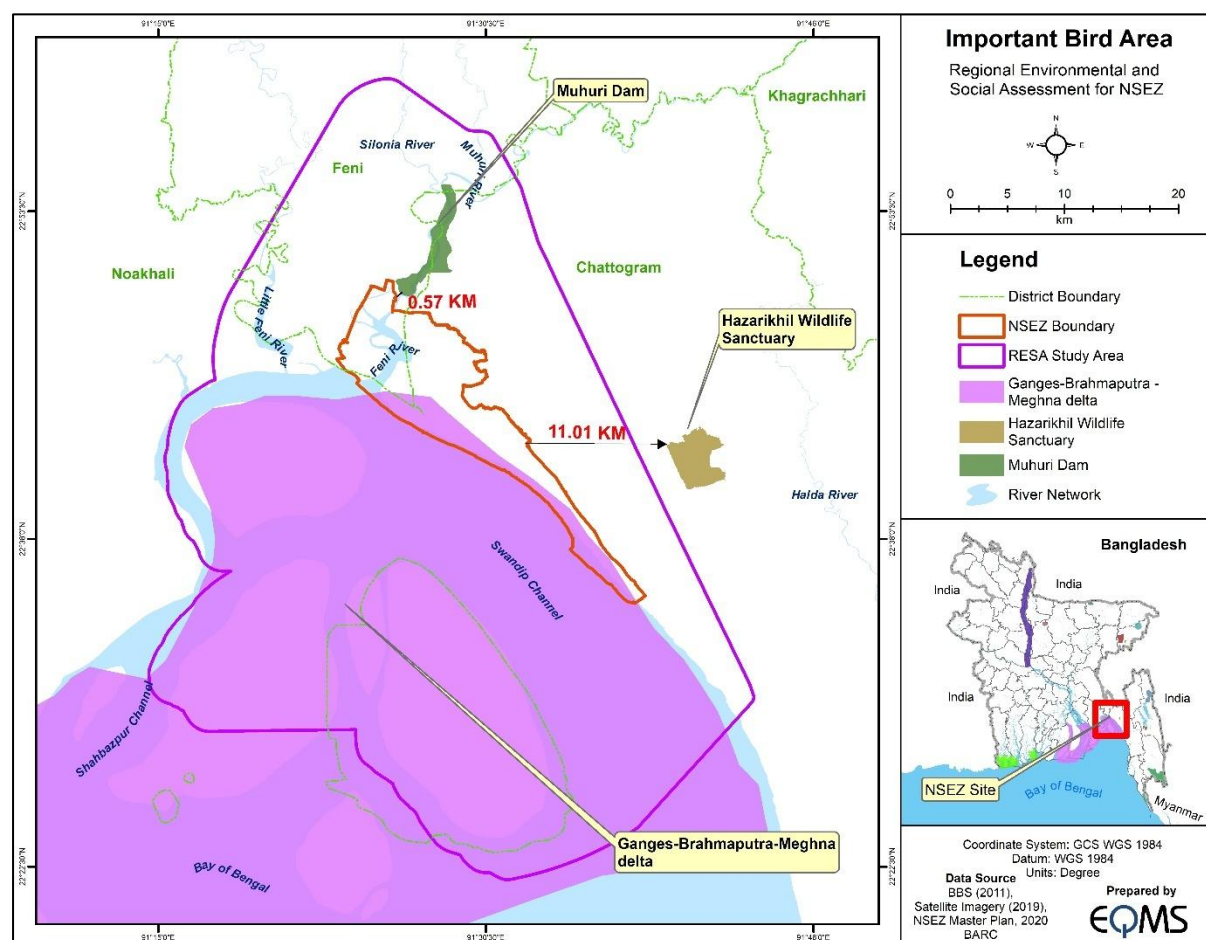
Considering the above issues, the impact of the development of the EZ on terrestrial mammals is evaluated to be **Medium Low**.

5.3.1.15 Impacts on Birds/Avifauna

Birds serve as important indicators of ecosystem health, reflecting the conditions of their habitats. While birds are highly mobile and may relocate once an area is developed, the presence of species of conservation concern, including those listed on the IUCN Red List and migratory species, highlights the cumulative impact on conservation obligations.

During the survey, two Important Bird and Biodiversity Areas have been identified, i.e., Ganges-Brahmaputra-Meghna delta and Muhuri Dam (Figure 5-5) in the study area. The Ganges-Brahmaputra-Meghna delta partially falls within the NSEZ boundary, and Muhuri Dam is approximately 0.57 km. far from the NSEZ boundary. The EZ site is situated along the Sandwip Channel of the Bay of Bengal, encompassing several islands. The mudflats in this area are crucial for migratory birds, as they lie along migratory routes of numerous species. From the primary baseline survey and secondary literature review, 89 species were recorded from the EZ site. Among the recorded birds of the EZ site, the Black-headed Ibis (*Threskiornis melanocephalus*) is categorized as Vulnerable, while all other species are categorized as Least Concern as per the IUCN Red List of Threatened Species. In the study region, all the documented species of the EZ site and an additional 96 species were exclusively found. Among the recorded birds of the study region, Grey-headed Fish Eagle (*Ichthyophaga ichthyaeetus*) is categorized as Near Threatened. The baseline survey in the study region recorded a total of 65 migratory bird species. Among the recorded species, 21 species were found in the EZ site, and 30 species were exclusively identified within the study region, except for the species found in the EZ site.

Figure 5-5: Important Birds and Biodiversity Areas in the Study Area



Source: EQMS

During the development of the EZ, noise and vibration may be an issue due to the vehicle's movement, construction machinery and equipment operation, and movement of workers, as one important bird area, i.e., the Ganges-Brahmaputra-Meghna delta, falls within the NSEZ boundary, and another lies within the study area. Access roads will be built, and traffic to the site will increase. It is apparent that when the site is cleared of forest, the birds have a tendency to migrate to a more suitable habitat for relocation. There will be a significant loss of species diversity due to the clearing of the site. Opportunistic species, e.g., scavenging birds, will replace them. The increase in human population and associated activities, e.g., waste disposal, is likely to attract and increase populations of scavenging and invasive bird species, e.g., Indian House Crows. This will have a direct effect on populations of indigenous avifauna species through mainly predation, as well as a risk to public health. One more ecological impact that is envisaged during development is related to lighting in the construction area. Light generally affects birds, especially the nocturnal ones.

The conversion of large areas of land for various purposes such as residential, commercial, and industrial zones will result in habitat loss and degradation. This can disrupt breeding, foraging, and migratory patterns, affecting bird populations in the long run.

Considering the above issues, the impact of the development of the EZ on avifauna species is evaluated to be **Medium High**.

5.3.1.16 Impacts on Herpetofauna

Herpetofauna refers to the collective group of reptiles and amphibians found in a particular region or habitat. From the primary baseline survey and literature review, a total of 28 species of reptilian fauna were documented in the study region. Among the recorded species, the Asian water monitor (*Varanus*

salvator) is categorized as Vulnerable, while the Bengal Monitor (*Varanus bengalensis*), Yellow Monitor (*Varanus flavecens*), Monocled Cobra (*Naja kaouthia*), Red-necked Keelback (*Rhabdophis subminiatus*), and Spectacled Cobra (*Naja naja*) are classified as Near Threatened according to the IUCN Red List of Threatened Species of Bangladesh 2015.

From the primary baseline survey and literature review, 9 amphibian species were documented in the study region. Among these species, the Cascade Frog (*Amolops marmoratus*) is categorized as Vulnerable according to the IUCN Red List of Threatened Species of Bangladesh 2015. It is noteworthy that all reptilian and amphibian species receive legal protection under the Bangladesh Wildlife (Conservation and Security) Act, 2012, safeguarding them from hunting, killing, and capturing.

The habitat loss will happen during the initial clearing or removal of vegetation. The development of EZ will involve landscaping, which will involve excavation, compacting, and flattening of some areas. This will clear all the herpetofauna habitats on the ground, like trees, dead tree trunks, and grasses, which are home to amphibians and reptiles. It will also remove the source of food, which are insects that are eaten by lizards who are in turn eaten by snakes, thereby interfering with the food chain. Cleared vegetation will expose herpetofauna to their predators when closing the roads and in open spaces. The animals will be prone to being crushed on the road by vehicles. This is especially during the wet season when the animals have more movement in search of mates for breeding.

During the clearing of the EZ site, animals such as snakes and lizards will move to other areas. However, due to the sudden change of environment, there is likely aggression from animals such as agitated snakes trying to escape. Further, snakes will move to other sites that are near the area. The concentration of snakes and lizards may rise, thus leading to competition for available resources near homes and for feeding on domesticated animals. Increased snake bites and snake encounters may occur to workers and the surrounding people. Waste and new habitats formed will attract lizards and rodents, which in turn attract snakes, this might cause human-wildlife conflicts as well as wildlife-wildlife conflicts.

Oils and fuels from machines, generators, and vehicles, plus other chemicals used, may accidentally spill on the site. This spillage, if collected by rainwater, will eventually accumulate and if not well disposed of on the land, will end up in the khals, sea, or other habitats. This will contaminate water and soil and affect amphibians more because they rely on their skin for respiration. This will lead to death and low reproduction due to the eggs and larval stages not getting enough air, thus leading to population changes.

During the development of EZ, there will be exhaust emissions from vehicles and dust during excavation, which may affect the breathing systems of herpetofauna. Amphibians that breathe through their skin and need to keep their skin moist for this purpose will be mostly affected.

Considering the above issues, the impact of the development of the EZ on herpetofauna is evaluated to be **Medium High**.

5.3.1.17 Impacts on Aquatic Mammals

The baseline survey reveals that the most frequently observed aquatic mammal in the study region is the Irrawaddy dolphin (*Orcaella brevirostris*), which is classified as globally Endangered on the IUCN Red List of Threatened Species. Another dolphin species expected to occur in the Sandwip Channel near EZ is the Indo-Pacific Humpback Dolphin (*Sousa chinensis*), listed as Vulnerable on the IUCN Red List of Threatened Species.

The development of the EZ, specifically the construction of jetty and dredging activities, will disturb sediments and release contaminants that degrade water quality at both extraction and dumping sites. These pollutants will pose considerable risks to aquatic marine life, including dolphin populations. Specifically, construction and dredging activities in the Sandwip Channel threaten Irrawaddy and Indo-Pacific Humpback Dolphins by altering their habitat and water chemistry, potentially causing temporary negative impacts on their health and survival. Pile driving for jetties, breakwaters, and other structures,

along with dredging activities for land and jetty development, can generate intense underwater noise. This can disrupt communication and echolocation (used for navigation and feeding) and cause hearing damage to dolphins. Increased vessel traffic associated with construction activities can elevate background noise levels, further impacting dolphin communication and the ability to detect prey. Construction of new marine intake and outfall pipelines for desalination plants, and blasting may directly affect surf-zone and nearshore species.

Accidental spills of oil, lubricants, or other contaminants can pollute the water and harm dolphins directly through exposure or indirectly through bioaccumulation in their prey. Activities in the marine environment can stir up sediments, increasing water turbidity and reducing prey visibility for dolphins. Noise pollution and habitat disturbance can alter dolphin behavior, making it more difficult to find food and mates, and increasing stress levels. Habitat alteration and pollution can harm fish populations that dolphins rely on for food. Exposure to intense underwater noise can cause physical injuries and permanent hearing damage in dolphins. However, all these potential impacts are expected to be temporary and limited to the duration of the dredging and jetty construction period only.

Considering the above issues, the impact of the development of the EZ on aquatic mammals is evaluated to be **Medium Low**.

5.3.1.18 Impacts on Ichthyofauna (Fish)

The baseline survey reveals a significant number of fisheries resources, encompassing both captured and cultured fish species, within the study region. Pond-based aquaculture practices are not very common, but fishing activities based on rivers are noted. Furthermore, the EZ is situated on the eastern side of the Sandwip Channel, where substantial fishing activities have been observed, with marine and estuarine fish being caught. A baseline fisheries survey in the Sonagazi, Mirsharai, and Sitakunda upazilas revealed a total of 30 species, comprising 22 species of finfish, 2 species of crab, and 6 species of shrimp. Additionally, fish farmers in the study region mostly culture fourteen species of fish and two species of crustaceans.

The development of EZ is likely to have several negative impacts on the ichthyofauna (fish populations) of the surrounding water bodies, including the Sandwip Channel. Land reclamation and infrastructure development will result in the loss and alteration of aquatic habitats, including estuaries, rivers, and coastal areas, where many fish species reside and breed. Construction of jetties and other marine structures can fragment existing aquatic habitats by acting as physical barriers that disrupt the natural flow of water and sediment, which can disrupt fish movement and spawning grounds. Habitat loss, degradation, and pollution can lead to a decline in fish species diversity in the affected water bodies.

Clearing of riparian vegetation can result in the loss of habitat and food sources for fish, reducing biodiversity and impacting the overall health of aquatic ecosystems. Development activities can disrupt fish spawning and recruitment, leading to a decline in fish stocks that are important for local fisheries. Dredging activities for jetty development and potential landfilling can directly destroy fish habitat by removing or smothering aquatic vegetation and altering the seabed composition.

Development activities can lead to increased erosion and runoff, resulting in sedimentation in waterways. This can suffocate fish eggs and clog gills, hindering fish respiration and development. Leakage or spills of oil, lubricants, concrete, or other construction materials can contaminate waterways, making them toxic to fish and other aquatic life. Increasing water turbidity and reducing light penetration can disrupt fish feeding behavior temporarily and reduce photosynthesis by aquatic plants, impacting the overall food web. Pollutants can bioaccumulate in fish tissues, posing a health risk to humans who consume these fish.

Pile driving, dredging, and other activities generate temporary underwater noise that can disrupt fish communication, breeding behavior, and the ability to detect predators. Increased vessel traffic associated with construction activities can disturb fish behavior and increase the risk of collisions with vessels. Dredging activities often disturb sediments, thereby reducing visibility and increasing the turbidity of water to the point where the amount of photosynthesis that can occur in the water is curtailed,

with the result that there will be an overall impairment of the function of the ecosystem. Consequently, the growth of fish and other organisms will be affected since the food supply will be reduced in turbid conditions. Other adverse effects of turbidity include a decrease in disease resistance, suffocation, and death.

Considering the above issues, the impact of the development of the EZ on ichthyofauna is evaluated to be **Medium Low**.

5.3.1.19 Impacts on Hilsa Fisheries

Hilsa comprises the largest and most valuable single fishery in Bangladesh. Hilsa is largely anadromous and fast swimming, being an euryhaline pelagic fish that thrives in brackish water and marine environments of the Bay of Bengal. The baseline study reveals the presence of hilsa fish, along with their spawning and breeding grounds, in the Sandwip Channel. The hilsa spawning ground boundary point is located within the study area, namely Mayani Point at Mirsharai, Chattogram. The peak spawning period occurs three days before and seven days after the full moon, including the day of the full moon, totaling eleven days of the moon, which first appears in the Bengali month of Ashwin each year.

Hilsa is classified as a species of Least Concern (LC) on the IUCN Red List in terms of its conservation significance. However, it is considered a nationally recognized important species. According to the review, there is one Hilsa breeding and spawning ground in the study area, but no Hilsa sanctuary is found. According to the national regulations, activities are restricted in the designated sanctuary area, but there are no such regulations for the breeding and spawning ground. The development of the EZ poses several threats to Hilsa fish, particularly in the vicinity of the identified spawning ground near Mayani Point. Activities such as land reclamation, infrastructure development, and dredging can lead to the loss and alteration of aquatic habitats temporarily, including the hilsa's spawning and breeding grounds in the Sandwip Channel. This loss of habitat may disrupt hilsa migration routes and access to spawning areas.

Increased sedimentation from construction-related activities can affect water quality temporarily in the Sandwip Channel, potentially impacting the survival of hilsa eggs and larvae. Sedimentation can also smother aquatic vegetation, which serves as an important spawning and nursery habitat for hilsa.

Discharge of untreated or inadequately treated construction-related pollutants such as heavy metals, organic compounds, and toxins into the water bodies can harm hilsa health and reproduction. Additionally, spills of oil, lubricants, and other materials during construction activities can contaminate the water and adversely affect hilsa populations. Activities such as dredging, pile driving, and vessel traffic can create underwater noise and disturbances that may disrupt hilsa spawning behavior and communication temporarily, particularly during their peak spawning period around the full moon.

The establishment of infrastructure, i.e., jetty may encroach upon or disrupt hilsa spawning and breeding grounds, including areas like the Mayani Point in Mirsharai, Chattogram. This loss of spawning grounds may have implications for hilsa reproduction and population dynamics. The development of jetty and improved access to waterways within EZ may attract more fishing vessels, leading to increased fishing pressure on hilsa populations. Overexploitation of hilsa stocks, especially during their peak spawning season, could further threaten their sustainability.

Considering the above issues and their importance nationally, the impact of the development of the EZ on hilsa fisheries is evaluated to be **Medium Low**.

5.3.1.20 Impacts on Plankton and Benthos

Plankton and benthos are two crucial components of aquatic ecosystems. Planktonic organisms form the base of the food chain for many aquatic animals and play a crucial role in the global carbon cycle by absorbing and releasing carbon dioxide. Meanwhile, benthic organisms play a vital role in nutrient cycling and sediment transport, serving as an important food source for many larger aquatic animals. Both plankton and benthos serve as important indicators of the health of aquatic ecosystems.

During the baseline study, sample analysis from predefined collection locations in the Sandwip Channel, downstream of the Feni River and its confluences, adjacent to the EZ, identified a total of nineteen species of phytoplankton, fourteen species of zooplankton, and sixteen species of benthos.

Several impacts on planktonic and benthic organisms in the Sandwip Channel can be anticipated during the development of EZ. Activities such as dredging, land reclamation, and infrastructure development in the water body will temporarily increase turbidity levels and sediment load, which can directly disturb the habitats of planktonic and benthic organisms in the Sandwip Channel. These disturbances can disrupt their natural environment, affecting their ability to thrive and reproduce. Development activities may lead to increased sedimentation and runoff, which can degrade water quality in the Sandwip Channel. Sedimentation can smother benthic organisms and reduce light penetration, affecting photosynthesis in important phytoplankton. Pollutants from EZ sites can also negatively impact planktonic and benthic communities.

Construction projects may introduce chemicals such as cement, oil, and lubricants into the water, posing a threat to planktonic and benthic organisms. Chemical spills or leaks can have acute and chronic effects on their health and survival. Infrastructure development, such as the construction of jetties and embankments, can create physical barriers that impede the movement of planktonic and benthic organisms, disrupting their natural migration patterns and dispersal.

Changes in water flow and circulation patterns due to development activities can impact planktonic and benthic communities. Alterations in hydrology may disrupt nutrient cycling, oxygen levels, and food availability, affecting the overall health of aquatic ecosystems. Combined disturbances from different activities may lead to population declines, shifts in species composition, and ecological imbalances. However, planktonic and benthic communities are generally resilient and recoverable due to their short life cycles and high reproductive rates. Plankton can begin to recover within weeks to a few months after the cessation of disturbance, assuming favorable conditions and water quality (Newell and Woodcock, 2013)¹⁴. In contrast, benthic recovery may take 1 to 3 years under natural conditions Thrush and Dayton, 2002)¹⁵.

Considering the above issues, the impact of the development of EZ on plankton and benthos is evaluated to be **Low**.

5.3.1.21 Impacts of Dredging on Marine Ecosystems

According to the IMD report (May 2024), each acre requires 13,333 cubic meters of soil for earth filling¹⁶. Therefore, it could be said that an approximate total amount of 450.89 million cubic meters of soil will be required for EZ site land development. This dredging and land development will be carried out phase by phase. The phase-wise quantity of dredging requirements and possible dredging locations has been given in Table 5-12.

Table 5-12: Phase Wise Dredging Requirements and Possible Dredging Locations

Phase	Dredging Requirements (million m ³)	Possible Locations
Phase 1	225.33	Sandwip Channel and Bay of Bengal
Phase 2	112.75	
Phase 3	112.81	

¹⁴ Newell, R. C., & Woodcock, T. A. (2013). The role of planktonic productivity and turnover in coastal ecosystem resilience. *Marine Pollution Bulletin*, 74(1), 7–15.

¹⁵ Thrush, S. F., & Dayton, P. K. (2002). Disturbance to marine benthic habitats by trawling and dredging: Implications for marine biodiversity. *Annual Review of Ecology and Systematics*, 33, 449–473.

¹⁶ Draft environmental and social impact assessment (ESIA) for the land development of part of Precinct F (IMD Zone and Housing Facilities) and Precinct B of NSEZ-BEZA (May, 2024)

Total	450.89	

Considering these large volumes of soil requirements, availability, and proposed dredging location distance from the land development site, Sandwip Channel and the Bay of Bengal could be a suitable source. However, a detailed assessment regarding the available volume and quality of dredging materials will be required before starting dredging activities. The Sandwip Channel is a tidally influenced estuarine system that naturally carries a high sediment load due to freshwater discharge from the Meghna River, strong tidal action from the Bay of Bengal, and sediment contribution from upstream floodplains and deltaic processes. These processes result in naturally turbid waters, particularly during monsoon and tidal surges, making it a sediment-rich source suitable for land reclamation.

During dredging, turbidity can rise sharply to 500-700 NTU or more near the dredging equipment. High turbidity will affect phytoplankton and algae, reducing primary productivity and oxygen availability. High turbidity levels will affect light penetration, which can influence photosynthetic aquatic organisms, leading to lower oxygen production and disruption of food webs.

Dredging will disturb the seabed, harming bottom-dwelling organisms. Dredging noise and water disturbance can disturb fish and dolphins, altering migration and spawning behavior. This impact may potentially reduce fish stocks, harming biodiversity and affecting local fisheries and food security.

Dredging disturbance of sediments can release contaminants into the water column, which has the potential to change the chemical properties of the sediment and reduce water quality at both extraction and dumping sites for some time after dredging has ceased. These pollutants can have a negative impact on water quality, posing risks to both aquatic marine life and human health.

Dredging will change in seabed elevation and currents, which may lead to erosion or accretion in nearby coasts. Changes in tidal and wave dynamics resulting from the modification to channel geometry and depths may also pose a risk to coastal stability and could undermine the integrity of the super dike. To prevent shoreline destabilization, the BWDB guideline of maintaining at least a 1.5 km buffer from critical coastal defenses (e.g., super dike) must be strictly followed.

The estimated duration of dredging for each phase of the NSEZ, based on the required volumes and assumed dredging capacity (continuous operation of each dredger 40,000 m³/day), has been given in Table 5-13.

Table 5-13: Phase Wise Dredging Duration

Phase	Dredging Requirements (million m ³)	Number of Dredgers	Estimated Duration (Days)	Estimated Duration (Months)	Estimated Duration (Years)
Phase 1	225.33	6	938.88	31.30	2.6
Phase 2	112.75	5	563.75	18.79	1.6
Phase 3	112.81	5	564.05	18.80	1.6

These long-term dredging activities have the potential to significantly disturb benthic habitats, marine mammals, and valuable fish resources. In particular, if dredging operations in the Sandwip Channel are not scheduled to avoid critical breeding and spawning seasons, they may adversely impact sensitive species such as Hilsha (*Tenualosa ilisha*). However, with careful project planning, phased implementation, and the application of adaptive environmental management strategies, including seasonal restrictions, sediment control measures, and continuous ecological monitoring, the overall ecological impacts can be substantially minimized in subsequent phases.

The quality of dredged material plays a critical role in determining its suitability for land reclamation. If the dredged sediments contain elevated levels of salinity, heavy metals, or organic pollutants, there is a risk of leaching into the surrounding soil and shallow groundwater. Such leachates may alter soil chemistry, reduce soil fertility, and contaminate groundwater resources. Proper testing, dewatering,

stabilization, and use of protective measures such as liners or geo-textiles are essential to mitigate potential impacts on soil structure and groundwater quality during and after filling operations.

Dredged materials may release pollutants trapped in sediments, including heavy metals and organic contaminants, into the water column. This contamination can harm dolphins, fish, invertebrates, and other marine life, impact species diversity, and potentially accumulate in the food chain, posing risks to human health.

Considering the above issues, the impact of the dredging activities on marine ecosystems is evaluated to be **Medium High**.

5.3.1.22 Ecologically Critical Areas

An Ecologically Critical Area (ECA) is an environmental protection zone in Bangladesh. As per the legal mandate, the Ministry of Environment, Forest, and Climate Change (MOEFCC) till now declared thirteen ECA areas in Bangladesh. According to the literature review, there is no ECA area located inside the EZ master plan area. Therefore, no impacts on ECAs are anticipated due to the development of EZ.

5.3.1.23 Protected Areas

According to the Wildlife (Conservation and Security) Act 2012, types of protected areas are national parks, sanctuaries, eco-parks, botanical gardens, community conservation areas, safari parks, Kunjaban, etc. According to the Bangladesh Forest Department's list of protected areas, there is no protected area located within the EZ area. Therefore, no impacts on protected areas are anticipated due to the development of EZ.

5.3.1.24 Critical Habitat Assessment

A critical habitat assessment (CHA) was undertaken as part of the ecological impact assessment to determine areas of high biodiversity value within the EZ site and the surrounding region. Based on an evaluation of the CHA within and around the EZ site coupled with the NSEZ activities, the potential environmental effects on terrestrial and marine populations of species at risk that are present will be mitigated with standard construction practices and scheduling of NSEZ components (e.g., clearing only those areas of the NSEZ footprint that are required for construction purposes). Mangroves that will be cut for the EZ and its related facilities mitigation measures will be taken by planting trees in the EZ area.

From the baseline biodiversity survey, fifteen (15) species were reported in the study region as potential trigger species for Critical Habitat (CH), including four (4) Critically Endangered (CR) and eleven (11) Endangered (EN) species according to global IUCN status. Conversely, only nine (9) species trigger the CH criterion based on their national IUCN status. The remaining six (6) species do not meet the CH criterion as their national IUCN status is Vulnerable, Near Threatened, or Least Concern. According to the assessment conducted following the ESS6 of the World Bank Environmental and Social Framework (ESF) and its Guidance Note (2018), none of the species in the study area meets the threshold limit for Criterion (a). Moreover, the species found in the study region do not qualify for CH Criteria (b) to (e) and do not fully or partially overlap with any internationally or nationally designated area.

Thus, it has been concluded that the proposed NSEZ site and study region are not a Critical Habitat for any of the identified species, because the study area does not meet any of the ESS6 of ESF, 2017, and its Guidance Note (2018) criteria during the critical habitat screening study. Hence, the NSEZ area and study area do not qualify as critical habitat areas. Even though the area isn't a designated Critical Habitat, some species found there are classified as Endangered, Vulnerable, or Near Threatened. This means they could be sensitive to disturbances from the development and operation phase of NSEZ. Activities related to the NSEZ project, like habitat alteration, noise, pollution, or increased human activity, may impact these vulnerable species. Details of the critical habitat screening have been provided in Appendix E (Vol-III).

5.3.1.25 Impacts due to Land Acquisition, Resettlement, Rehabilitation, and Speculation

The total land area of EZ is 33,805 acres. To date, BEZA has received approximately 17,000 acres of land from the Deputy Commissioner offices of Feni and Chattogram districts. The concerned DC offices are responsible for providing the land needed to develop the EZ. According to the discussion with the BEZA and review of secondary documents, most of the land was reclaimed from the sea through dredging in the Sandwip Channel. As of now, the land has been acquired, emphasizing the development of Zone 2A and Zone 2B in the Mirsharai area. The land acquisition for the development of accommodation facilities and heavy industrial zones, respectively, at Sonagazi and Sitakunda areas, is yet to be completed.

Both physical and economic displacement occurred because of land acquisition. It is anticipated that the future development of the proposed NSEZ will lead to a significant increase in physical and economic displacement. To date, approximately 76 households (135 persons) have been displaced due to land acquisition for the development of the access road, and they were mostly poor fishermen who were living on the government-owned land¹⁷. Among them, 10 households have been resettled.

In terms of economic displacement, a significant number of buffalo owners, gazers, and fishermen are displaced due to the intervention of the EZ.

Land acquisition and the provision of resettlement will be required for the new construction, expansion, and improvement of related facilities, including roads, railways, and accommodation facilities. The anticipated sources of future land acquisition and resettlement for the EZ include the following:

- **Railway:** for the development of railways, around 89 acres of land, 990 residential and commercial structures, 1,209 households, and some other assets are likely to be impacted.
- **Road Development:** the development of access roads will require land acquisition and resettlement in some respects. The following structures are the potential subjects to be considered under resettlement:
 - *Feni-Sonagazi Roads: a total of 61 residential structures, 60 commercial structures, and 16 other structures (Schools/Madrasah, Mosque, Hospital).*
 - *Sonagazi-Muhuri Road: a total of 95 residential structures and 550 commercial structures.*
 - *Muhuri Road: a total of 35 residential structures, 180 commercial structures, and 17 other structures (Schools/Madrasah, Mosque, Mondir, Graveyard, Small Mill).*
 - *Bamonsundar Road: a total of 26 HHs comprising 60 residential structures, 120 commercial structures, and 5 other structures (Schools/Madrasah, Mosque).*
 - *Barodarogarhat-Mohanagar Road: a total of 80 residential structures, 500 commercial structures, and 16 other structures (Schools/Madrasah, Mosque, Hospital).*
 - *NSEZ Saroni (north): A total of 117 HHs comprising 225 residential structures, and 2 other structures (Schools/Madrasah, Mazar).*
 - *NSEZ Saroni (south): a total of 84 HHs comprising 177 residential structures, and 3 other structures (Schools/Madrasah, Mandir).*
 - *NSEZ Saroni (main): 69 HHs were affected by the intervention of the NSEZ.*
- **Housing and Accommodation Facilities Development:** development of accommodation facilities for incoming workers and followers, service providers, etc., would further require land acquisition and resettlement. For example, the National Housing Authority (NHA) is planning for township development near EZ boundaries, and they have initially identified around 200-300 acres of open land, which is adjacent to the EZ's boundary (opposite side of the BEPZA main gate). This land is owned by the community people and will require acquisition if it is finally considered by NHA for any development.

¹⁷ <https://www.beza.gov.bd/wp-content/uploads/2020/08/Publication-of-BSMSN-14-August-2020.pdf>

A Resettlement Policy Framework (RPF) has been prepared by BEZA under the Private Investment and Digital Entrepreneurship Project (PRIDE) to guide the Resettlement Action Plans (RAP) preparation in case of land acquisition and resettlement in the EZ. It is strongly recommended to prepare a Resettlement Action Plan and Land Acquisition Plan (where required) and ensure proper compensation prior to starting construction activities. Also, proper consultation with the Project Affected Persons (PAPs) should be ensured in order to share information about entitlement, eligibility, type of compensation, and the Grievance Mechanism (GM).

To address the resettlement issue, four resettlement sites, namely RS1, RS2, RS3, and RS4, have been provided in EZ. RS1 is located in Precinct A in Char Khondakar Mouza in Sonagazi Upazila of Feni District with an approximate area of 13.19 acres of land. Whereas, both RS2 and RS3 are located in Precinct D and Precinct F in Purba Ichakhali Mouza of Mirsharai Upazila with an approximate area of 21.71 acres and 21.39 acres of land, respectively. RS4 is located in precinct B. Moreover, during the site visit, it was identified that 36 HHs had been relocated to the Bangla Bazar area of Ichakhali Union.

While land acquisition and industrialization for the National Special Economic Zone (NSEZ) has made good progress, a new issue has started to appear - land speculation. This means people are buying land not to use it, but to sell it later at a higher price.

This is pushing land prices up, especially in areas like Mirsharai and Sonagazi areas where development is planned. Many local and outside investors are buying land near proposed roads and development zones, hoping the value will rise. As per the discussion, the people living around the Mirsharai and Sonagazi areas are expecting high prices of the land. One major reason for this is the National Housing Authority's plan to build a township adjacent to the NSEZ. This has made some landowners, including those who don't live nearby, demand high prices and refuse to sell at fair rates.

The sharp rise in land prices is making resettlement much more difficult. It's harder to figure out the financial resources required for land acquisition, relocation, and the construction of replacement housing. If compensation is given based on older prices, it won't match the current market value. This can cause frustration and disputes among the affected people in Sonagazi.

The problem is even worse for poorer groups like fishermen, grazers, or people living informally. They now can't afford to buy new land, or houses close to where they lived before. If this continues, more informal settlements may grow near the NSEZ, leading to new problems for both the project and the community.

Urban planning rules, like zoning and building controls, can help stop people from buying land just to wait for profits. Clear communication with local communities is also important - people need to know what land will be needed, what compensation they can expect, and how the process will work. Finally, to discourage land hoarding, taxes or fees could be introduced for land that remains empty without development. If not effectively managed, escalating land prices and speculation will significantly hinder resettlement planning and increase associated costs. Compensation based on outdated land values - particularly in areas like Sonagazi - may lead to dissatisfaction and disputes among affected communities. These challenges could delay project implementation and jeopardize the equitable and inclusive development of the NSEZ. Considering the above issues, the impact of the development of the EZ on land acquisition, resettlement, rehabilitation, and speculation is evaluated to be **Medium High**.

5.3.1.26 Community Health, Safety, and Security

The development of EZ will have certain impacts beyond the EZ boundaries. The local communities around EZ may be affected by various health and safety issues. Due to the construction and transportation activities, local communities will be exposed to excessive dust and noise that can lead to an increase in respiratory diseases and nuisances. From the mobility of workers, sexually transmitted diseases, such as HIV/AIDS, will be the most concerning communicable diseases. The impact of increased risk of HIV includes pressure on local health systems, impact on community livelihood, and social cohesion. Diseases such as malaria, dengue, pneumonia, dysentery, hepatitis, and tuberculosis can increase due to poor sanitation.

The migrated workers may bring emerging diseases to the EZ surrounding area. If this happens, local villagers will likely be exposed to new strains of diseases. Common cold and flu, as well as respiratory tract infections caused by probably new strains, are also possible. An increase in alcoholic drinking, smoking, and substance abuse, and an increase in migrant laborers, violence, and social disturbance are expected as well.

With the influx of people in an area as a result of construction works and the introduction of equipment and various materials comes associated impacts that affect the health and safety of the communities in the EZ area. Machinery and equipment such as vibrators, graders, trucks, rollers/compactors, excavators, concrete mixers, vehicles, etc., increase traffic on the roads and increase the risks of accidents, especially in institutions such as schools near the EZ access roads.

Unsafe vehicle transport with existing road conditions can trigger vehicle accidents and injuries, particularly among young adults. Accidents may occur while transporting materials and supplies, including chemicals such as gasoline, solvents, or lubricants. These accidents will lead to the release of hazardous materials that may result in fire, explosion, and/or toxic chemical leaks into the environment.

The influx of workers and service providers into communities may increase the rate of crimes in the region and/or a perception of insecurity by the local community. Such illicit behavior or crimes can include theft, hijacking, physical assaults, substance abuse, prostitution, and human trafficking.

To ensure security in EZ, BEZA has deployed different security forces, including the Police and Ansar. Currently, 25 nos. of police have been deployed at the site. In addition, BEZA has a plan to deploy a full-scale industrial police unit where 500 active servicemen will be on duty. An accommodation facility for 300 members of the police has already been constructed. Further, the entire industrial city will be surrounded by a boundary wall to ensure more security¹⁸.

Social Cohesion Risks and Conflict Mapping

In addition to the health, safety, and security concerns described above, the NSEZ development and associated labor influx present potential social cohesion risks that could affect stability, trust, and cooperation within local communities and between host and migrant populations. These risks arise from competition over resources, livelihoods, employment, access to services, and perceived inequities, and are amplified by the scale and duration of construction and operational activities.

Conflict Mapping

Conflict mapping has been conducted to systematically identify potential sources of tension and disputes, categorize them as latent or active, and link them to the affected stakeholders. Key conflict drivers include:

Land and Resource Access: Restricted fishing zones and reduced grazing lands may trigger disputes between fishermen, buffalo owners, herders, farmers, and SEZ authorities.

Livelihood Disruption: Traditional livelihoods may be affected due to land acquisition, industrial expansion, or environmental impacts, generating economic stress among vulnerable households.

Employment Competition: The influx of migrant labor creates potential tension over access to jobs, skills development programs, and business opportunities.

Cultural and Social Friction: Differences in language, customs, social norms, and community practices between local residents and migrant workers can lead to misunderstandings or segregation.

Gender-Based Violence and SEA/SH Risks: Women, adolescent girls, and marginalized groups may face heightened risks of harassment, exploitation, or exclusion from project benefits.

¹⁸ beza.gov.bd/wp-content/uploads/2020/08/Publication-of-BSMSN-14-August-2020.pdf

Pressure on Local Services: Health, education, and sanitation services may be strained due to population growth, increasing competition and stress on local infrastructure.

Perceived Inequities or Elite Capture: Lack of transparency in decision-making, employment, and compensation processes may erode trust and create latent social conflicts.

Host-Migrant Interaction Gaps: Absence of structured dialogue channels may result in misunderstandings and reduced cooperation between communities.

Grievance Redress Needs: Inefficient or inaccessible complaint mechanisms may allow minor disputes to escalate into significant social tension.

Social Cohesion Risk Analysis

Based on the conflict mapping, the following social cohesion risks have been identified:

Economic and Livelihood Stress: Loss or disruption of fishing, grazing, and small-scale trade can exacerbate poverty, food insecurity, and household stress.

Intergroup Tensions: Friction between host communities and migrant labor may arise over employment, housing, and access to services.

Vulnerability of Women and Marginalized Groups: Increased exposure to GBV/SEA/SH and limited access to livelihood opportunities.

Competition over Shared Resources: Limited access to water, grazing land, and natural resources may cause inter-household or community disputes.

Service Overload: Strain on local health, education, and utility services may increase dissatisfaction and potential conflict.

Perceived Inequity: Lack of transparency or exclusion from decision-making and project benefits may generate distrust and latent conflict.

To proactively address these risks relating with social cohesion and conflict, NSEZ has established a comprehensive set of mitigation measures. Short-, medium-, and long-term livelihood restoration programs ensure continuity of income for fishing and livestock-dependent households, providing alternative access points, designated grazing areas, skill development opportunities, and enterprise support. Local hiring is prioritized within the SEZ and tenant companies, reinforced by vocational and factory-based training programs to ensure that local communities benefit directly from emerging employment opportunities.

Transparency and equity are central to the project's social safeguard approach. All compensation, access to employment, and participation in project-related programs are conducted openly and fairly, supported by participatory consultations with community members. To protect women and marginalized groups, NSEZ has implemented a GBV/SEA-SH Action Plan, including awareness campaigns, safe reporting channels, rapid response mechanisms, and women-focused skills and economic programs.

In addition, community engagement platforms have been established to foster dialogue, resolve disputes proactively, and strengthen social cohesion. These interventions are complemented by the broader health, safety, and security measures addressing traffic safety, machinery operation, dust, noise, communicable diseases, and community policing.

Together, these initiatives form an integrated framework that not only mitigates community and security risks but also promotes sustainable, equitable development, reinforces community trust, and ensures that the benefits of NSEZ are shared inclusively across all affected populations.

Considering the above issues, the impact of the development of the EZ on community health, safety, and security is evaluated to be **Medium High**.

5.3.1.27 Occupational Health, Safety, and Security

During the development of EZ, accidents and injuries will be notable for workers, especially among untrained workers. A wide range of injuries may be found from minor or medical aid required only to serious cases, disabling injuries, and/or death. Faulty electrical devices, blunt injuries, cut wounds, falling, as well as eye irritation and burns are common; however, broken limbs, trauma, and or serious injuries can also occur. Besides, an increased number of traffic accidents can be expected. The risks and impacts on health and safety are increased if contractors and employees do not adhere to the administration of the Personal Protection Equipment (PPE) relative to their respective scope of work and are not equipped with relevant training in occupational health and safety procedures.

Potential respiratory diseases may be aggravated due to pollutant exposure in the workplace, such as dust, exhaust gas, chemicals, or solvents. Underlying chronic diseases such as asthma, allergy, peptic ulcer, or mental disorder, can be exacerbated by exposure to hazardous/chemical wastes. Moreover, noise, vibration, and workplace temperature are likely to be expected. Workers will experience new jobs, hard work, and an unfamiliar environment. Hence, they may encounter stress, anxiety, and hypertension. Being away from home, workers easily turn to drinking more alcoholic beverages, smoking, and/or substance abuse.

Moreover, unhygienic habits, poor personal hygiene, and environmental sanitation may increase diarrhea, hepatitis, and communicable diseases. Malaria and dengue fever, and local diseases from the affected area can be easily spread. Sexually transmitted diseases and HIV/AIDS are also expected and need to be seriously concerned to designate prevention and control measures.

Fire may occur from the ignition of flammable materials or other reactive chemicals, which can lead to accidents and injuries as well as loss of property. The project owners should always provide a first-aid unit in the working area. Qualified first-aid units should also be established to ensure that they can properly handle serious or trauma cases. Patients should be taken care of and transferred to appropriate medical facilities in time.

Considering the above issues, the impact of the development of EZ on occupational health and safety is evaluated to be **Medium High**.

5.3.1.28 Labor Influx

Labor influx is accompanied by follower populations, including traders, informal service providers, food vendors, and other support workers, who establish secondary settlements and informal economic activities near worker housing or NSEZ facilities.

Labor influx will be triggered due to the EZ development attracting various categories of workers from local, regional, national, and international markets. There are, within the local population, high expectations of getting employed by the NSEZ. During the stakeholder consultation, the issues raised were related to employment opportunities.

According to the Masterplan and available assessments, approximately 1.4 million employments are expected to be created in the NSEZ by 2040. It is assumed that 40% as single employees and 60% living with their families, based on an average family size of four people (three dependents per family). These assumptions form the basis for phase-wise population projections aligned with the NSEZ development stages.

Phase 1 (Years 1–5; up to 2025): In the initial development stage, corresponding to early construction and infrastructure setup, 0.7 million employees are projected to be engaged in the NSEZ. Of these, .28 million will be single employees and 0.42 million will be employees living with families, generating approximately 1.26 million dependents. The total resident population during Phase 1 is therefore projected at about 1.96 million people. This phase will involve temporary worker accommodation, the emergence of informal settlements near construction sites, and the initial provision of community services to support workers and their families.

Phase 2 (Years 6–10; up to 2040): As construction expands and industrial operations commence, the number of employees residing within NSEZ is expected to increase to 1.05 million, with 0.42 million single employees and 0.63 million employees living with families, generating nearly 1.89 million dependents. The total population in Phase 2 will therefore be approximately 2.94 million people. During this stage, semi-permanent housing, schools, healthcare centers, marketplaces, and other community facilities will develop further to meet the growing demands of workers and their families. Infrastructure expansion, including utilities, transport, and social services, will support the integration of these early communities.

Phase 3 (Years 11–20; by 2040): In the full development and operational stage, 1.4 million employees are expected to reside in the region. Of these, 0.56 million will be single employees and 0.84 million will live with their families, generating approximately 2.52 million dependents. The total resident population by Phase 3 will therefore reach nearly 3.92 million people. By this stage, NSEZ is projected to function as a fully integrated industrial city with established residential zones, commercial hubs, and comprehensive social infrastructure. Follower populations, including informal traders and service providers, will be fully integrated into the local economy, contributing to the emergence of vibrant urban settlements.

These projections highlight that the majority of the NSEZ population will consist of dependents rather than direct employees, emphasizing the critical need for planning housing, schools, healthcare, recreation, and transportation alongside industrial development. The phased growth trajectory provides a clear basis for designing infrastructure and social services to accommodate the evolving demographic and economic landscape of the NSEZ. The development stage will involve the labor of unskilled (general labor, security, cleaning services), semi-skilled (machine operators, assemblers, maintenance personnel), skilled, and highly skilled (technicians, engineers, supervisors, administrative staff) types. Considering the dynamics of the development in both on and off-site infrastructure, several types of construction workers will be housed near the NSEZ, such as building construction, road construction, embankment construction, railway construction, gas pipeline installation, electric line installation, dredging, and khal re-excavation, transportation workers, etc. From the stakeholder consultation, it was revealed that approximately 10,000 to 12,000 laborers have already been engaged in different construction works across the NSEZ. Construction activities could continue even after the NSEZ enters its operation phase. Moreover, according to the phasing in the NSEZ's master plan, different construction works will be required at different phases, while many industries will be in operation at the same time.

As per the consultation findings, currently, a majority of the workers are residing in the EZ surrounding communities like Abu Torab Bazar, Boro Takia, Mirsharai, and other nearby areas. While the construction works offer employment opportunities for local skilled and unskilled laborers along with outsider workers, the influx of outsiders is likely to have some negative impacts, such as conflicts between construction workers and local communities due to differences in lifestyle, habits, customs, culture, employment, and income.

A major risk is the shortage of affordable and adequate housing. The rapid arrival of workers and their followers may lead to the emergence of informal settlements or slums that lack basic infrastructure such as clean water, sanitation, electricity, drainage, and waste management. These living conditions can pose serious public health risks, including the spread of waterborne diseases and poor hygiene conditions.

This significant labor influx will place considerable pressure on the region's already limited public services and environmental resources. One of the most immediate concerns is the strain on the local education system. As migrant families settle in the surrounding areas, the sudden rise in school-aged children will overwhelm existing educational infrastructure, leading to overcrowded classrooms, shortages of trained teachers, and inadequate learning materials. This could diminish the quality of education and create tensions between host and migrant communities competing for limited spaces.

Similarly, healthcare facilities will face considerable demand beyond their existing capacity. The increase in population density, especially in informal labor settlements, will heighten the risk of communicable diseases such as respiratory infections, tuberculosis, diarrheal diseases, and sexually transmitted infections (including HIV/AIDS). The local health system, often under-resourced and lacking in emergency response preparedness, may be unable to cope with the increased burden, especially during public health emergencies or industrial accidents.

Water supply, sanitation, and waste management systems are also expected to come under severe stress. Most informal settlements established by incoming workers are likely to lack access to safe drinking water, proper toilets, and regulated waste disposal systems. This could lead to contamination of local water bodies, the spread of vector-borne and waterborne diseases, and general environmental degradation. Open defecation, poor hygiene, and uncollected solid waste will pose serious public health hazards, particularly in densely populated and unplanned areas.

The influx will also increase demand for public transport, local markets, and recreational spaces. Without proper urban and service planning, this may lead to congestion, unsafe pedestrian environments, and overburdened public infrastructure. Furthermore, the sudden demographic shift could disrupt local social dynamics, strain existing social cohesion, and potentially increase incidents of crime, gender-based violence, and tension between host and migrant populations, particularly in areas lacking adequate law enforcement and community safety mechanisms.

The presence of a predominantly male workforce may increase the risk of gender-based violence (GBV), harassment, and exploitation, particularly in informal settlements or poorly managed worker camps. Women and vulnerable groups in host communities may be disproportionately affected if proper safeguards and awareness programs are not in place.

Inadequate regulation of labor recruitment can result in informal or undocumented employment. This includes risks of child labor, poor working conditions, unfair wages, and a lack of grievance redress mechanisms. There is also the risk of labor exploitation, human trafficking, and the use of unregulated third-party brokers.

Security and law enforcement may also be challenged by increased population density and unplanned settlements. There is potential for increased petty crimes, substance abuse, and other illegal activities, which can damage community relations and create long-term safety concerns.

Additionally, without proper planning, pressure on environmental resources may increase. Settlements built in ecologically sensitive areas may lead to deforestation, pollution, and encroachment on public land, undermining environmental sustainability.

During the development phase of the NSEZ, several environmental risks are anticipated due to increased population, industrial activity, and rapid land use changes. A significant concern is the depletion of natural resources, as the influx of workers and construction demands will sharply increase the consumption of water, fuelwood, aggregates, and other raw materials. This over-extraction could strain local supplies, reduce resource availability for communities, and cause irreversible damage to local ecosystems.

Another critical issue is the generation of solid and liquid waste, both from temporary worker settlements and initial industrial or commercial operations. If waste management systems are not adequately scaled, this could lead to uncontrolled dumping, soil and water contamination, air pollution from open burning, and broader public health risks.

Furthermore, the increased volume of vehicle and pedestrian traffic, including heavy trucks transporting construction materials and equipment, is expected to overwhelm existing road infrastructure. This not only increases the risk of traffic congestion and road accidents but also contributes to air and noise pollution in nearby communities. To address these challenges, NSEZ has developed a phase-wise Labor Influx Management Plan, aligned with World Bank ESS2 and ESS4, integrating spatial planning, service projections, and timelines. Some services have already been implemented, while others will be

rolled out according to the phased plan to ensure orderly workforce migration and minimize social and health risks.

Table 5-14: Phase-wise Labor Influx Plan: Timelines, Spatial Planning, and Service Projections

Phase & Years	Workforce & Migration Features	Spatial Planning / Key Locations	Service Projections / Planned Actions	Expected Outcomes
Phase 1 (Years 1–5; up to 2025)	Initial construction workforce; temporary workers; early family relocation	Temporary housing within and near EZ; priority sites for early township development	Basic water, sanitation, drainage, and healthcare; registration of early service providers and vendors; hygiene & occupational safety awareness; some housing and clinics already implemented	Reduced health risks; organized temporary settlements; minimized social tension
Phase 2 (Years 6–10; up to 2030)	Expanded workforce, family relocation, secondary migration; contractors' labor influx	Phased township expansion; designated commercial areas; integration with EZ access roads	Operational schools, vocational institutes, hospitals; structured vendor zones; host–migrant forums; contractor labor oversight; additional housing and sanitation facilities to be developed	Stable living conditions; equitable access to services; regulated settlements; improved social cohesion
Phase 3 (Years 11–20; up to 2040)	Long-term settlement of workforce and families; full integration	Fully developed townships; expansion of community services; permanent commercial areas	Full operation of education, healthcare, sanitation, and social services; formalized local and migrant businesses; continuous grievance and GBV/SEA-SH monitoring; remaining facilities completed	Sustainable, inclusive communities; resilient infrastructure; social stability; equitable service access

Considering the above issues, the impact of the development of the NSEZ on labor influx is evaluated to be **Medium High**.

5.3.1.29 Child Labor, Forced Labor, and Bonded Labor

The development of the National Special Economic Zone (NSEZ) is expected to attract a substantial labour demand, including both local residents and migrant laborers from other regions or even neighboring countries. This surge in labor demand will primarily be driven by the need for large-scale civil works, infrastructure installation, logistics, and service provisioning in the initial development stages. Several interconnected sources of impact could give rise to child labor, forced labor, and bonded labor within this context.

First, the urgent and high-volume hiring needs may push contractors and subcontractors to rely on informal labor supply chains, including unregistered brokers or middlemen, many of whom operate without regulatory oversight. These brokers often recruit workers without verifying their identity, age, or employment eligibility, making it possible for children below the legal working age or individuals vulnerable to coercion to be employed. Lack of stringent verification mechanisms and gaps in the monitoring of supply chain labor increase the risk that underage or trafficked individuals may be included in the workforce.

Second, economic vulnerability and poverty among certain local and migrant populations can act as a strong push factor. Families in economic hardship may encourage their children to work in low-skill, informal roles within the NSEZ (e.g., in canteens, housekeeping, waste sorting, or support services), especially when school access is limited or when there is a perceived opportunity for quick income. In parallel, migrant laborers, particularly those without legal documentation, may be exposed to exploitative conditions, such as delayed or withheld wages, excessive working hours, lack of freedom to leave the job, or the confiscation of personal documents, which are characteristics of forced labor.

Additionally, the potential use of bonded labor schemes is a key concern, particularly where recruitment is facilitated through advanced wage payments or debts incurred during job placement. Migrants or poor rural workers may agree to unfair terms due to their limited bargaining power and understanding of their rights, thereby entering debt bondage relationships with recruiters or employers. These arrangements may be reinforced by cultural, economic, or social pressures, especially where employment opportunities are scarce and workers are isolated from support networks.

The complex and multilayered nature of construction and service supply chains in the NSEZ ranging from large contractors to small local subcontractors-increases the difficulty of tracking labor conditions across tiers. Without robust oversight, these dynamics can foster an environment where exploitative practices remain hidden and unchecked. Furthermore, the lack of worker voice, union representation, and formal grievance mechanisms heightens the risk that victims of abuse or exploitation cannot seek redress or report violations.

Considering the above issues, the impact of the development of the EZ on child labor and forced labor is evaluated to be **Medium High**.

5.3.1.30 Gender Based Violence, Sexual Harassment, and Abuse/Sexual Harassment

The development and construction of the National Special Economic Zone (NSEZ) are expected to span several years through phased implementation, continuing up to 2040. This will require the engagement of a large, predominantly male construction workforce, many of whom will be recruited from outside the local region. The long-term and large-scale presence of these workers, many residing temporarily in worker camps or rented accommodations, introduces significant risks to their safety and well.

The arrival of hundreds or thousands of male laborers disrupts the demographic balance in local communities. These men, often separated from families and community accountability structures, may engage in inappropriate behavior such as catcalling, stalking, or unsolicited approaches. This shift creates a volatile context where GBV, SEA, and SH may arise in host communities-particularly women, adolescent girls, and other vulnerable groups.

Workers disconnected from their home environments may feel less bound by social norms. In the absence of strict codes of conduct and behavioral training, risks of misconduct increase. Informal and unregulated after-hours interactions in markets, tea stalls, or leisure spaces heighten the risk of verbal, physical, or psychological harassment.

Local women and girls, especially those from poor or female-headed households, may be at risk of exploitation. They might be lured into transactional sex due to economic need or coerced into relationships with promises of money, gifts, or employment.

Host communities may lack functioning grievance mechanisms, legal protections, or survivor support services. Survivors may fear social stigma, retaliation, or disbelief, leading to underreporting and continued abuse.

Unprotected or exploitative sexual encounters may result in sexually transmitted infections (STIs), including HIV/AIDS, and unwanted pregnancies, especially among adolescents.

In extreme cases, the demand for commercial sex work in male-dominated construction zones can lead to trafficking or forced involvement of women and adolescent girls in sex work. This typically occurs in areas where law enforcement is weak and economic desperation pushes families or individuals into exploitative arrangements. Such situations are often hidden but represent some of the most severe forms of SEA associated with large infrastructure projects.

To prevent and minimize the risks of Gender-Based Violence (GBV), Sexual Exploitation and Abuse (SEA), and Sexual Harassment (SH) in the NSEZ, a comprehensive SEA/SH Action Plan has been developed. This plan will be implemented throughout all phases of the NSEZ development, from Phase 1 (Years 1–5) through Phase 3 (Years 11–20), to address risks associated with labor influx and industrial activities.

The Action Plan includes mandatory Codes of Conduct and Behavioral Training for all workers, integrated into employment contracts, to ensure zero tolerance for GBV, SEA, and SH. Safe spaces and support services will be established, providing confidential psychosocial support and referral to medical and legal services for survivors. A Confidential Grievance Redress Mechanism (GRM) will operate through multiple channels, including hotlines, suggestion boxes, and digital platforms, ensuring anonymity and timely response. Regular monitoring, reporting, and liaison with local authorities will support adaptive management and strengthen protection networks.

A Community Awareness Strategy will complement these measures, aiming to empower host communities and workers. This includes public campaigns, workshops, and training sessions on GBV, SEA, and SH risks, rights, and reporting procedures. Local institutions such as schools, religious centers, and youth groups will act as multipliers for awareness messages. Digital channels and confidential hotlines will facilitate anonymous reporting and communication.

The Confidential GRM will ensure safe, accessible, and trusted mechanisms for complaints and follow-up. It will be managed by the NSEZ Social Safeguard Department, which will maintain confidentiality, provide referrals to health, legal, and psychosocial services, and regularly monitor and report anonymized outcomes to ensure effectiveness. These measures collectively aim to create a safer, more equitable environment for both the workforce and the host communities during the NSEZ development.

Considering the above issues, the impact of the development of the EZ on gender-based violence and sexual exploitation and abuse/sexual harassment is evaluated to be **Medium Low**.

5.3.1.31 Violence Against Children

Violence against children is defined as physical, sexual, emotional, and/or psychological harm, neglect, or negligent treatment of minor children (i.e., under the age of 18), including exposure to such harm that results in actual or potential harm to the child's health, survival, development, or dignity in the context of a relationship of responsibility, trust, or power. This includes using children for profit, labor, sexual gratification, or some other personal or financial advantage. This also includes other activities such as

using computers, mobile phones, video, digital cameras, or any other medium to exploit or harass children or to access child pornography.

To reduce construction costs, child labor can be used for some jobs that do not require high qualifications. Due to limited knowledge, children can suffer from labor abuse that will affect their psychological health and ability to learn.

Considering the above issues, the impact of the development of the EZ on violence against children is evaluated to be **Medium Low**.

5.3.1.32 Impact on Social Infrastructures

The presence of construction workers and their followers will generate additional demand for the provision of public services such as healthcare/medical services, education, transport, housing and sanitation, waste management, and social services. This demand for services will require a significant number of service providers. The local people in the host community will face more or less changes and inconveniences in various aspects of their life, for example, the increase in users for the existing social infrastructures/services such as schools, health care centers, roads, etc. Therefore, it needs to be considered and planned the expansion of capacity and the improvement of specification in advance. In this case, EZ will consider planning the arrangement of necessary public facilities according to the expected demand of future users.

According to the stakeholder consultation, the existing social infrastructures/services in the EZ surrounding area are absolutely insufficient and barely up to the mark while the social infrastructure that EZ is expected to develop through other government departments will benefit the local citizens a great deal. Roads and public transport exist, but they need a lot of improvement.

Healthcare/Medical Services

From the recent information, it was identified that there are a few basic health units and hospitals functioning in the area. Besides, there are no emergency hospitals in Mirsharai, Sitakunda, and Sonagazi Upazila. As per the Population and Housing Census, 2011, the existing available healthcare facilities, including health personnel in the EZ region, are given in Table 5-15.

Table 5-15: Number of Government Health Complex and Health Personnel

Upazila	Number of Beds	Number of Doctors	Number of Nurses	Number of Technicians	Number of Other Staff
Mirsharai	50	26	9	2	186
Sitakunda	31	23	7	4	54
Sonagazi	31	7	5	1	158
Total	112	56	21	7	398

Source: Population and Housing Census, 2011

A list of union-level health centers¹⁹ in the EZ region has been given below:

Mirsharai Upazila: there are 18 centers in Mirsharai Upazila including Zorawarganj Sadar Clinic, Khaiyachhara Union Health & Family Welfare Centre (UHFWC), Hinguli UHFWC, Ichhakhali UHFWC, Karerhat UHFWC, Katachhara UHFWC, Durapur UHFWC, Maghadia UHFWC, Mayani UHFWC, Mirsharai UHFWC, Mithanala UHFWC, Saherkhali UHFWC, Osmanpur UHFWC, Dhum UHFWC, Wahedpur Rural Dispensary, Joralgoanj maternal and child health - family planning Unit, Kumarlihat Mother & Child Welfare Centre, and Mirsharai Mother & Child Welfare Centre.

¹⁹ https://www.dgfpmis.org/ss/others8/facility_name.php

Sitakunda Upazila: there are 9 centers in Sitakunda Upazila, including Sitakunda Sadar Clinic, Banshbaria UHFWC, Bariadyala UHFWC, Muradpur UHFWC, Saidpur UHFWC, Salimpur UHFWC, Sonaichhari UHFWC, Barakunda UHFWC, and Kumira Rural Dispensary, and Bhatiari Others.

Sonagazi Upazila: there are 10 centers in Sonagazi Upazila, including Dagonbhuiyan Sadar Clinic, Dagonbhuiyan UHFWC, Jailashkara UHFWC, Purba Chandrapur UHFWC, Matubhuiyan UHFWC, Rajapur UHFWC, Ramnagar UHFWC, Sindurpur UHFWC, Yakubpur UHFWC, & Fazilerghat UHFWC.

Local healthcare services and healthcare personnel, in quantitative and potential dimensions, are quite limited at present. However, injuries and illnesses will increase in the future in terms of quantity and complexity. The wide range of injuries and disabilities will create an excessive burden on the existing health services. Death and serious injuries from accidents will be increased in the region. Moreover, the complexity of illness from long-term and multiple exposures to health hazards is expected. Consequently, an effective health surveillance system needs to be established within the EZ.

During the stakeholder consultation, the following health institutions' establishment proposals were raised by the participants.

Type of Medical Institution Proposed	Proposed Location
Medical College Hospital	Mirsharai
	Sitakunda
	Sonagazi
Hospital/Medical Center/Facility	Mirsharai
	Sitakunda
	Sonagazi
Upgradation of Existing Facilities (e.g., Community Clinics, Upazila Health Complex, Clinics)	Mirsharai
	Sitakunda
	Sonagazi

Regarding the significant number of workers in the EZ, a hospital/healthcare facility located in the project township should be established. This newly established healthcare facility should be a comprehensive one, in terms of adequacy, capability, and accessibility, since, at present, public health facilities and services provided by local authorities are quite limited.

Education

Existing available educational institutes in the EZ region have been given in Table 5-16.

Table 5-16: List of Educational Institutes

Type of Educational Institutions	Mirsharai	Sitakunda	Sonagazi	Total
Government primary school	145	73	76	294
Registered primary school	38	22	24	84
Private (non-registered) primary school	2	3	1	6
Kindergarten school	12	54	20	86
NGO Schools	16	5	0	21
Madrasa (under Madrasah Board)	16	14	14	44
Kawmi madrasah	20	3	6	29
Ebtedayee madrasah	12	15	3	30

Type of Educational Institutions	Mirsharai	Sitakunda	Sonagazi	Total
Government secondary school	0	1	0	1
Non-government secondary school	46	27	17	90
School and college operating jointly	0	2	0	2
Government College	0	1	1	2
Non-government College	6	5	1	12
Technical and vocational institution	0	0	0	0

Source: Population and Housing Census, 2011

There are three vocational educational institutes and courses have been found in the concerned upazilas are listed in Table 5-17.

Table 5-17: List of Schools with Vocational Courses

Upazila	Name of School	Vocational Courses
Mirsharai	Maghadia N.A.C. High School	Refrigeration and Air-conditioning
Sitakunda	Zafar Nagar Aparna Charan High School	General Electrical Works
Sonagazi	Amirabad B.C Laha High School	Refrigeration and Air-conditioning

Source: sesip.gov.bd²⁰

There are many nearby educational institutes (primary and high schools) in the surroundings of the EZ. These are:

- **High Schools:** Maghadia Orphanage Nurul Absar Chow. High School, Shaher Khali High School, Mirsharai Girls High School, Mirsharai Pilot High School, Zhulon Pol Beni Madhab High School, Zorwargonj Model High School, Abutorab High School, Mithanala Ramdayal High School, Mithachara High School, Aburhat High School, and Bamon Sundor Fakir Ahmed High School.
- **Primary Schools:** Mithachara Government Primary School, Mithanala Government Primary School, Mithanala Sufia Government Primary School, Abu Torab Government Primary School, Shaherkhali Jamal Shafi Government Primary School, Magadia Anzumer Government Primary School, Ichakhali Government Primary School, Ichakhali Sufia Government Primary School, Char Shorot Government Primary School, and Aburhat Government Primary School.

In addition, two textile engineering colleges, namely Textile Engineering College at Zorargonj (CTEC) and Professor Kamal Uddin Chowdhury College, have been founded in Mirsharai Upazila.

During the stakeholder consultation, the following educational institution's establishment proposals were raised by the participants.

Type of Educational Institution Proposed	Proposed Location
Primary School and Kindergarten	Mirsharai
	Sitakunda
	Sonagazi
High School	Mirsharai
	Sitakunda

²⁰ https://sesip.gov.bd/wp-content/uploads/2020/08/Vocational-Database-for-Student-Data-for-BTEB_23_07_2020.pdf

Type of Educational Institution Proposed	Proposed Location
Degree College	Sonagazi
	Mirsharai
	Sitakunda
	Sonagazi
University	Mirsharai
	Sitakunda
	Sonagazi
Technical Institute/Engineering College	Mirsharai
	Sitakunda
	Sonagazi
Upgradation of Existing Institutes	Mirsharai
	Sitakunda
	Sonagazi

The supply and quality of human resources in the EZ region are not commensurate with what is required in EZ by and large, human resources in the project region are not trained and capable enough to operate modern technological machinery. This is one of the major challenges that the GOB and BEZA need to address to benefit from the employment opportunities presented by EZ. The establishment of new technical and vocational training institutes and the upgrade/upscaling of existing institutes is a critical pre-requisite to meet the requirements of technically trained human resources for industries being set up in EZ, as well as associated businesses in the region.

EZ has the potential to transform positively the lives of women in the region. A significant portion of the local population comprises women who are currently unable to contribute to the national economy because of cultural constraints and a lack of income-generating opportunities. The GOB via BEZA can categorically focus on the engagement of women in businesses that are directly and indirectly generated by EZ. Tax reliefs for industries that employ women, schools for children of employees working EZ, housing facilities in the vicinity, and healthcare insurance are facilities that would encourage native women to engage in income-generating activities. In addition, the GOB could also consider the allocation of reserved seats and incentives such as fully funded scholarships for women in technical and vocational institutes.

Transportation/Roads

During the construction phase, the transportation of huge quantities of construction material (quarry material, gravel, stone, aggregate, sand, bricks, cement, steel, bitumen, paint bricks, etc.) for the EZ development results in the use of public infrastructure like roads, which in turn results in an extra burden on the existing infrastructure. The current road condition in the EZ region is not adequate to support additional traffic volume due to the implementation of the EZ.

According to the master plan of the EZ, the anticipated movement pattern of passenger and freight, Dhaka - Chattogram Highway (N1), and Feni - Sonagazi Road are likely to assume greater importance, especially for predominant north-south movement. The connecting roads are proposed mainly from Dhaka-Chattogram Road and can be listed as follows:

- Muhuri Project Road (Zorarganj - Muhuri Project)
- Bamonsundar Road
- NSEZ Saroni

- Mohan Nagar Barodarogarhat Road

These roads will be developed in different phases of EZ. In addition, EZ is quite likely to be connected with the Dhaka-Chattogram Highway via internal road networks however passenger transportation in the whole region needs to be improved on a priority basis. From the stakeholder consultation, the road development proposals that have been raised by the participants are provided in Appendix I (Vol. III).

Housing and Sanitation

Currently, there is a lack of adequate accommodation for the construction workforce in the EZ. Due to the increasing number of workers and also the growth of other supporting industries and surrounding areas, numerous accommodations are being constructed outside the EZ. This is creating pressure on public health services, public health facilities, and sanitation. Currently, the public health services provided by local authorities are rather limited. Improper management of sewage, wastewater, and solid waste may generate sources of diseases. Therefore, township development for the workers is very crucial to facilitate the workers living close to the EZ.

Due to the increasing demand for accommodations, local people are developing infrastructures in an unplanned way without considering drainage and road networks. It will create long-term flooding/waterlogging and traffic congestion in the region.

The development of NSEZ, along with the influx of workers and supporting industries, generates substantial demand for social infrastructure, including healthcare, education, transport, housing, sanitation, and community services. To address these needs, NSEZ, in collaboration with relevant ministries, agencies, and local authorities, has developed a phased Infrastructure Readiness Plan: Phase 1 (Years 1–5; up to 2025), Phase 2 (Years 6–10; up to 2030), and Phase 3 (Years 11–20; up to 2040).

All planned infrastructure is being designed and constructed in accordance with national standards and international best practices, ensuring universal access for all, including women, children, the elderly, and persons with disabilities. While some components have already been implemented, others will be developed progressively according to the phase-wise schedule. This phased and collaborative approach ensures that infrastructure provision keeps pace with workforce growth, industrial expansion, and community needs, while minimizing social tension, service overload, and health and safety risks.

Table-5-18 depicts the NSEZ Phase-wise Infrastructure Readiness Plan with collaborative agencies/Partners.

Table-5-18: NSEZ Infrastructure Readiness Plan – Phase-wise (Collaborative Implementation)

Sector	Planned Infrastructure	Proposed Location	Phase 1 (Years 1–5; up to 2025)	Phase 2 (Years 6–10; up to 2030)	Phase 3 (Years 11–20; up to 2040)	Collaborative Agencies / Partners	Expected Benefits / Service Projection
Healthcare	Medical College Hospital, Hospital/Medical Centers, Upgradation of Clinics	Mirsharai, Sitakunda, Sonagazi	Feasibility, land acquisition, initial construction of priority facilities	Completion and operationalization of hospitals and clinics; recruit personnel	Full-scale operation of medical colleges, hospitals integrated with EZ health	Ministry of Health and Family Welfare, local health authorities	Adequate capacity to handle injuries, occupational hazards, communicable diseases; reduces burden on

Sector	Planned Infrastructure	Proposed Location	Phase 1 (Years 1–5; up to 2025)	Phase 2 (Years 6–10; up to 2030)	Phase 3 (Years 11–20; up to 2040)	Collaborative Agencies / Partners	Expected Benefits / Service Projection
					surveillance		local facilities
Education	Primary, Secondary, Degree Colleges, Universities, Technical & Vocational Institutes	Mirsharai, Sitakunda, Sonagazi	Planning and design of new schools, vocational institutes; initial upgrades	Construction and partial operationalization of schools, vocational institutes; scholarships for women	Full operation of universities, technical colleges; aligned with industrial workforce needs	Ministry of Education, Technical Education Board, NGOs	Equitable access to education; technically skilled workforce; enhanced women participation
Transport / Roads	Highway upgrades, internal EZ roads, key access roads	EZ surrounding areas	Road surveys, priority patching, safety improvements	Phased widening, bridge construction, traffic management	Full internal and connecting road network; efficient freight & passenger movement	LGED, RHD, BRTC	Reduced accidents and congestion; improved connectivity and safety
Housing / Township	Planned worker townships, accommodations, drainage, sanitation	Within and near EZ	Site selection, township layout, water & sanitation design	Phased construction of housing and essential services	Full township development with complete facilities	National Housing Authority (NHA), local authorities	Reduced unplanned settlements; safe living conditions for workers; minimized health risks
Sanitation & Waste Management	Sewage, wastewater treatment, solid waste systems	EZ township and surrounding areas	Baseline assessment, system design	Installation of initial sanitation and waste management systems	Full-scale operation integrated with township	Local government, city corporations	Prevents flooding, waterlogging, disease spread; ensures hygiene for workers

Sector	Planned Infrastructure	Proposed Location	Phase 1 (Years 1–5; up to 2025)	Phase 2 (Years 6–10; up to 2030)	Phase 3 (Years 11–20; up to 2040)	Collaborative Agencies / Partners	Expected Benefits / Service Projection
							and community
Community & Social Services	Multipurpose centers, women's training, cultural facilities	EZ and host communities	Needs assessment, planning of facilities	Construction and partial operationalization	Full operation with integrated community services	EZ Authority, relevant ministries, NGOs	Strengthened social cohesion; equitable service access; enhanced community resilience

Considering the above issues, the impact of the development of the EZ on social infrastructures is evaluated to be **Medium High**.

5.3.1.33 Impacts on Fishermen's Livelihood and Fishery Activity

The livelihoods of the people in Mirsharai, Sitakunda, and Sonagazi Upazilas are mainly farming, fishing, livestock grazing, small business, day laboring, service, etc. During the development of the EZ, the impact on the living and livelihoods of the fishermen and land-dependent communities will arise due to the construction activities. According to the consultation with stakeholders, there are 2,557,800 and 6,000 registered fishermen in Mirsharai, Sonagazi, and Sitakunda Upazila, respectively. In addition, there are unregistered/seasonal fishing activities in the study region, and a mentionable number of fishermen are engaged. Three types of fishing are practiced within the study region, which are freshwater aquaculture (extensive, semi-intensive), fishing in rivers, estuaries, and adjacent khals, and fishing in the Bay of Bengal/Sandwip Channel.

Disruption and loss of livelihoods related to the fishing industry are a concern expressed by the local community during stakeholder consultation meetings. The fish industry-related livelihoods, including fishing boat owners, fish vendors, day laborers of fish landing stations, mechanics, fuel suppliers, boat building and repair, net and fish trap manufacture and repair, marketing and transportation, etc., will also be impacted. The extent of the impact associated with the disruption of livelihoods has already been observed in the Jaladash community, who are the artisanal fishermen communities of the area of Domkhali, Saherkhali, Joynagar, Mirzanagar, Mogadia (Bodulla Para Mozumdar Hat), 6 No. Ichakhali (Boro Darogar Hat Jaladash Para, Char Khandoker). The fishing community has also experienced a reduction in fish catching due to the dredging activities in the Sandwip Channel for EZ partial land development and increasing marine traffic. To date, approximately 7,000 acres of land have already been filed, and approximately 346.67 million cubic meters of soil will be required for land development purposes. Therefore, the dredging activities in the Sandwip Channel for phase-by-phase land development will also impact the fisherman community. Previously, one fishing boat could catch fish from 40 kg to 100 kg per visit, and this rate started reducing since 2018 from 5 kg to 40 kg per visit. The increasing marine traffic in the Sandwip Channel is damaging the fishing nets, which is creating extra economic pressure on the fishing community. The community's perception is that the EZ will adversely impact fish through hazardous discharges into the sea. The majority of the fishermen in the region employ traditional techniques that have limited their capacity to fish in deep seas. An expressed concern was that project activities would destroy the current fishing area in Sandwip Channel and result in the

migration of fish to the deep sea. Therefore, the impacts on livelihood and income generation are expected to be permanent in duration for the fishing community.

The fish landing stations/ghats/boat parking areas, i.e., Saherkhali, Domkhali, Muhuri, Bamonsundor, and Ichakhali Ghat already been impacted. All these fish landing stations are being relocated to places that are 2-3 km distance from the Jaladash/fishermen community. Now, they are facing difficulties in accessing the fish landing site/boat parking site due to relocation. In addition, the khals, i.e., Ichakhali, Bamon Sundar, Saherkhali, Domkhali, Daborkhali, Khutakhali, Hoania, Donakhali, etc., were previously used by the fishermen to access the Sandwip Channel as well as used as a shelter during Cyclones. However, the construction of super-dyke and sluice gates along the Sandwip Channel has restricted the free movement of fishermen to access the fishing sites, as well as losing the shelters for Cyclones. The fishermen have parked their fishing boats outside of the Super Dyke, and the boats were damaged by the cyclone-associated severe wave action.

Due to the restriction on the EZ site and the Sandwip Channel will lose fisherman employment, as they are not skilled laborers to relocate them to other jobs. Fishermen mostly lack an institutional education background, so they cannot get high-ranking jobs in EZ; they can work only as casual laborers. The situation will lead to the worsening of their socioeconomic condition. Therefore, in addition to suitable financial compensation, the impacted fishermen and allied workers should be given preference in employment by the EZ or in the business units in the EZ. There should be a provision for their subsequent absorption of employment in different industries in the EZ.

Women, who are heavily involved in post-harvest activities like fish cleaning, drying, and selling, face additional burdens when landing sites move to inaccessible or unsafe locations, often lacking basic facilities such as sanitation and storage.

Furthermore, many affected fisherfolk lack formal recognition or documentation, excluding them from compensation or support programs. Younger generations are increasingly abandoning fishing due to economic pressures, while elderly people face difficulties adapting to new employment opportunities offered by EZ. These changes also threaten the cultural identity and social fabric of fishing communities, including the loss of traditional knowledge and community cohesion.

A LRP has been developed to support Fisheries-Based Livelihood Support including the following,

- Construction of fishermen shelters and boat parking facilities outside the Super Dyke.
- Establishment of alternative fish landing stations and local markets.
- Training in aquaculture and cage fisheries to diversify income streams.
- Provision of modern fishing equipment and safety gear to improve efficiency.
- Driver Training Program for fisher youth, creating alternative income opportunities in the logistics and transport sectors.
- Integration of fishing households into the Social and Skills Development (SSD) Program, ensuring access to entrepreneurship and vocational training.

To safeguard incomes and ensure a smooth transition, a phased livelihood restoration and enhancement strategy has been designed. This strategy addresses immediate risks, creates medium-term employment opportunities, and builds long-term resilience by integrating fishermen into diversified and sustainable livelihood systems. The interventions are structured into short-term (2025–2026), medium-term (2026–2028), and long-term (2028 and beyond) measures, ensuring that fishermen and their families are not left behind in the transformation brought by the NSEZ.

Short-Term Interventions (2025–2026)

In the immediate phase, fishermen will be protected against sudden income loss caused by SEZ construction activities such as dredging and restricted marine access. A designated sea access point and boat-keeping facilities will be established adjacent to the SEZ boundary to ensure uninterrupted fishing operations. Beginning in 2025, fishermen and their youth dependents will be enrolled in driver training and alternative skill-building courses under the Social and Skills Development (SSD) Program

and the Enterprise Skills Agency (ESA) Skills Voucher Program. To reduce reliance on fishing alone, entrepreneurship training and access to microfinance will be provided, enabling diversification into small-scale trade, services, or enterprises. These measures will serve as an immediate livelihood bridge to prevent income gaps during the early years of SEZ development.

Medium-Term Interventions (2026–2028)

From 2026 onward, focus will shift toward building sustainable employment pathways for fishermen. BEZA will operationalize job placement mechanisms with SEZ tenants, supported by a priority hiring clause for affected fishermen. Those choosing to transition away from traditional fishing will be offered specialized factory training and enterprise development support. Alternative income options will be promoted through small-scale logistics, service businesses, and other non-fishing enterprises. Women from fishermen households will also be included through targeted vocational training in ICT, tailoring, retail, and food processing, ensuring broader household resilience. By this stage, fishermen families will begin to stabilize incomes, with opportunities to move beyond subsistence-level fishing.

Long-Term Interventions (2028 and Beyond)

In the long run, fishermen households will be enabled to diversify and strengthen resilience. Support will be provided to shift into aquaculture, micro-enterprises, and logistics services, thereby reducing dependency on traditional fishing alone. Skilled fishermen and their dependents will be integrated into SEZ supply chains, gaining long-term market access and stable employment opportunities. Local fishermen cooperatives will be formed to collectively manage resources, negotiate with SEZ tenants, and ensure equitable participation in economic opportunities. The SSD Program will evolve into a permanent community skills hub, offering continuous reskilling aligned with future industrial and technological trends. This will secure intergenerational benefits and position fishermen households as long-term partners in NSEZ development.

Considering the above issues, the impact of the development of the EZ on fishermen and fishery activity is evaluated to be **Medium High**.

5.3.1.34 Impacts on Livestock Population and Dependent Community

The communities in the study region are dependent on livestock for income and livelihood. Livestock production contributes considerably to improving the economic status of the rural poor in the EZ surrounding area. The common livestock resources in the area are buffalo, sheep, cows, and goats. There are two types of Buffalo. Firstly, buffalo totally depend on grazing land and stay there in the natural environment all the time. Secondly, the types that are grazed for a certain time of the day and stay at owners' homes in a domesticated environment, like other cattle. This type is mostly dependent on stall feeding. The char areas and khals inside of EZ were the source of grazing for herds of buffalo, sheep, cows, and goats in a natural environment.

From the start of the development of the EZ, it impacted the livestock resources by reducing the grazing land, and the grazing area became restricted for them. As a result, many buffalo owners have already decided to find other businesses and have started selling their buffalo. A few of them are now shifting to other areas for grazing, although they reported facing restrictions from the forest department for their random grazing in the forest department's areas. According to the consultation findings, the grazed buffalo and sheep have been reduced to around 8,000 currently, which was more than double previously. Concern was also raised by them about the negative impact on the dairy value chain of the areas and other cattle-related business activities.

Buffalo grazers, on the other hand, have started experiencing a reduction in grazing areas due to the construction and development works in EZ. Some portions of land within the boundary of the EZ were a major area for buffalo, sheep, and cow grazing. During the development of the EZ, the grazers started shifting towards the seaside/char area for a temporary period. Experiencing the reduction of grazing lands during the construction period, many of the grazers/owners decided to sell their buffalo, which

impacted the livelihoods of the categories including buffalo boys (*Batainna/Rakhal*), owners of buffalo, sheep, and cows, buffalo vendors, and people involved dairy business, and other involved parties.

According to the consultation with buffalo owners and grazing boys, there were around 20,000 buffalos and sheep of 700 owners and 400 grazing boys (*Rakhal*) before NSEZ started, which have been reduced to 8,000 buffalos and sheep of 300 owners and 150 grazing boys currently.

As per LRP, developed by NSEZ to Fisheries-Based Livelihood Support, following tailored interventions has been designed to safeguard and enhance their livelihoods:

- Allocation of designated grazing areas in coordination with local authorities.
- Introduction of a fodder supply program, including cultivation of high-yield fodder crops such as Napier grass, maize stalks, and sorghum.
- Investment in a dairy value chain model, including milk collection centers, chilling facilities, and market linkages with SEZ-based industries.
- Training for households in small-scale commercial dairy farming, supported by veterinary services, artificial insemination, and improved breeds.
- Promotion of poultry and small livestock enterprises, which require less land and capital, especially targeting women-headed and landless households.
- Integration of livestock-dependent youth into the driver training program and other industrial employment streams.
- These programs will transform the livestock sector from subsistence-based practices to modern, market-oriented enterprises, enhancing household income security and women's empowerment.

Since livestock plays a vital role in food security, dairy production, and supplementary income for rural families, targeted interventions are essential to safeguard and enhance these livelihoods. To address these risks and create sustainable opportunities, a phased approach has been developed. This strategy ensures that livestock-dependent communities receive short-term (2025–2026) support to prevent immediate losses, medium-term (2026–2028) programs to build stable income pathways, and long-term (2028 and beyond) measures to strengthen resilience and integrate with SEZ-driven growth.

Short-Term Interventions (2025–2026)

In the immediate phase, livestock-rearing households particularly buffalo owners and grazing boys will be supported to safeguard their primary source of income. With grazing lands expected to shrink due to SEZ development, short-term fodder supply assistance and the establishment of temporary designated grazing areas will be arranged in collaboration with local authorities. Livestock-dependent youth will be enrolled in driver training and alternative vocational programs through the Social and Skills Development (SSD) Program and the Enterprise Skills Agency (ESA) Skills Voucher Program. In addition, entrepreneurship training and access to microfinance will be extended to livestock households, enabling them to explore opportunities in small-scale dairy, poultry, or service enterprises. These transitional measures will protect household income and prevent the immediate loss of livestock-based livelihoods.

Medium-Term Interventions (2026–2028)

As the SEZ becomes operational, the strategy for livestock-rearing households will focus on building stable income opportunities and strengthening the livestock economy. Affected buffalo owners and grazing boys will be included in SEZ tenant job placement programs, with priority hiring clauses in place. Specialized reskilling programs will provide training in dairy processing, poultry enterprises, and logistics businesses. To enhance livestock-based income, BEZA will expand the dairy value chain by establishing milk collection points, chilling plants, and reliable market linkages. Women from livestock households will also gain access to vocational and entrepreneurial training, ensuring household-wide participation in new economic opportunities. By this stage, livestock households will have diversified income streams while maintaining strong links to their traditional livelihoods.

Long-Term Interventions (2028 and Beyond)

In the longer term, livestock-dependent communities will transition toward resilience and integration with the SEZ economy. Buffalo owners and herders will be supported to diversify into dairy enterprises, poultry farming, fodder production, and other micro-businesses. Their livestock and dairy products will be linked directly to SEZ supply chains, providing stable markets and sustained income opportunities. To ensure collective strength and equitable participation, livestock cooperatives will be established, enabling households to jointly market products, negotiate contracts, and manage resources. Continuous reskilling opportunities will be provided through the SSD Program, which will evolve into a permanent skills hub aligned with technological and industrial changes. These measures will secure intergenerational livelihood benefits and ensure livestock-rearing households become active partners in the success of the NSEZ.

Considering the above issues, the impact of the development of EZ on the livestock population and the dependent community is evaluated to be **Medium High**.

5.3.1.35 Tourism

There are many tourist spots in the EZ surrounding area, i.e., Mahamaya Lake, Khoiyachara Waterfalls, Napittachora Waterfall, Sitakunda Eco Park, Botanical Garden, Sohosrodhara Waterfall, Jharjhari Waterfalls, Bhatiari Lake, Komoldoho Trail, Muhuri project, among others. However, one tourist spot, namely Guliakhali Sea Beach, is located within the proposed EZ boundary. Therefore, the existing master plan boundary of the EZ needs to be revised, and the tourist spot should be excluded. The implementation of the EZ master plan will have both positive and negative impacts on the tourism activity in the region. During the development of the EZ, a large number of workers will be influx in the region to be engaged in the EZ will translate to more visitors to these tourist spots. Negative impacts from tourism may occur when the level of visitors' use is greater than the environment's ability to cope with their use within acceptable limits of change. Uncontrolled conventional tourism may pose potential threats to many natural areas around EZ.

The development of tourism facilities in the region by the Bangladesh Parjatan Corporation under the Ministry of Civil Aviation & Tourism such as accommodation, water supplies, restaurants, and recreation facilities can put enormous pressure on an area and lead to impacts such as soil erosion, sand mining, increased pollution, discharges into the sea, natural habitat loss, increased pressure on wildlife. It will put a strain on water resources, and it can force local populations to compete for the use of critical resources. In addition, road construction can lead to land degradation, loss of wildlife habitats, and deterioration of scenery.

Considering the above issues, the impact of the development of the EZ on tourism is evaluated to be **Low**.

5.3.1.36 Cultural Heritage

Cultural heritage encompasses tangible and intangible heritage. Tangible cultural heritage includes movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. In addition, intangible cultural heritage includes practices, representations, expressions, knowledge, skills as well as the instruments, objects, artifacts, and cultural spaces associated therewith that communities and groups recognize as part of their cultural heritage, as transmitted from generation to generation and constantly recreated by them in response to their environment, their interaction with nature and their history.

According to the literature review, baseline data collection, and stakeholder consultation, there are no known cultural heritage sites located within the EZ master plan area. However, unknown cultural heritage sites, which may exist beneath the surface or as undiscovered surface scatters, may be impacted due to the construction activities, including civil works and excavation activities. Therefore, a "Chance Find Procedure (CFP)" has been recommended to be prepared in accordance with national

legislation and WB ESS8 and followed by the EZ authority to mitigate the potential impact if previously unknown cultural heritage is encountered during master plan implementation. This should also be considered in the screening procedure of the environmental and social risks and impacts identification process.

5.3.1.37 UNESCO World Heritage Sites

As per the UNESCO cultural heritage listing, there are two cultural heritage sites in Bangladesh, i.e., the Historic Mosque City of Bagerhat and Ruins of the Buddhist Vihara at Paharpur, and one natural heritage site, i.e., the Sundarbans. No heritage sites are available in the EZ master plan area, as well as the study region. Therefore, no impacts on UNESCO heritage sites are anticipated by the development of EZ.

5.3.1.38 Impacts on Community Dynamics

Men and women from different parts of the country will come over to the EZ area for jobs, and they are likely to assimilate into local culture. Depending on the number of incoming workers and their engagement with the host communities in the project region, the composition of the local community, and with it the community dynamics, may change significantly.

Considering the above issues, the impact of the development of the EZ on community dynamics is evaluated to be **Low**.

5.3.1.39 Changes of Landscape - Visual Impact

Impacts on the physical environment will consist of landscape transformation, causing visual impacts. The construction of the industries in EZ and related facilities for EZ will alter the total landscape of the EZ site. These impacts will remain during the operational phase.

According to the land use in the EZ site, the main land use was mangroves/ forest/ vegetation (31.65%), which is followed by barren lands (27.6%), water bodies (8.71%), and underdevelopment (6.53%) area before implementing the NSEZ master plan. These mangroves are planted by Bangladesh Forest Department. The existing landscape has already been changed from time to time because of the construction work for Mirsharai EZ 2A and 2B. Approximately 900 acres of land have already been cleared and altered as the industrial zone among the entire area of EZ, and several industries have already moved into and partly started their operation so far. Moreover, 500 acres of land have been cleared and altered into industrial areas as part of the Zone 2B development. Therefore, the existing landscape is in the process of urbanization due to EZ 2A and 2B development, and it will push the urbanization more and more due to the project.

According to the Bangladesh Economic Zones (Construction of Building) Rules 2017, the owner of the individual industry shall be responsible for landscaping the plot and maintaining the same in a well-kept condition, including, but not limited to, trimming, watering, and fertilization. According to the rules, about 5% of the total land area shall be reserved as green space along the road network, green strips used along the roads may not be less than 1.5m, green strips less than 3m may not be used for any kind of utility service line, and central green median, roadside green strips, channel, water body are part of these requirements. In addition, the plantation will be done outside of the EZ by the Forest Department, Bangladesh Water Development Board, and other organizations. Therefore, as long as the industry follows the rules, the project proponent will make an effort to maintain a green area, which enables it to secure environmental friendliness for users and residents around EZ. Hence, it is judged that the impact of the landscape in and around the project area would be controlled well by the Project.

Considering the above issues, the impact of the development of EZ on visual impact is evaluated to be **Medium Low**.

5.3.1.40 Impacts due to Disasters

Natural hazards anticipated at the EZ site are cyclones, earthquakes, tsunamis, and floods/flash floods. As per the seismic zone map of Bangladesh, the country is divided into four seismic zones, i.e., Zone-

I, II, III, and IV (BNBC, 2020). Zone 1 is the low-hazard zone, and Zone IV is the most hazardous zone. As per the seismic zone map, the NSEZ site and study region fall in both severe seismic intensity zone (zone 3) with coefficients of 0.28 and moderate seismic intensity zone (zone 2) with coefficients of 0.20. Thus, it is essential to take this into consideration while designing the structure of the proposed intervention so that the site can withstand earthquakes of severe and very severe intensity. According to the Master plan of the EZ, the study has been carried out following the BNBC 2015, and measures have been proposed considering the BNBC 2015. However, in the meantime, the previous BNBC has been updated therefore the new BNBC should be adopted for the infrastructure development in the EZ.

Bangladesh has experienced several earthquakes in the past and there is a possibility that earthquakes will occur in and around the EZ. If an earthquake occurs during the construction phase, the damage would be extended to some extent, such as the collapse of buildings and injury from falling objects. To minimize the damage caused by earthquakes, working conditions, and disaster prevention activities should be managed by the contractor based on occupational health and safety training.

Another natural hazard associated with the EZ site is cyclones. The site is located in the high-risk zone for cyclones and its associated disasters like storm surges. Thus, safety and prevention measures should be included in the NSEZ design to minimize the damage due to these events.

Tsunamis are a series of waves produced by the displacement of a large volume of water, generally generated by earthquakes or volcanic eruptions. As per the tsunamigenic zones map of Bangladesh, the coast is divided into three tsunamigenic zones, i.e., zones I, II, and III. Zone-I is the most vulnerable, and zone-III is the lowest vulnerability zone. According to this classification, the EZ site falls within zone-I, which is reportedly the most vulnerable belt. Though the Indian subcontinent is in a seismically active region, tsunamis along the coastline of India and Bangladesh have been rare, but not unprecedented. In the master plan, measures for tsunami disasters have not been proposed, considering the location of EZ on the coastline of the Bay of Bengal.

All the interventions will be developed along the shoreline of the Bay of Bengal thus are highly vulnerable to coastal floods caused by tidal surges. According to the Upazila Disaster Management Plan of Mirsharai and Sitakunda, both upazilas are flood-prone areas, specifically vulnerable to flash floods. According to the consultation with BEZA, the whole EZ site will be filled with an elevation of 6.5 m. The finished level of both the offshore and on-shore structures should be above the high flood level of the sea and rivers/khals to prevent flood hazards. At the Mirsharai site, an embankment/super dyke approximately 22.5 km in length has already developed along the Sandwip Channel; thus, the site is not prone to flooding. Further, a 12.5 km embankment will be constructed along the coastline from Domkhali in Mirsharai to Guliyakhali in Sitakunda. Later, an embankment will also be constructed on the Feni site. The super dykes are designed and constructed with crest elevations at MSL+9m to protect the site against a 100-year return period coastal flood. River embankments are designed and constructed with crest elevations at MSL+8m to protect the site against river overflow from a 25-year return period river flood. The land plots are being raised from initial ground levels from an average of MSL +6.5m, to protect all development/investment from inundation by historical maximum water levels at the coastline and rivers. It is recommended to develop a greenbelt outside of the super dyke to protect the dyke from erosion from wave action, tidal surges, and impacts from tsunami-induced waves. In addition, a disaster management committee shall need to be established in the NSEZ for monitoring of disasters in the region, emergency declaration, and effective management of disasters.

Considering the above issues, the impact on EZ due to the disaster is evaluated to be **Medium High**.

5.3.1.41 Climate Change and Greenhouse Gas Emissions

Climate change differs fundamentally from other potential environmental considerations in that it has global impacts that cannot be directly linked to one specific source. Climate change is a cumulative effect caused by the combined impact of past, present, and future human and natural processes. Impacts on climate change can be measured in terms of the amount of Greenhouse Gas (GHG) emissions from a project or activity, as well as through its emissions intensity (emissions per output).

GHGs are a range of gases that have the ability to trap radiation in the upper atmosphere, contributing to global warming. GHGs include the following:

- Carbon dioxide (CO₂) - by far the most abundant, primarily released during fuel combustion.
- Methane (CH₄) is released through biomass decomposition, solid waste landfills, and wastewater treatment.
- Nitrous Oxide (N₂O) - from industrial activity, fertilizer use, and production.
- Hydrofluorocarbons (HFCs) are commonly used as refrigerant gases in cooling systems.
- Perfluorocarbons (PFCs) are used in a range of applications, including solvents, medical treatments, and insulators.
- Sulphur hexafluoride (SF₆) is used as a cover gas in magnesium smelting and as an insulator in heavy-duty switchgear.
- Nitrogen trifluoride (NF₃).

Each of the above gases has a global warming potential (GWP), which is a measure of the degree to which a greenhouse gas mass can contribute to global warming as compared with the same mass of CO₂. Global Greenhouse gases are usually expressed as carbon equivalents (Ce) or carbon dioxide equivalents (CO₂e).

Table 5-19: Global Warming Potential

Gas	Global Warming Potential for Given Time Horizon (100 years)
Carbon Dioxide (CO ₂)	1
Methane (CH ₄)	25
Nitrous Oxide (N ₂ O)	298

Source: IPCC, Fourth Assessment Report (AR4), 2007²¹

Development activities will lead to emissions emanating from fuel-powered equipment, i.e., vehicle engines, vessels, construction equipment, etc. The exhaust will contain pollutants, notably Carbon Dioxide (CO₂), Nitrogen Oxides (NO_x), Sulphur Dioxide (SO₂), Carbon Monoxide (CO), Hydrocarbons, and Particulate Matter (PM). These greenhouse gases (GHGs) are known to interfere with temperature regimes and cause climate change effects. CO₂ is the main GHG gas that contributes maximum to the warming of the atmosphere, and increased CO₂ concentration is one of the major drivers of climate change. It is noteworthy to mention that the quantity of emissions during the development phase will depend on the vehicles/vessels/equipment type, amount, and condition (e.g., level of maintenance).

To minimize GHG emissions during the development of the EZ, mitigation measures shall be taken by the investors and contractors, such as management of the operation time of construction machinery, avoidance of excessive loading operations, and education of construction workers/drivers about the idling stop practice for construction machinery and vehicles.

Considering the above issues, the impact of the development of the EZ on climate change and greenhouse gas emissions is evaluated to be **Medium Low**.

Summary of Environmental and Social Impact Significance During the Development of the EZ

A summary of environmental and social impact significance during the development of the EZ has been provided in Table 5-20.

²¹ https://www.epa.gov/system/files/documents/2023-03/ghg_emission_factors_hub.pdf

Table 5-20: Summary of Environmental and Social Risks and Impacts During Development of the EZ

Aspects/Issues/Impacts	Nature	Extent & Location	Duration	Intensity/Severity	Irreplaceable	Probability	Significance
Impacts on Air Quality	Direct	Local	Medium	High	Low	High	Medium Low
Impacts from Noise	Direct	Local	Medium	Medium	Low	High	Medium Low
Impacts on Surface Water	Direct	Local	Medium	High	Low	High	Medium Low
Impacts on Groundwater	Direct	Regional	Long Term	High	Medium	High	Medium High
Impacts on Topography and Soil	Direct	EZ Site	Permanent- no mitigation	Medium	Low	Medium	Medium Low
Impacts on Sediment	Direct	Local	Long Term	Medium	Medium	High	Medium Low
Impact due to Changes in Land Use	Direct	EZ Site	Permanent-no mitigation	High	Medium	High	Medium High
Impact due to Solid Waste Generation	Direct	EZ Site	Medium	Medium	Low	Medium	Low
Impacts of Liquid Waste Generation	Direct	Local	Medium	High	Low	Medium	Low
Impacts on Drainage	Direct	Local	Permanent mitigated	Medium	Low	Medium	Medium Low
Impacts of Traffic	Direct	Local	Permanent mitigated	Medium	Low	Medium	Medium Low
Loss of Ecosystem Services	Direct	Local	Permanent mitigated	Medium	Low	Medium	Medium Low
Impacts on Terrestrial and Mangrove Flora	Direct	Local	Permanent mitigated	High	Medium	High	Medium High
Impacts on Terrestrial Mammals	Direct	Local	Long Term	Medium	Medium	High	Medium Low
Impacts on Birds/Avifauna	Direct	Local	Permanent mitigated	High	Medium	High	Medium High

Aspects/Issues/Impacts	Nature	Extent & Location	Duration	Intensity/Severity	Irreplaceable	Probability	Significance
Impacts on Herpetofauna	Direct	Local	Permanent mitigated	High	Medium	High	Medium High
Impacts on Aquatic Mammals	Direct	Local	Short Term	Medium	Medium	High	Medium Low
Impacts on Ichthyofauna (Fish)	Direct	Local	Short Term	High	Medium	High	Medium Low
Impacts on Hilsa Fisheries	Direct	Local	Short Term	High	Medium	High	Medium Low
Impacts on Plankton and Benthos	Direct	Local	Short Term	Low	Low	High	Low
Impact of Dredging on Marine Ecosystems	Direct	Local	Long Term	Medium	High	High	Medium High
Ecologically Critical Areas	No impacts are anticipated as there are no ECAs in the EZ area						
Protected Areas	No impacts are anticipated as there are no protected areas in the EZ area.						
Critical Habitat Assessment	EZ area and study region do not qualify for critical habitat areas.						
Impacts due to Land Acquisition, Resettlement, and Rehabilitation	Direct	Regional	Permanent-mitigated	High	Medium	High	Medium High
Community Health, Safety, and Security	Direct	Regional	Permanent-mitigated	High	Medium	Medium High	Medium High
Occupational Health and Safety	Direct	EZ site	Permanent-mitigated	High	Medium	High	Medium High
Labor Influx	Direct	Regional	Long-term	High	Medium	High	Medium High
Child Labor and Forced Labor	Direct	Regional	Permanent-mitigated	Medium	Medium	High	Medium High
Gender Based Violence and Sexual Exploitation and Abuse/Sexual Harassment		Direct	Regional	Long-term	Medium	Medium	Medium Low
Violence Against Children	Direct	Regional	Long-term	Medium	Medium	Medium	Medium Low

Aspects/Issues/Impacts	Nature	Extent & Location	Duration	Intensity/Severity	Irreplaceable	Probability	Significance
Impact on Social Infrastructures	Direct	Regional	Long-term	High	Medium	High	Medium High
Impacts on Fisherman and Fishery Activity	Direct	Local	Long-term	High	High	High	Medium High
Impacts on Livestock Population and Dependent Community	Direct	Local	Long-term	High	High	High	Medium High
Tourism	Indirect	Regional	Long-term	Low	Low	Low	Low
Impacts on Community Dynamics	Direct	Regional	Long-term	Low	Low	Low	Low
Changes of Landscape - Visual Impact	Direct	EZ Site	Permanent Mitigated	Low	Medium	Medium	Medium Low
Impacts due to Natural Disasters	Induced	Regional	Permanent Mitigated	High	Medium	High	Medium High
Climate Change and Greenhouse Gas Emissions	Induced	National	Permanent Mitigated	Low	Medium	Medium	Medium Low

5.3.2 Impacts During Operation Phase

5.3.2.1 Impacts on Air Quality

During the operation of the EZ, there will be an increase in the movement of traffic, and hence, emissions from the moving vehicles will also increase. The exhaust from the DG set in different industries, diesel-operated small boats, vessels, dredgers, etc., will enhance the pollution load during operation.

Increased traffic on the access road has the potential to cause an impact on the air quality experienced by the residents along the access roads, specifically an increase in pollutants such as NO_x and particulate matter. Concentrations of primary pollutants generated by road traffic decrease exponentially with increasing distance from the road. This means that 50m to 100m from the road center, the concentrations of carbon monoxide, oxides of nitrogen, particulates, and non-methane hydrocarbons (benzene and related compounds) are considerably less than half the levels at the central median.

With the increase in the number of ships and boats, their operation and movement of cargo to and from will also increase. These activities will increase the pollution load in the atmosphere. The sources of air pollutants from jetty operations will include combustion emissions from ships' propulsion and auxiliary engines and boilers, mainly consisting of SO₂, NO_x, greenhouse gases (e.g., CO₂ and CO), fine particulate matter, and VOC, followed by combustion source emissions from vehicles, port equipment, and land-based engines and boilers contributing similar pollutants. VOC may also be emitted for fuel storage and transfer.

Furthermore, another air pollutant that needs to be considered for the economic zone is dioxin, which will be generated from waste incinerators. Dioxin is known as a persistent environmental pollutant and accumulates in the food chain mainly in the fatty tissue of animals. Dioxin is known as a highly toxic substance and can cause reproductive and developmental problems, damage the immune system, interfere with hormones, and cause cancer. It is obvious that dioxin formation occurred at temperatures above 450°C and was reduced significantly at temperatures above 850°C. The reaction occurring in an incinerator is extremely complex, and there are many factors in addition to combustion temperature influencing dioxin formation. The selection of manufacturing processes and incinerators with low dioxin emissions is recommended to reduce the formation of dioxin. In addition, stack emissions standards for municipal solid waste incinerators have been provided in the Air Pollution (Control) Rules 2022, and this should be followed during the operation of the incinerator plant.

Methane gas, one of the greenhouse gas groups, generated from landfill sites and leachate treatment by anaerobic process, is also of concern. Gas flaring must be provided to cope with this methane gas for the reduction of emitted greenhouse gases.

During the operation, air pollution is generated from various sources, in the production process, and from the stacks. Air pollutants of concern and their major sources from the activities expected to take place in the economic zone include:

- Particulate matter (PM₁₀) will be generated from combustion processing, which includes fuel combustion in manufacturing and vehicle exhaust.
- Sulfur dioxide (SO₂) will be generated from the combustion of fossil fuels, which contain sulfur, in boilers and power plants.
- Nitrogen oxide (NO_x) is a result of the reaction between oxygen and nitrogen in the air in the combustion process.
- Volatile Organic Compounds (VOCs) will be generated from electronic manufacturing industries.
- Dioxin will be generated from waste incinerators.

Potential impacts from the above air pollutants are mostly focused on human health, particularly on those living in the vicinity of the sources, in this case, around the economic zone.

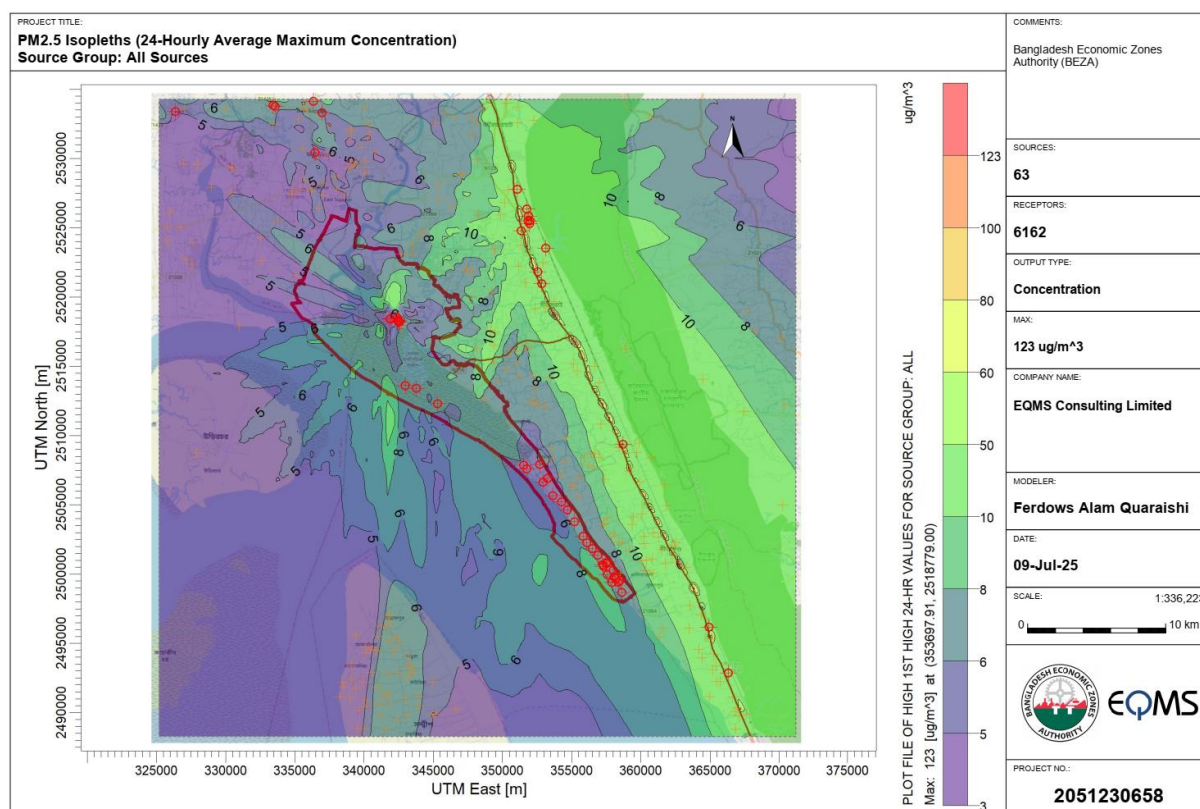
Air Quality Modelling Result

Details of the ambient air quality model output have been given in Appendix G (Vol-III).

Concentration of Particulate Matter (PM_{2.5})

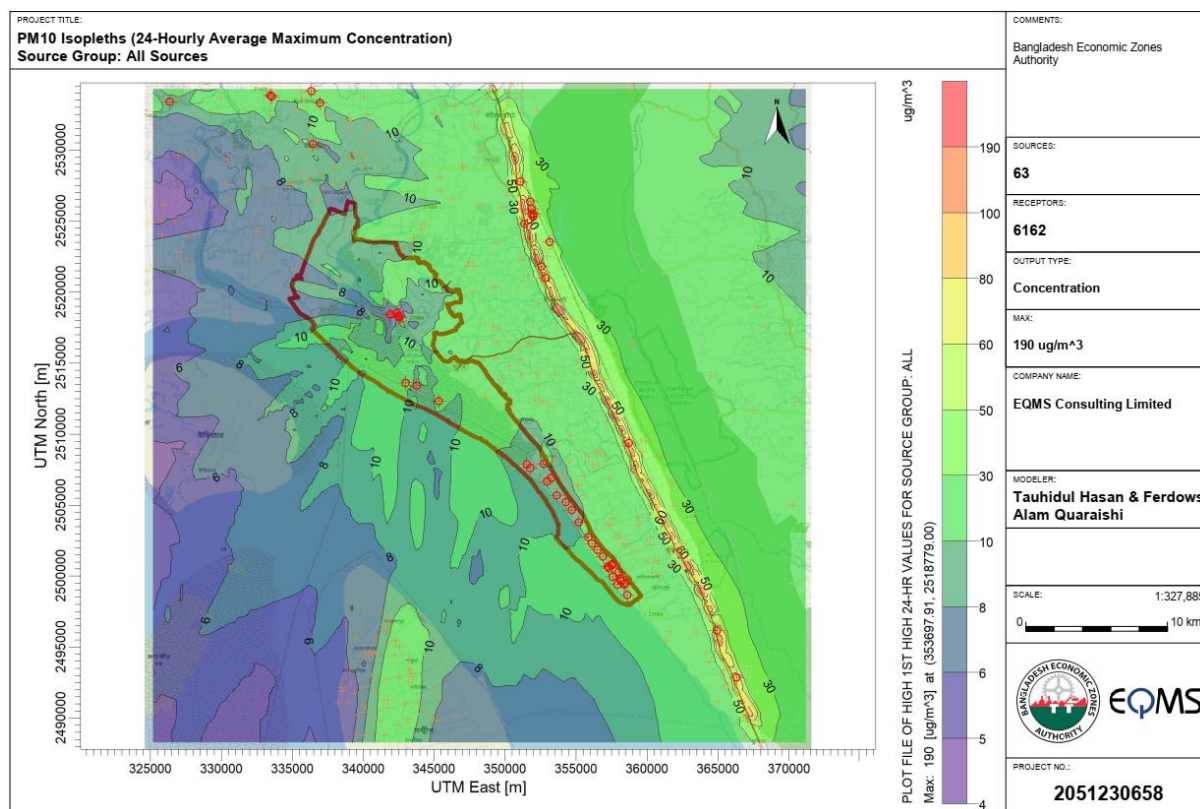
The contribution of PM_{2.5} from existing and future industries including power plants, chemical, paint, steel, cement, fertilizer, petroleum refinery, glass, and brick industries has been assessed through dispersion modeling. The results reveal that road dust and brick kilns are the major contributors to PM_{2.5} concentrations in the study area. As brick kilns typically operate during the dry season, their contribution is seasonal. The modeling predicts a maximum ground-level concentrations (GLCs) of 23.88 µg/m³ at the ambient air quality monitoring locations. The 24-hourly maximum GLCs of PM_{2.5}, represented as isopleths, are illustrated in Figure 5-6. Details of the ambient air quality model output have been given in Appendix G (Vol-III).

Figure 5-6: Isopleths of 24-Hourly Maximum PM_{2.5} GLC- All Sources



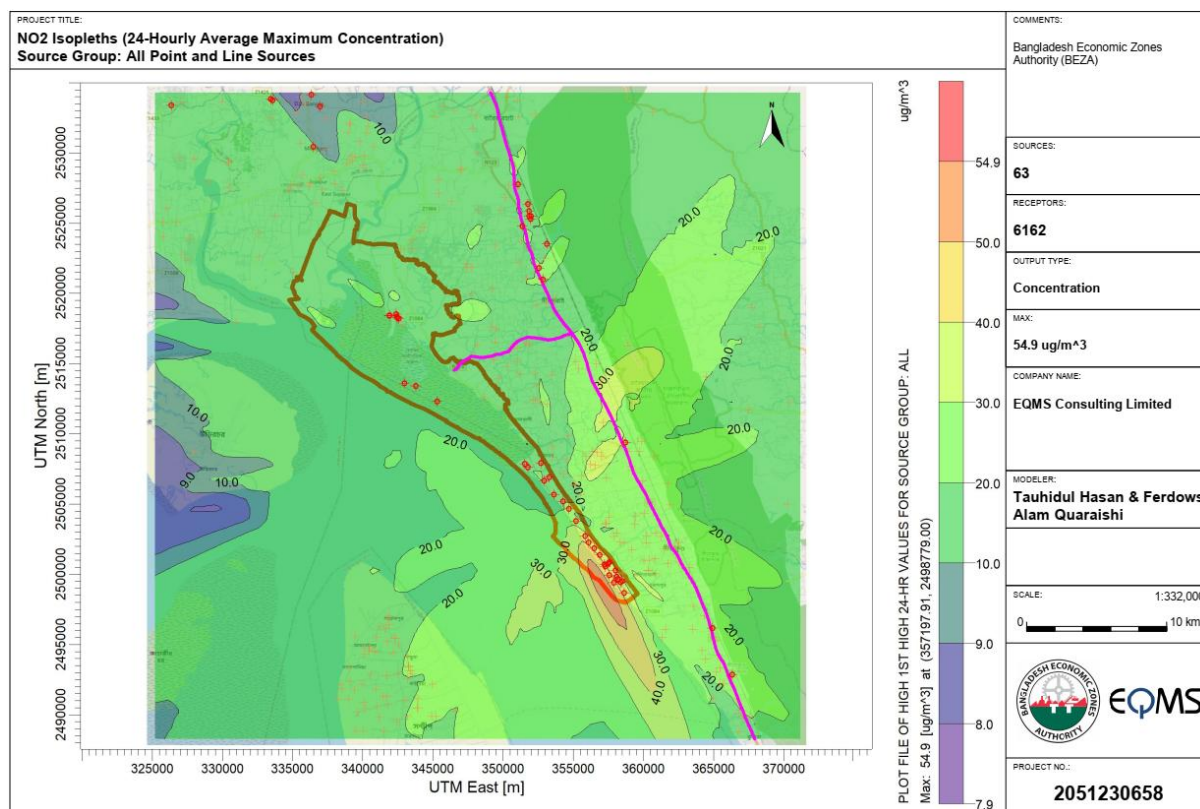
Concentration of Particulate Matter (PM₁₀)

The contribution of PM₁₀ from existing and future industries including power plants, chemicals, paint, steel, cement, fertilizers, petroleum refinery, glass, brick, and glass has been predicted through modelling study. The modelling result reveals that brick kilns and road dust will cumulatively result in increased concentrations of PM₁₀ in the study area. The model reveals that major PM₁₀ contributors in the study area are road dust and brick kilns. However, the brick kilns only contribute to air pollution during the dry period. The modeling predicts a maximum ground-level concentrations (GLCs) of 36.75 µg/m³ at the ambient air quality monitoring locations. The isopleths representing 24-hourly maximum PM₁₀ GLCs is presented in Figure 5-7. Details of the ambient air quality model output have been given in Appendix G (Vol-III).

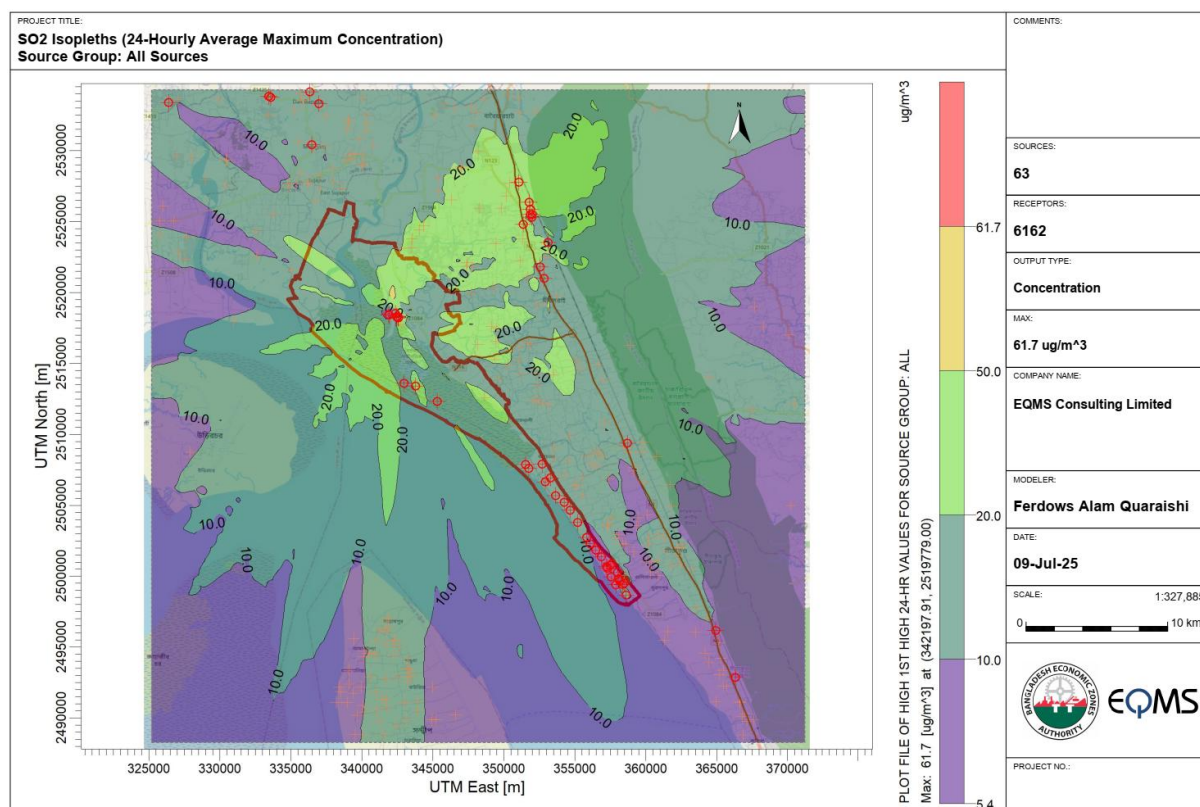
Figure 5-7: Isopleths of 24-Hourly Maximum PM₁₀ GLC- All Sources

Concentration of NO₂

The past, present, and future industrial activity will cumulatively impact the condition of the NSEZ and the surrounding area airshed. The model shows that the contribution of NO₂ from the other industries inside the NSEZ contributes the maximum, followed by the power plant in the NSEZ, road traffic, brick kiln, and industries outside the NSEZ. It can be stated that the industry in the NSEZ will contribute NO₂ significantly to the airshed. The modeling predicts a maximum ground-level concentration (GLC) of 29.10 µg/m³ at the ambient air quality monitoring locations. The isopleths representing 24 hourly maximum NO₂ GLCs are presented in Figure 5-3. Details of the ambient air quality model output have been given in Appendix G (Vol-III).

Figure 5-8: Isopleths of 24-Hourly Maximum NO₂ GLC- All Sources**Concentration of Sulfur Oxides (SO₂)**

The cumulative impact of past, present, and future industrial activities is expected to significantly influence the air quality within the NSEZ and its surrounding airshed. Model results indicate that sulfur dioxide (SO₂) emissions from power plants and brick kilns are the highest contributors. The modeling predicts a maximum ground-level concentrations (GLCs) of 26.37 µg/m³ at the ambient air quality monitoring locations. The isopleths representing 24 hourly maximum SO₂ GLCs are presented in Figure 5-9. Details of the ambient air quality model output have been given in Appendix G (Vol-III).

Figure 5-9: Isopleths of 24-Hourly Maximum SO₂ GLC- All Sources

Considering the above issues, the impact of the operation of the EZ on ambient air quality is evaluated to be **Medium High**.

5.3.2.2 Impacts from Noise

During the operation, vehicle movements in the access roads for staff mobilization, materials/product transportation in and out of the economic zone, and the operation of industries will be the major sources of noise pollution from the economic zone. Noise will be generated due to industrial activities (operation of heavy-duty machinery like boilers, compressors, pumps, hydraulic systems, various industrial operations, etc.) involved in raw material/product handling and transportation, and the same will be felt upon work personnel and nearby settlements.

Noise will also be generated from jetty and terminal operational activities such as vessel loading/unloading, container handling, and access road/rail traffic that will result from container traffic arriving and departing through the jetty business day. Water is an efficient medium for sound propagation, particularly low-frequency sound, and therefore, marine life over a wide area could be potentially affected. The day-to-day terminal activities, such as vessel loading/unloading, container handling, etc., will cause additional underwater noise emissions. These are, however, not expected to be significant.

Noise sources in the operation phase will vary depending on the production processes of each facility/industry in the economic zone. Control of noise at the source will be the most effective approach to control the impact on the receptors outside the boundary of the facility/industry. Equipment that generates a high level of noise is usually installed in enclosed buildings. The noise level in the fence line of each facility/industry needs to be routinely monitored so that the ambient noise level does not exceed the standards applicable for industrial areas stipulated in the Noise Pollution (Control) Rules, 2006. The effects of noise on the receptors outside the initial phase of the industrial estate area are negligible. Nevertheless, each factory must provide earplugs and/or earmuffs for employees or workers who work in places that have noise levels exceeding 80 dB(A).

Noise Modelling Result

The environmental noise prediction model Sound PLAN 8.2 has been used for modeling noise emissions from all phased development and operation of all future industries in the economic zone and noise from other sources in the surrounding area. Based on the noise propagation from all the projects at the economic zone, a noise contour map has been prepared using the modeling tool. The predicted noise level at different receptor points is shown in Table 5-21, and the noise contour map is shown in Figure 5-10. Details of the ambient noise model have been given in Appendix G (Vol-III).

Table 5-21: Predicted Noise Levels at Receptors for the full phase development of NSEZ

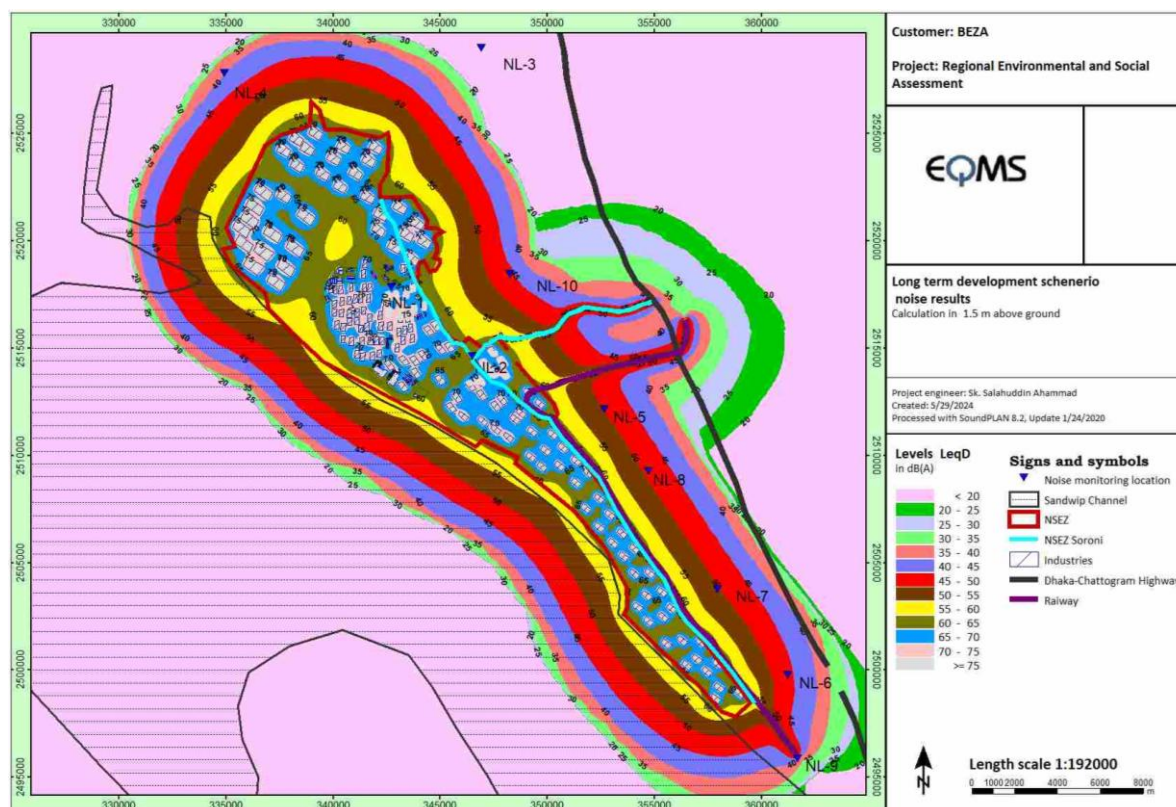
Receptor	Category of Area/ Receptor	Baseline Sound Pressure Levels at Receptors, Leq (dBA) ²²		Predicted Sound Pressure Levels at Receptors, Leq (dBA)		Total Sound Pressure Level (Baseline + Predicted), Leq (dBA)		Applicable National Standard ²³ , dB(A) as per Land use		IFC Guidelines	
		Leqd	Leqn	Leqd	Leqn	Leqd	Leqn	Leqd	Leqn	Leqd	Leqn
ANL-1	Industrial	48.0	44.0	65.2	65.2	65.3	65.2	75	70	70	70
ANL-2	Mixed	62.2	53.5	63.4	63.4	65.9	63.8	60	50	55	45
ANL-3	Silent	60.6	48.4	<20	<20	60.6	48.4	50	40	55	45
ANL-4	Commercial	69.6	58.4	38.9	38.9	69.6	58.4	70	60	70	70
ANL-5	Commercial	60.2	39.4	49.7	49.7	60.6	50.1	70	60	70	70
ANL-6	Commercial	65.0	51.6	46.2	46.2	65.1	52.7	70	60	70	70
ANL-7	Commercial	61.0	51.9	50.3	50.3	61.4	54.2	70	60	70	70
ANL-8	Commercial	61.1	57.9	48.9	48.9	61.4	58.4	70	60	70	70
ANL-9	Industrial	60.7	46.4	38.7	38.7	60.7	47.1	75	70	70	70
ANL-10	Commercial	56.5	47.0	45.6	45.6	56.8	49.4	70	60	70	70

Source: EQMS, June 2024

It has been observed that the predicted noise level in all the receptors is within the permissible limit set in the Noise Pollution (Control) Rules 2006, except the ANL-2 and ANL-3, which already exceed the standard due to industrial activities and vehicular movement around the receptors. In addition, a few locations are very close to the national noise level standards.

²² Ambient noise levels as monitored during the regional baseline survey

²³ Noise Pollution (Control) Rules, 2006

Figure 5-10: Noise Contour Map For all Phase Development of NSEZ

Source: EQMS, January 2025

Considering the above issues, the impact of the operation of the EZ on noise level is evaluated to be **Medium Low**.

5.3.2.3 Impacts on Surface Water

According to the master plan, the wastewater from individual industries that are highly polluting (such as Asian Paints and Modern Modern Syntex Ltd.)/ hazardous substances including toxic chemicals, heavy metals, and solvents, etc. will need to be pretreated to meet the requirements according to the ECR 2023 or other relevant/designated requirements. The pretreated wastewater will then be combined and transferred into central effluent treatment plants located in the NSEZ. All industries connected to the CETP will be required to ensure that their discharged effluent meets the pre-defined inlet quality parameters. The treated wastewater from all wastewater treatment plants will have to comply with the standards mentioned in Schedule-3 and Schedule-4 of the ECR 2023. According to the Master Plan, wastewater after treatment will be recycled to meet various industrial water usages (viz. steel plant) as well as other usages to meet non-domestic demand, including gardening, cleaning, car washing, etc. Effort shall be given to recycle about 70% of the wastewater after treatment to meet various industrial usages". The rest of the treated wastewater will then be transferred through the drainage system and discharged into the Sandwip Channel. According to the NSEZ Master Plan, domestic wastewater will be collected in holding tanks and directed to NSEZ STP-1 and STP-2 with a proposed capacity of 45 MLD and 80 MLD respectively, while industrial wastewater will be collected and directed to NSEZ CETP-1, CETP-2, CETP-3, and CETP-4 with a proposed capacity of 50 MLD, 50 MLD, 100 MLD, and 150 MLD respectively via the installed wastewater network system.

Raw sewage can impact surface water quality by promoting the growth of algae and delivering pathogens that may be harmful to human and ecological receptors. Sewage is generally characterized as having a high concentration of suspended solids and dissolved solids, biochemical oxygen demand, chemical oxygen demand, nutrients (nitrogen, ammonia), and fecal coliform counts. Organic

substances are decomposed in water, and the decomposition of organic matter will reduce the oxygen content dissolved in water.

The operation activities may cause increased soil erosion and sediment loading of nearby khals/rivers/sea, while accidental leaks or spills of hydrocarbons (oil, fuel, or other substances) can also pollute surface water. During operations, the major threats to surface water quality are likely to be pollution from sewage, effluents from the operation of industries, etc. Gradually, seepage of improperly stored materials, chemicals, and products from the storage continent may also continue to contaminate surface water.

According to the discussion with BEZA, desalination plant are considered to meet the water demand in the NSEZ during the operation of the EZ. The brine effluent from the desalination plant will be injected into the water discharge pipe and ejected into the Sandwip Channel. Discharging brine effluent from the desalination plant may lead to elevated levels of salinity in the direct vicinity of the discharge. Effluents may also contain biocides, chlorine, and lower levels of dissolved oxygen, which will influence water chemistry and quality.

5.3.2.3.1 Water Quality Model

A water quality modeling study has been undertaken considering the future industrial entities. The assessment of water quality encompasses the prediction of water quality in the future Sandwip channel and rivers after the implementation of the NSEZ master plan, and how the water quality is expected to evolve over time with the operation of the NSEZ. To understand the present water quality status in the study region, both primary and secondary water quality data were collected, reviewed, and incorporated into the prediction model. Using MIKE-21 FM and ECO Lab FM Modules, a suitable water quality model has been developed for the study region, and the impact of various pollutants that will come from industrial and heavy hydrologic runoff from the upper catchment has been assessed. All the pollution dispersion has been presented as the normal CETP and STP operation, the effect of STP and CETP combined failure scenario, and the effect of climate change and CETP failure on the water quality of NSEZ inside canals and Sandwip channel as well. The model data presented in the current model primarily reflects the worst-case scenario, assuming the failure of both the STP and CETP. This approach was taken to evaluate the potential maximum impact on water quality under extreme conditions.

Under normal operating conditions, the model results show that most parameters remain within the permissible limits defined by the ECR, 2023. However, parameters such as COD, Ammonia, and Phosphate exceed acceptable limits in several internal khals, though these exceedances are not observed on the Sandwip Channel. In contrast, during the failure of CETPs and STPs systems, significant degradation in water quality is observed, with elevated concentrations of COD, Ammonia, Phosphate, BOD, Lead, and Mercury, particularly during low tide conditions, and pollutants dispersing up to several kilometers from their sources. The worst-case scenario, incorporating climate change effects alongside treatment system failure, further intensifies the dispersion and concentration of pollutants across the internal khals and the Sandwip Channel. While some parameters like pH and Nitrate remain within regulatory limits, others, such as Ammonia, Chromium, Lead, Mercury, Phosphate, and Total Coliform, show extensive spatial spread, indicating heightened environmental vulnerability under compounded stress conditions.

The predicted water quality dispersion models have been evaluated for the water quality parameters like pH, Nitrate, Dissolved Oxygen, Chemical Oxygen Demand, Ammonia, Phosphate, Total Suspended Solids, Total Chromium, Total Coliform, Biochemical Oxygen Demand, Mercury, and Lead.

A summary of the water quality model output has been given in Table 5-23. Details of the water quality models have been presented in Appendix F (Volume III).

The timeline for the water quality model is considered here for the operation phase of the project. The model was run continuously for a period of three months during the dry season, as this period typically represents the worst-case scenario for water quality, especially considering the failure of both the STP

and CETP. By focusing on the dry period, we were able to assess the potential impacts on water quality under conditions where natural dilution is minimal and effluent concentrations are highest.

The key pollutants mentioned in the Environmental Conservation Rules (ECR, 2023) have been presented below. The detailed water pollution dispersion model is shown in Appendix F (Volume III).

The water quality modeling results have been presented as the following considerations:

- 1) Normal conditions when CETP and STP function properly
- 2) Combined Effect of STP and CETP Failure Condition
- 3) Climate Change Effect on the Key Pollutant Dispersion

All these scenarios and model outputs are presented in the following subsequent sections.

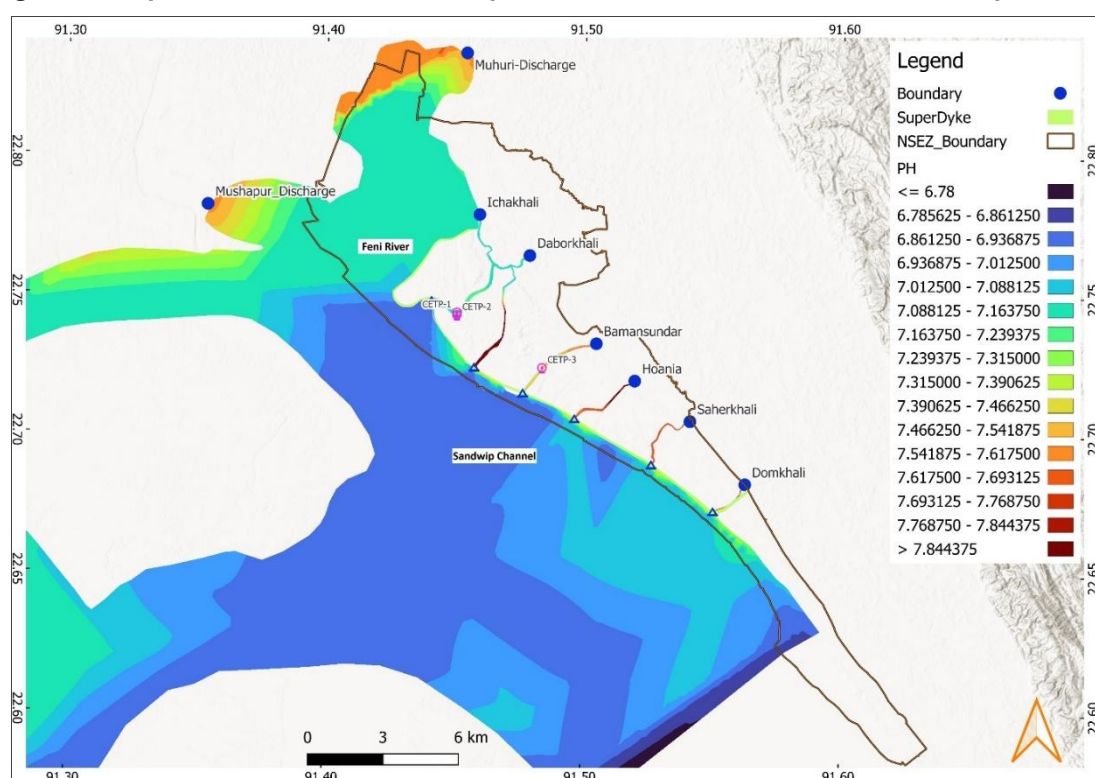
5.3.2.3.1.1 Water Dispersion During Normal Conditions

This model illustrates the dispersion of water quality parameters across various khals and the Sandwip Channel. The parameters include pH, nitrate, dissolved oxygen (DO), chemical oxygen demand (COD), ammonia, phosphate, total suspended solids (TSS), total chromium, total coliform, biological oxygen demand (BOD), mercury, and lead. Key pollutant parameters of significance are highlighted below.

pH

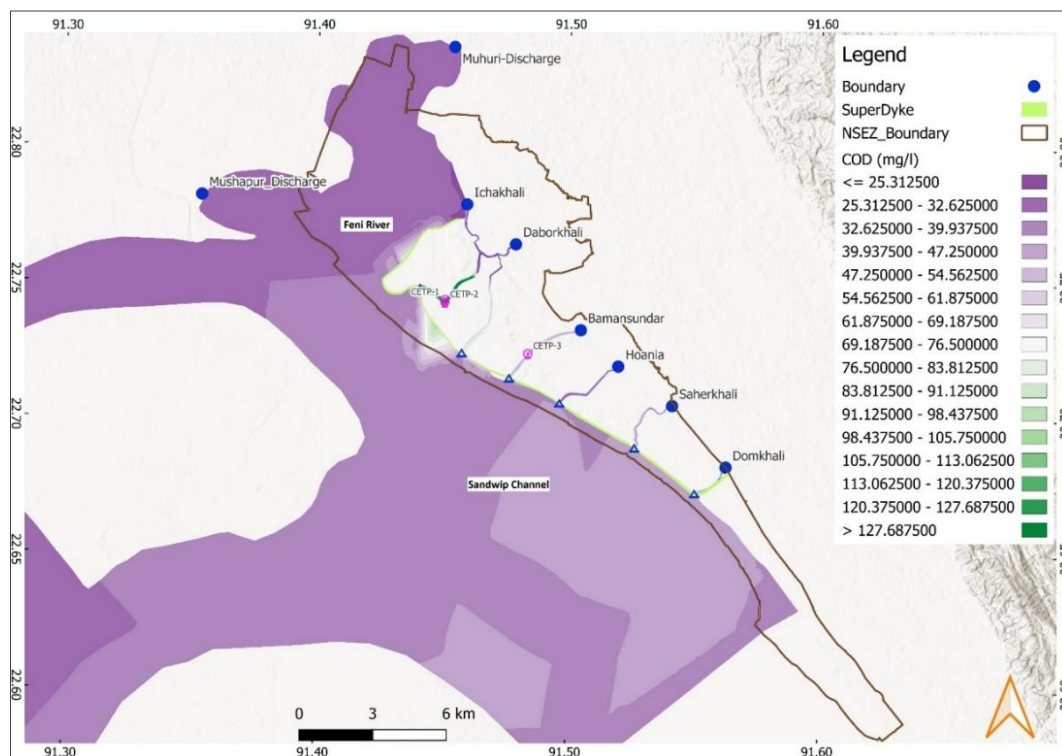
pH ranges above 7.84, and the minimum pH ranges around 6.72 or below it, as shown in Figure 5-11.

Figure 5-11: pH variation in horizontal spatial direction in the Khals and Sandwip Channel

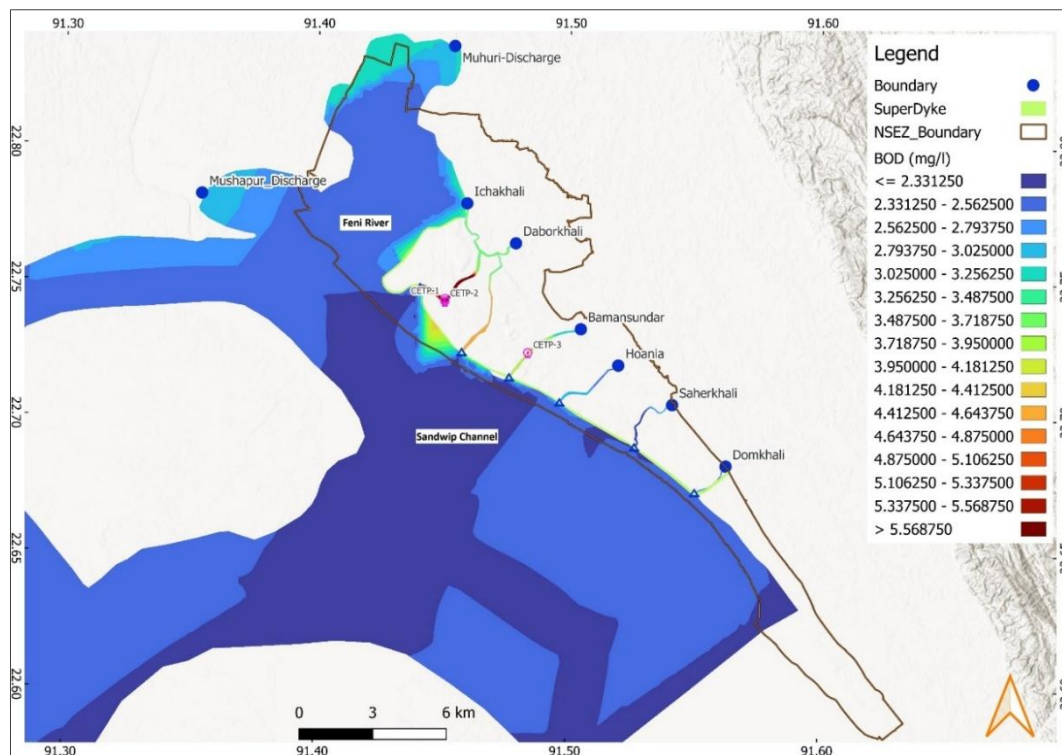


Chemical Oxygen Demand (COD)

COD spatial distribution was found between 16 mg/l to 128 mg/l, which indicates an exceedance of the limits stipulated in ECR 2023. Figure 5-12 shows the COD variation in different Khals and the Sandwip Channel.

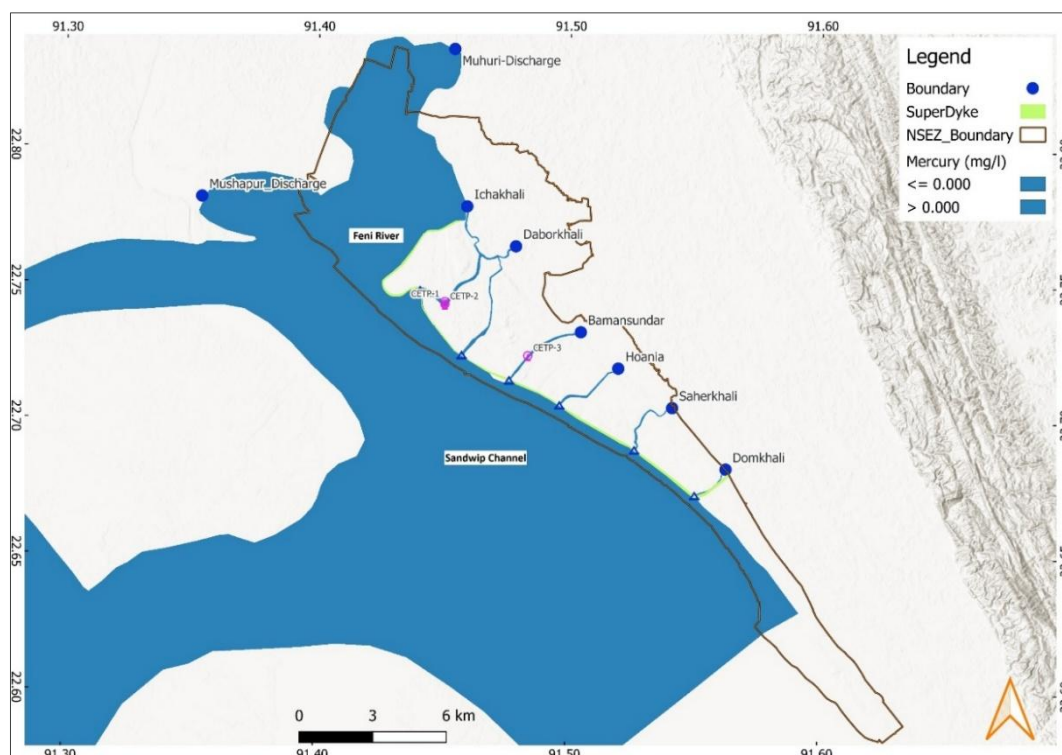
Figure 5-12: COD variation in the Khals and Sandwip Channel**Biological Oxygen Demand (BOD)**

It is observed that the BOD level is less than 6.0 mg/l at the present condition, as shown in Figure 5-13.

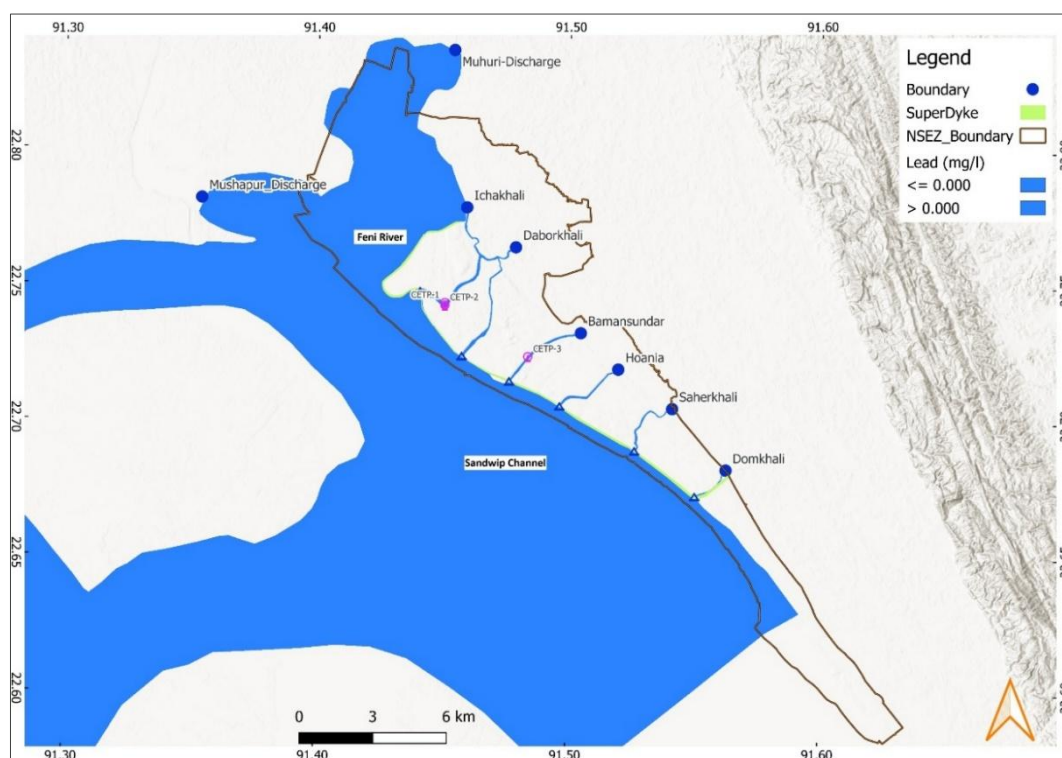
Figure 5-13: BOD variation in the Khals and Sandwip Channel**Mercury and Lead**

At present, Mercury and Lead are constant everywhere in the model domain, and both values have been found to be 0.001 mg/l and 0.01 mg/l, respectively. Both values are within the limit of ECR 2023. Figure 5-14 shows the Mercury and Lead variation in the Khals and the Sandwip Channel.

Figure 5-14: Spatial Distribution of Mercury and Lead



Spatial Distribution of Mercury



Spatial Distribution of Lead

The following table represents the normal condition scenarios from the CETPs and STPs water quality model, which shows that in most cases, the water quality dispersion remains within the limit. All the effects have been considered in comparison with the ECR 2023 suitability for fisheries/recreational purposes that may impact the ecosystem services of the NSEZ and related facilities. A summary of the model results under the CETPs and STPs normal operation conditions has been provided in Table 5-22.

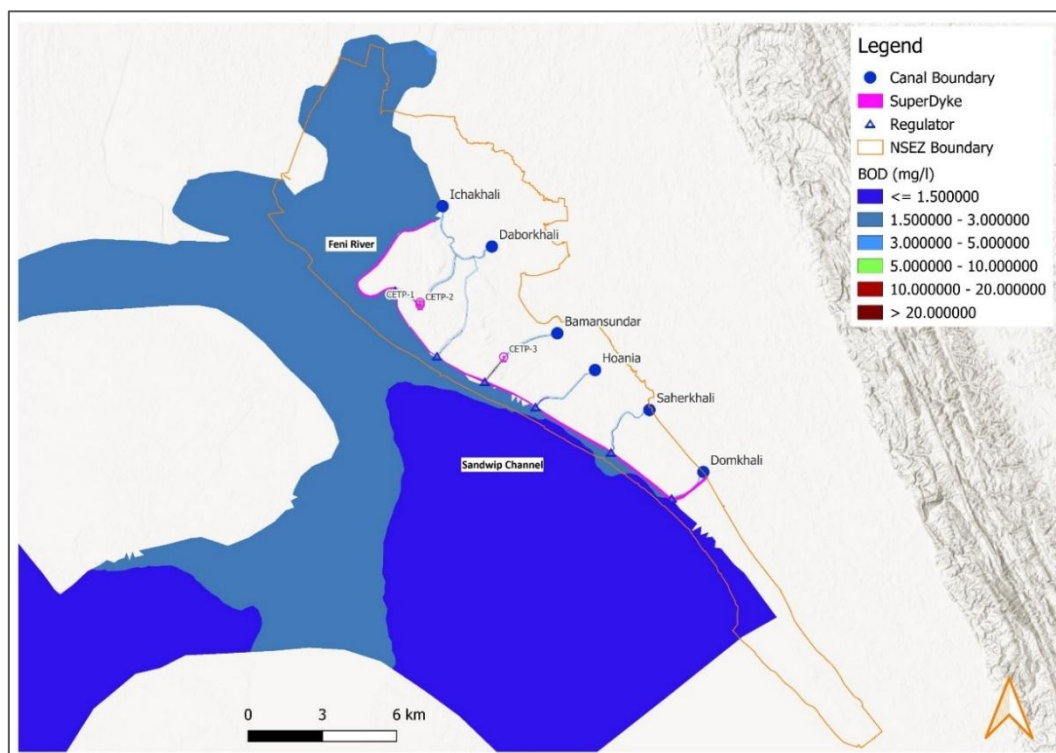
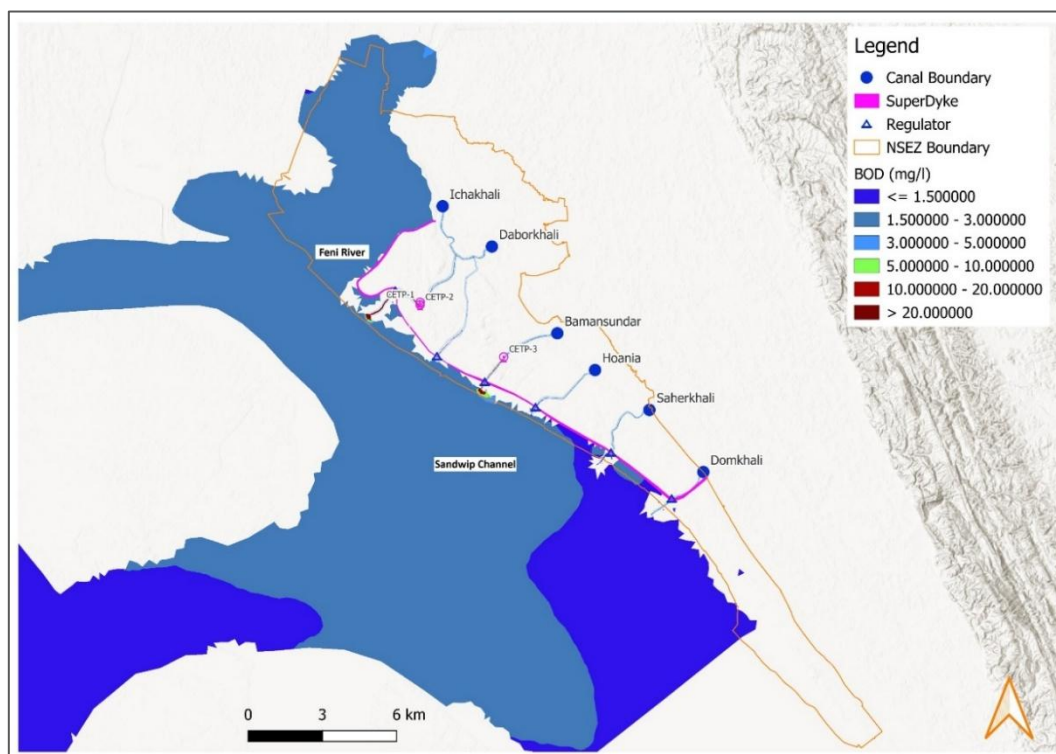
Table 5-22: Summary of the Model Results Under the Normal Operation Conditions

Parameters	Model Result	Ichakhali	Daborkhali	Bamansundar	Hoania	Saherkhali	Domkhali	Sandwip Channel	Remarks
pH	6.78-7.84	7.1-7.3	7.6-7.8	7.39-7.69	7.69-7.84	7.39-7.6	7.2-7.3	7.08-7.2	All are within limit
Nitrate (mg/l)	0.27-4.03	0.27-2.1	1.8-4.03	0.27-1.35	0.54-1.35	0.54-0.81	1.61-2.1	0.81-1.08	All are within limit
DO (mg/l)	5.82-7.57	5.95-6.5	6.07-6.32	6.32-6.7	6.82-7.07	6.82-6.95	6.95-7.07	5.82-6.7	All are within limit
COD (mg/l)	25.3-127.6	25.3-39.93	47.2-69.1	54.5-76.5	47.2-61.8	61.8-76.5	54.5-61.8	47.2-61.8	Most cases exceed the limit
Ammonia (mg/l)	0.19-2.8	0.38-0.56	0.19-0.56	1.6-2.8	0.38-0.75	0.38-0.75	1.3-1.5	0.38-0.75	Most cases exceed the limit
Phosphate (mg/l)	0.61-3.68	0.83-1.05	1.05-1.27	2.3-2.5	2.58-2.80	2.80-3.02	2.80-3.02	1.71-2.15	Exceed the limit in all cases
TSS (mg/l)	124.5-202.4	124.5-130.1	130.1-135.6	157.9-174.6	163.5-169.0	163.5-191.3	185.7-191.3	146.8-163.5	--
Total-Cr (mg/l)	0.0014-0.0075	0.0014-0.0018	0.0018-0.0075	0.0014-0.0023	0.0071-0.0075	0.0036-0.0075	0.0014-0.0075	0.0036-0.0045	All are within limit
Total Coliform (CFU/100 ml)	11.87-38.12	13.75-17.5	17.5-36.25	17.5-25.0	32.5-36.25	21.25-25.0	23.12-25.0	23.1-36.25	All are within limit
BOD (mg/l)	2.33-5.56	3.48-4.41	3.25-4.64	3.48-3.95	2.56-3.25	2.33-3.25	2.56-3.02	2.56-4.18	All are within limit
Mercury (mg/l)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--
Lead (mg/l)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--

5.3.2.3.1.2 Combined Effect of STP and CETP Failure Condition

Biochemical Oxygen Demand (BOD)

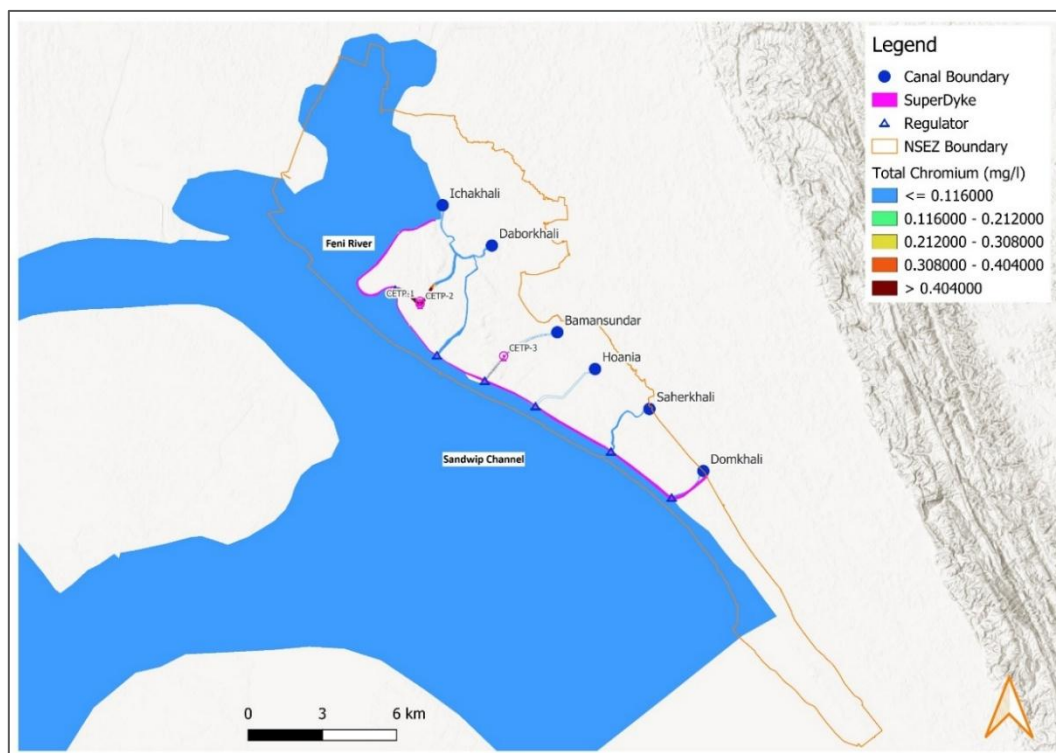
Figure 5-15 shows the BOD variation in the study area during high tide and low tide. It is observed that BOD affects the Ichakhali khal, Bamansundar khal, and Sandwip Channel's water and crosses the allowable limit for all purposes of water use. BOD disperses up to 2.14 km in low tide time and 0.51 km in high tide time from the Ichakhali regulator gate due to the failure of STPs and CETPs mixing water.

Figure 5-15: BOD dispersion in the study area during High and Low Tide**BOD dispersion during High Tide****BOD dispersion during Low Tide****Total Chromium**

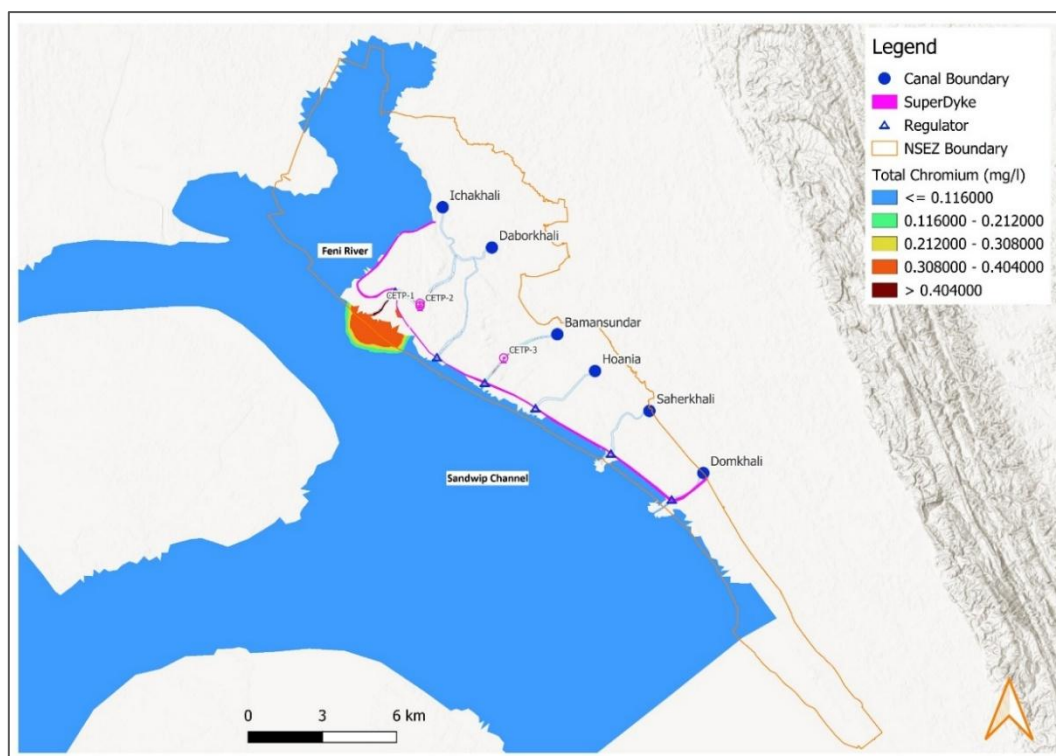
Chromium is dispersed up to 0.8 km from the super dyke area with a maximum intensity of 0.50 mg/l from Ichakhali and Bamansundar Khals during the low tide time, which value is a little bit high for

fisheries due to the STPs and CETPs failure condition as per the model output. Figure 5-16 shows the Chromium dispersion during high and low tide, respectively.

Figure 5-16: Chromium dispersion in the study area during High and Low Tide



Chromium dispersion during High Tide

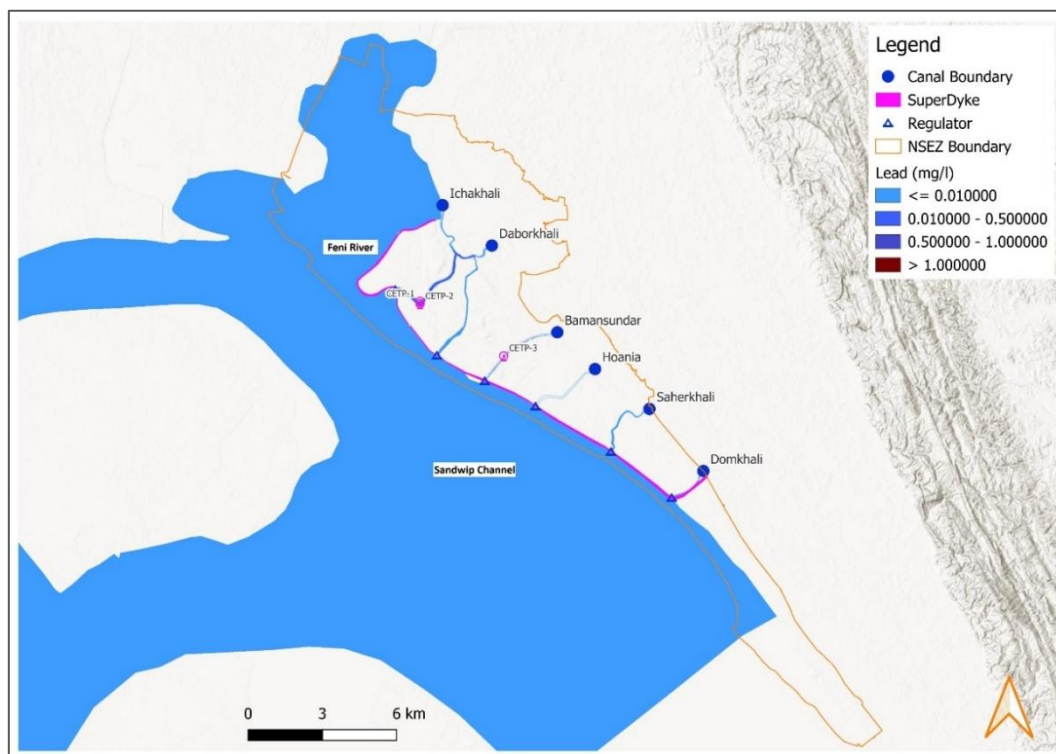


Chromium dispersion during Low Tide

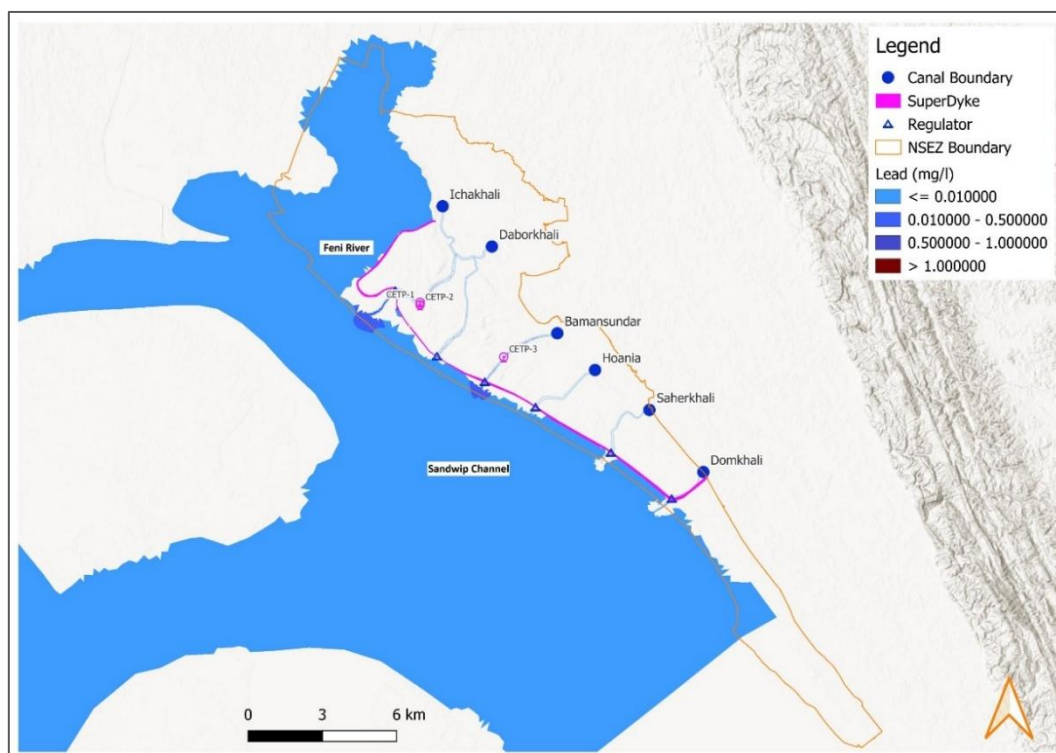
Lead

Due to STPs and CETPs failure, lead concentration crosses the allowable limit of all water quality parameters in Ichakhali khal, Bamansundar khal, and Sandwip channel (1.89 km from Ichakhali regulator). STPs and CETPs mixing failure conditions are shown in Figure 5-17, where both figures show the variation of Lead concentration, and high concentration dispersion spread over up to 2.55 km in the Sandwip Channel from the super dyke area due to the high concentration of lead.

Figure 5-17: Lead dispersion in the study area during High and Low Tide



Lead dispersion during High Tide

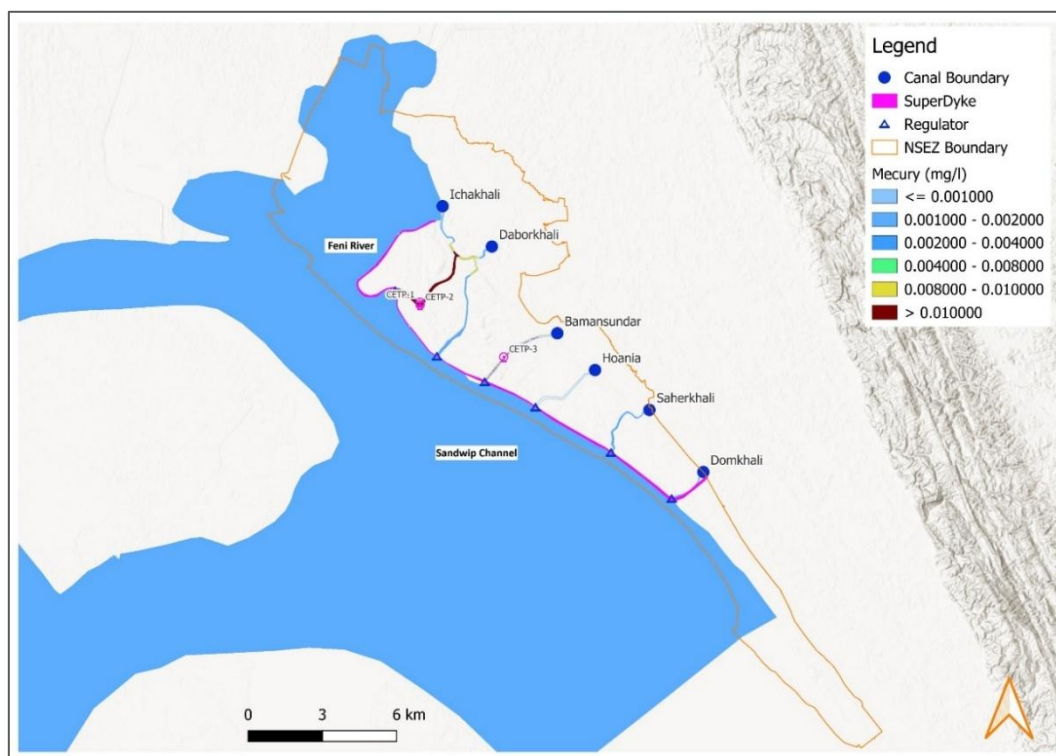


Lead dispersion during Low Tide

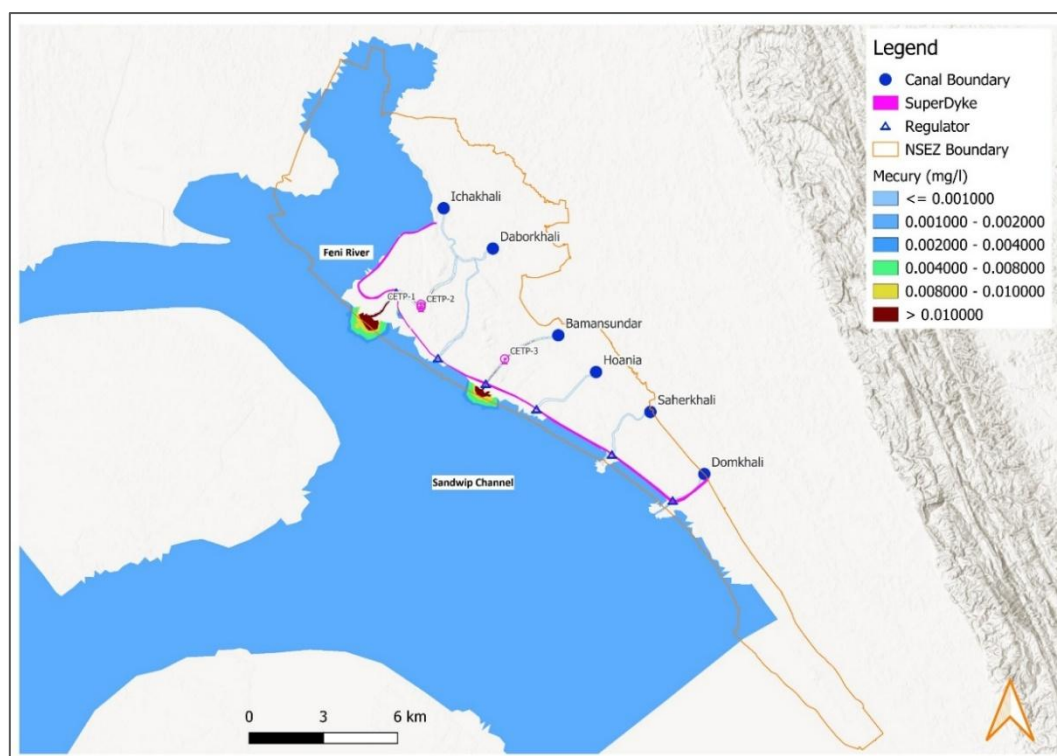
Mercury

Over the model domain, Mercury concentration was found within the limit, except for Ichakhali Khal, Bamansundar Khal, and Sandwip Channel also have the same conditions. Figure 5-18 shows the Mercury dispersion during high and low tide times.

Figure 5-18: Mercury dispersion in the study area during High and Low Tide



Mercury dispersion during High Tide



Mercury dispersion during Low Tide

A summary of the model results under the CETPs and STPs failure conditions has been given in Table 5-23.

Table 5-23: Summary of the Model Results Under the CETPs and STPs Failure Condition

Parameters	Model Result	High Tide	Low Tide	Remarks
pH	>8.0	Due to the combined failure value of 8.0-9.0. pH increases in the Ichakhali khal	Low dispersion in any khals or the Sandwip Channel	Exceeds during high tide, thus impacting high tide
Nitrate (mg/l)	1-6.375	No dispersion	Ichakhali, Daborkhali, and Bamansundar Khals exceed 7.0 mg/l and spread up to 1.23 km	Impact in the Sandwip channel during low tide
DO (mg/l)	1.0-10.0	Found critical in Ichakhali and Bamansundar Khals. No dispersal in the Sandwip Channel	Disperse up to 1.67 km from Ichakhali and 1.53 km from Bamansundar Khal	Impact during low tide
COD (mg/l)	50 - >100	Less than 50.0 mg/l, within limits	Spreads up to 2.86km in the Sandwip Channel	Impact during low tide
Ammonia (mg/l)	1.0-15.0	Ichakhali and Bamansundar Khals	1-15.0 mg/l from Ichakhali and	Impact during low tide

Parameters	Model Result	High Tide	Low Tide	Remarks
		possess 0.3-3.0 mg/l during dispersion	Bamansundar Khals up to 3.6 km	
Phosphate (mg/l)	2.0 - >10.0	Ichakhali and Bamansundar Khals crossed the 10.0 mg/l limit spreads up to 1.7 km	Ichakhali khal dispersion up to 10.0 mg/l	All khals exceeded the limit and affected the Sandwip channel as well
TSS (mg/l)	50-200	Low dispersion	High dispersion up to 1.83 km with 131 mg/l from Ichakhali and Bamansundar khals	Impact during low tide
Cr (mg/l)	0.02-0.5	>0.5 mg/l in Ichakhali khal. Other khals have low dispersion	High dispersion with >0.5 mg/l spreads up to 0.8 km	dispersed up to 0.8 km, impact in low tide
TC (CFU/100 ml)	50	<50.0 mg/l in the Sandwip channel, low dispersion	Not exceeding 50.0 CFU, spreads up to 2.6 km in the Sandwip Channel	does not exceed 50.0 CFU, with no impact
BOD (mg/l)	1.5- >20.0	Ichakhali, Daborkhali, and Bamansundar Khals with 5-10 mg/l spread up to 0.51 km	Ichakhali, Daborkhali, and Bamansundar Khals with 5-12 mg/l spread up to 2.14 km	Impact during low tide
Mercury (mg/l)	0.001-0.010	High dispersion in Ichakhali and Bamansundar Khals	Low dispersion	Impact during high tide
Lead (mg/l)	0.01- >1.0	Exceeds the limit in Ichakhali and Bamansundar Khals, spreads up to 1.89 km	Exceeds the limit, spreads up to 2.55 km	Impact during high and low tide

5.3.2.3.1.3 Climate Change Effect on the Key Pollutant Dispersion

Climate Change Scenarios

The Bangladesh Delta Plan 2100 has developed various climate scenarios based on Representative Concentration Pathways (RCPs) to provide indicative projections for key variables like rainfall, temperature, and mean sea level rise. Table 5-24 shows the different climate change scenarios that have been considered for the water quality modeling as an input parameter in the mathematical section.

Table 5-24: Climate change scenarios and projections across different time frames

Climate Change		2015 (reference)	2030	2040	2050	2100
Mean Sea level rise in cm	Productive	7100	10-20	15-25	20-30	40-60
	Resilient	7100	15-30	30-40	40-60	80-125
	Congestion	7100	10-20	15-25	20-30	40-60

Climate Change		2015 (reference)	2030	2040	2050	2100
	Stagnation	7100	15-30	30-40	40-60	80-125
Longest dry day period Increase in mean number of consecutive dry days	Productive		0	0	0	+5
	Resilient		+5	+8	+10	+20
	Congestion		0	0	0	+5
	Stagnation		+5	+8	+10	+20
Rainfall intensity % change of mean total precipitation	Productive		10	10	10	20
	Resilient		20	20	20	50
	Congestion		10	10	10	20
	Stagnation		20	20	20	50
Cyclone intensity % change	Productive	?	25	45		90
	Resilient	?	70	90		100
	Congestion	?	25	45		90
	Stagnation	?	70	90		100

The above table depicts projected climatic variables (such as temperature, precipitation, or sea-level rise) under various Representative Concentration Pathways (RCP2.6, RCP4.5, RCP6, and RCP8.5) for different future horizons (e.g., 2030, 2040, 2050, 2100).

In this study, we focus on the most extreme climate scenario, the stagnation scenario, for predicting the inflow boundary conditions and local runoff contributions for the Water Quality Model in different canals. Specifically, a projected 20% increase in rainfall by the 2050s under this scenario has been factored into the model. To account for these changes, the rainfall data was reanalyzed using the Delta Plan's stagnation scenario projection, and boundary conditions were recalculated accordingly to reflect future climate impacts on water quality in the canal systems, as shown in Table 5-25.

Table 5-25: Inflow boundary condition based on climate scenario of Delta Plan 2100

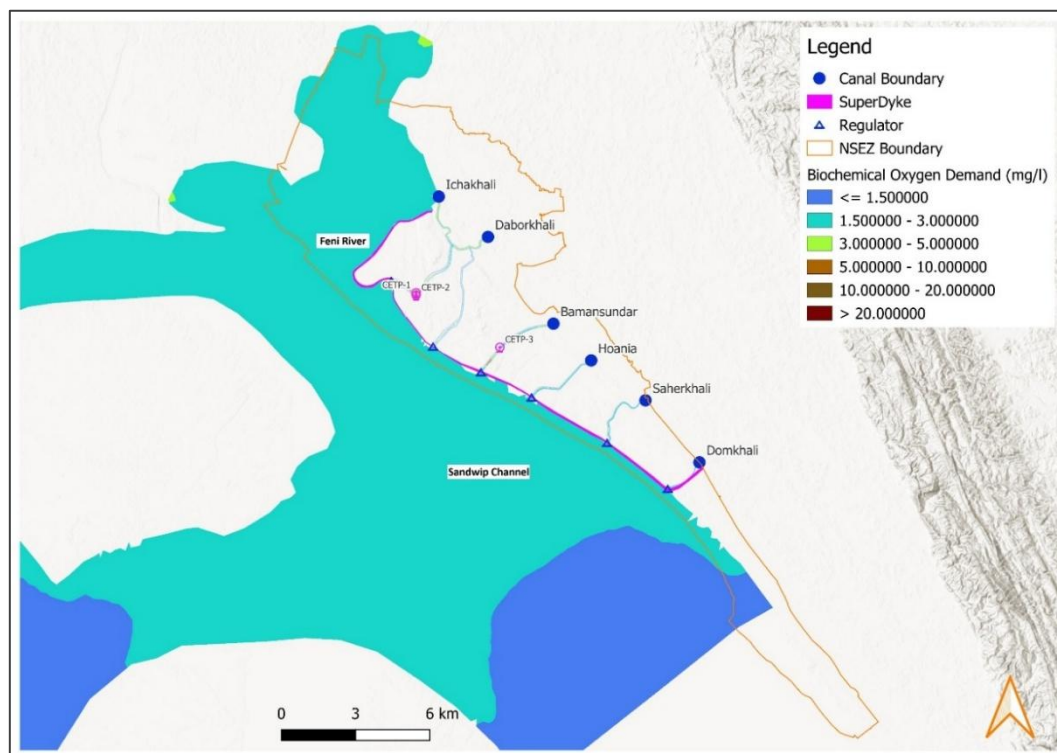
Canal/Khal	Maximum Runoff (m ³ /s)	Minimum Runoff (m ³ /s)	Average Runoff (m ³ /s)
Ichakhali Khal	6.798	0	1.064
Daborkhali Khal	70.882	0.01	12.528
Bamansundar Khal	87.108	0.2	6.743
Honiakhali Khal	9.269	0	0.864
Saherkhali Khal	45.123	1.1	3.839
Domkhali Khal	70.444	0	5.614
NSEZ Catchment	131.692	1.1	5.446

The time frame for the model is set during the operational phase, and the simulation was run continuously for three months during the dry season to capture the worst-case scenarios. This includes the scenario of potential failure of pollution control measures, such as the STPs and CETPs, to analyze water quality without functional pollution control systems.

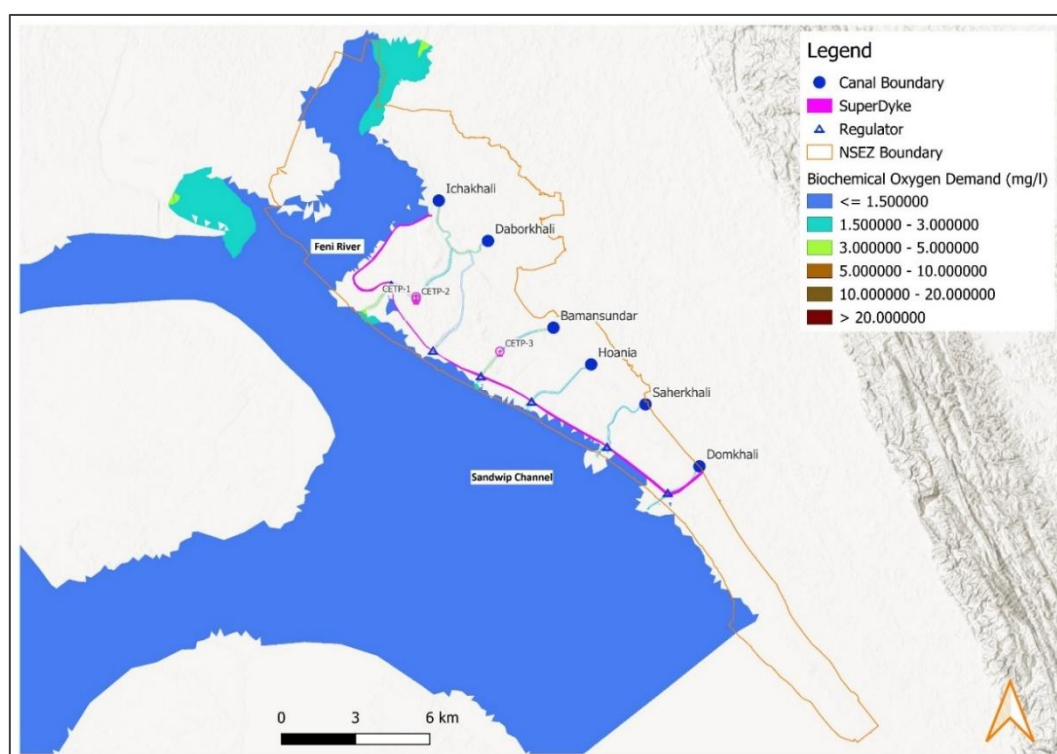
Biochemical Oxygen Demand (BOD)

Figure 5-19 shows the BOD variation in the study area. It's observed that the BOD affects the Ichakhali Khal, Bamansundar Khal, and Sandwip Channel water and crosses the allowable limit of all purposes of water use as per the ECR 2023 of Bangladesh. Biochemical Oxygen Demand (BOD) spreading more than normal conditions due to high flow push the CETPs water into the Sandwip Channel.

Figure 5-19: BOD dispersion in the study area during High and Low Tide



BOD dispersion during High Tide

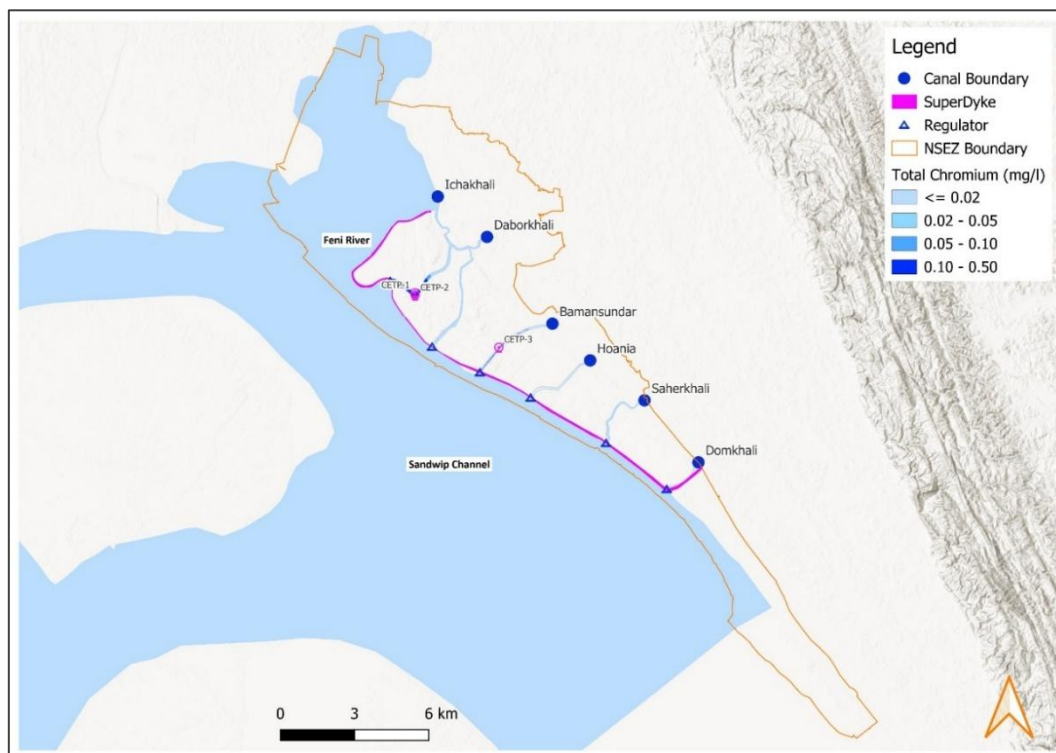


BOD dispersion during Low Tide

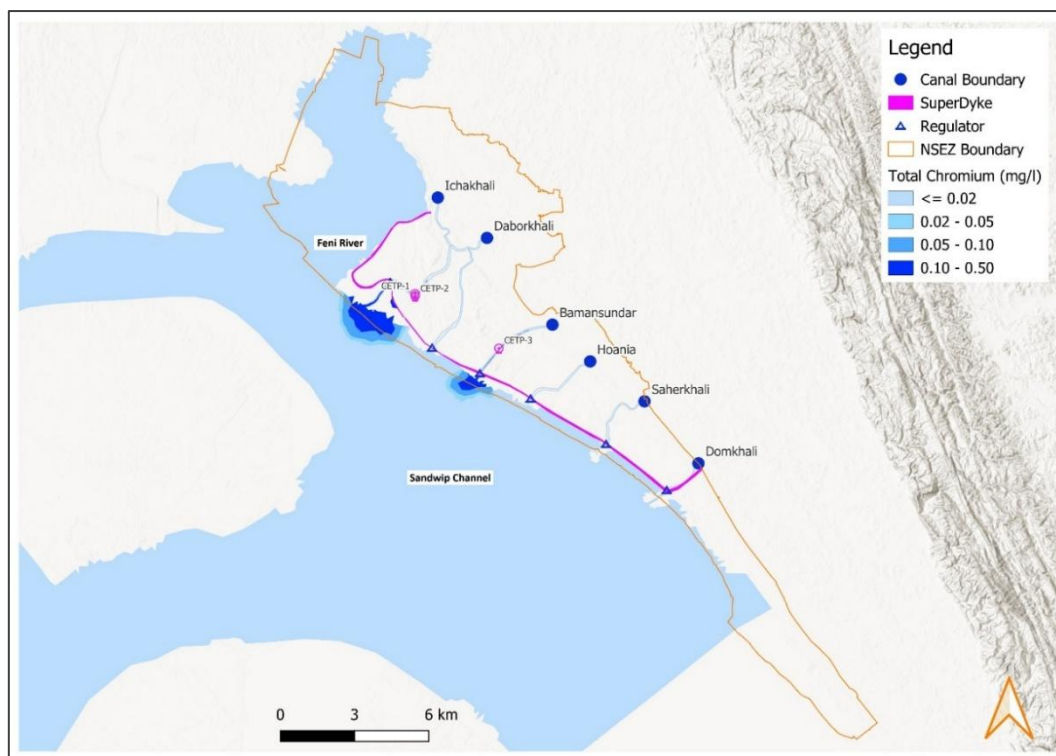
Chromium

Total chromium ranges from 0.02 mg/l to more than 0.5 mg/l during low and high tide times as per the model output. Total chromium will disperse up to 4.33 km from the super dyke area with a maximum intensity of 0.02 mg/l, which is allowable for fisheries purposes. Total Chromium spreads up to 0.6m more due to the high flow from the upstream catchment under the climate change scenarios. Figure 5-20 shows the Total Chromium dispersion during low and high tides.

Figure 5-20: Total Chromium dispersion in the study area during High and Low Tide



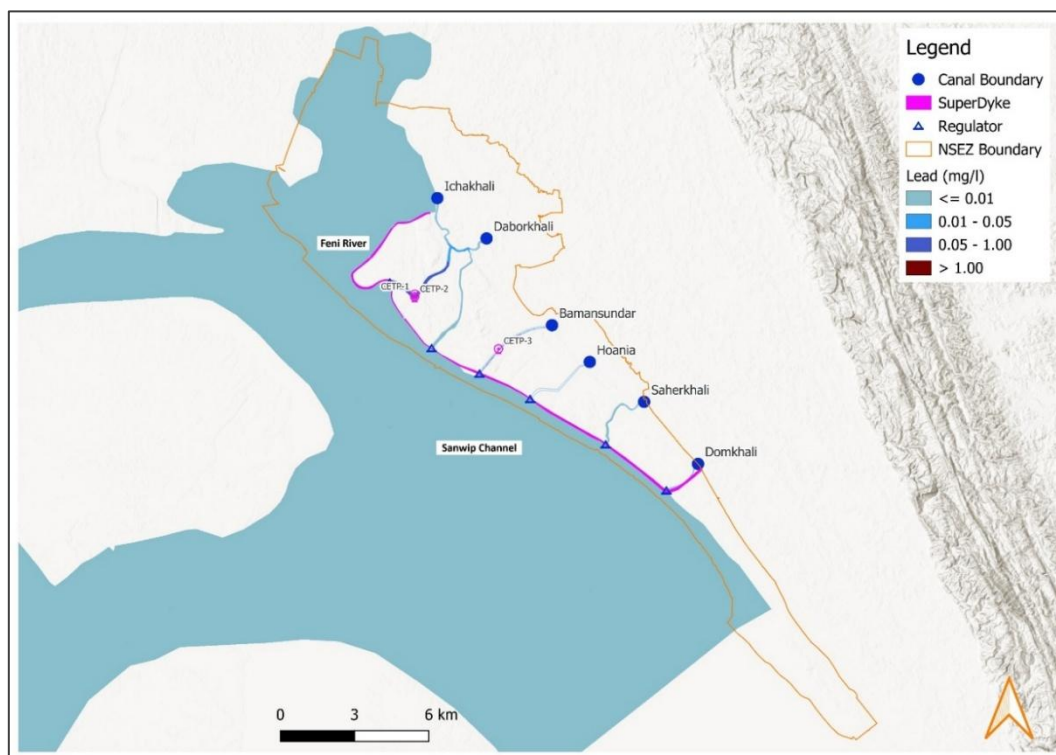
Total Chromium Dispersion During High Tide



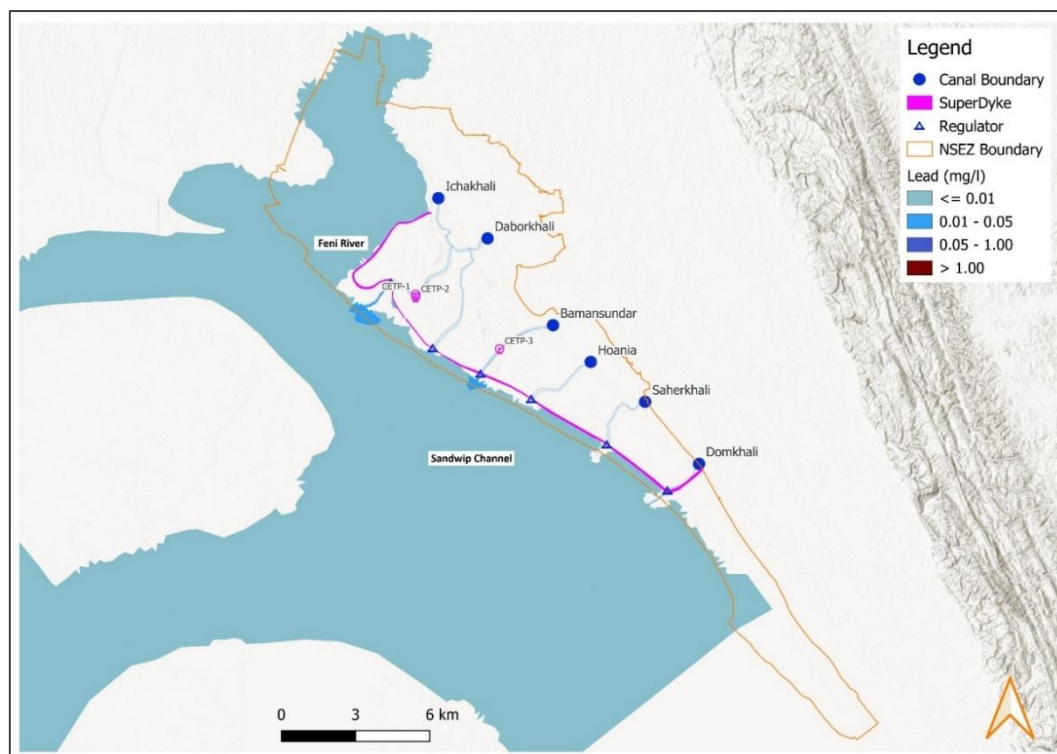
Total Chromium Dispersion during Low Tide

Lead

Figure 5-21 shows the variation of Lead concentration, and high concentration is dispersed up to 3.85 km into the Sandwip Channel from the super dyke area due to climate changes.

Figure 5-21: Lead dispersion in the study area during High and Low Tide

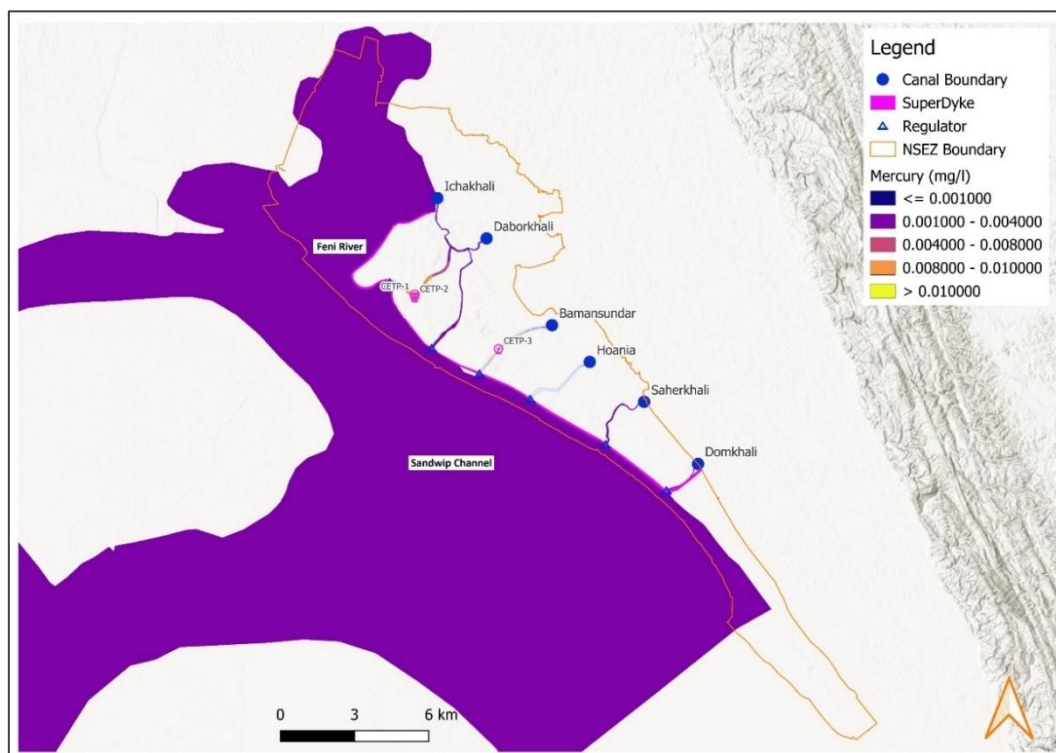
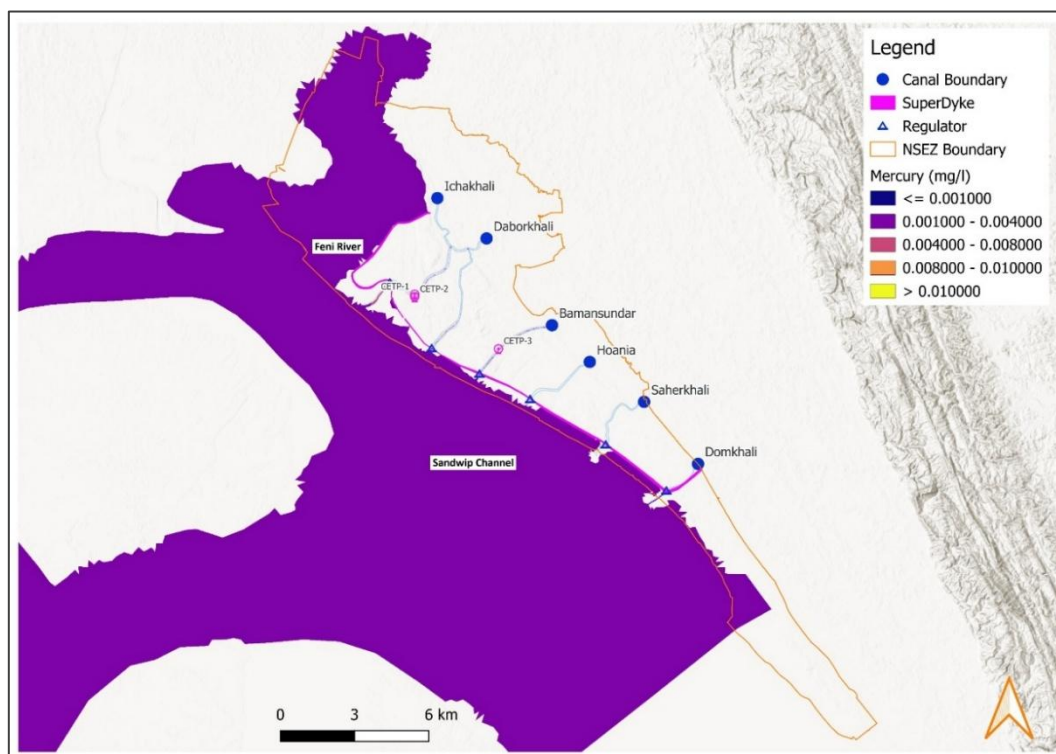
Lead dispersion during High Tide



Lead dispersion during Low Tide

Mercury

Over the model domain, Mercury concentration was found within the limit except for the Ichakhali khal, Bamansundar khal, and Sandwip channel, just near to Ichakhali and Bamansundar regulator gates. The dispersion area is higher than the normal condition. Figure 5-22 shows the Mercury dispersion during low and high tides.

Figure 5-22: Mercury dispersion in the study area during High and Low Tide**Mercury dispersion during High Tide****Mercury dispersion during Low Tide**

In the water quality model, climate change scenarios are considered based on the projections provided by the Bangladesh Delta Plan 2100, which includes variations in rainfall, temperature, and sea level rise. Specifically, we accounted for a 20% increase in rainfall and a 15% increase in river inflows under extreme (stagnation) scenarios by 2050. Additionally, a sea level rise of 38 cm was incorporated to

simulate its effect on salinity and water quality, particularly for downstream boundaries influenced by tidal flows. These projections were used to assess future water quality changes under potential climate impacts. A summary of the model results under the CETPs and STPs failure conditions has been provided in Table 5-26.

Table 5-26: Summary of the Model Results Under the Climate Change Conditions

Parameters	Model Result	High Tide	Low Tide	Remarks
pH	>8.0	Ichakhali khal downstream will be affected with a pH value >8.0	Low dispersion except for the Ichakhali Khal	No effect on the Sandwip Channel
Nitrate (mg/l)	1-6.375	Low dispersion, within the limit	Low dispersion, within the limit	No impact on the Sandwip Channel
DO (mg/l)	1.0-10.0	1-5 mg/l, no dispersion in Sandwip	1-5 mg/l in Ichakhali and Bamansundar khals, spreads up to 0.5-1 km	No high impact on the Sandwip Channel
COD (mg/l)	50 - >100	Always prevails >50.0 mg/l in the Ichakhali and Bamansundar khals	Spreads up to 1-1.5 km	Low impact in the Sandwip Channel
Ammonia (mg/l)	1.0-15.0	Dispersion ranges 1.0 – 5 mg/l, spreads in Sandwip channel	Low dispersion in the Sandwip Channel	High impact during high tide
Phosphate (mg/l)	2.0 - >10.0	Crosses the limits in Ichakhali Khal	Disperse up to 1.78 km	High impact during low tide
TSS (mg/l)	50-200	All Khal's TSS ranges 130 mg/l	Low dispersion	No impact on the Sandwip Channel
Cr (mg/l)	0.02-0.5	Dispersed up to 0.02-0.5 mg/l, low spreading	>0.5 mg/l in the Sandwip channel, spreads up to 4.33 km	Impact during low tide in Sandwip Channel
TC (CFU/100 ml)	50	50 CFU, low dispersion in Sandwip	Spreads up to 3.06 km, with >7000 CFU	Impact during low tide in Sandwip Channel
BOD (mg/l)	1.5- >20.0	10-20 mg/l in Ichakhali, Bamansundar Khals, low dispersion	High dispersion with 10-20 mg/l in the Sandwip Channel	Impact during low tide in Sandwip Channel
Mercury (mg/l)	0.001-0.010	0.004-0.008 mg/l high dispersion in Ichakhali and Bamansundar Khals	0.004-0.008 mg/l dispersion in Sandwip Channel	Impact during low tide time
Lead (mg/l)	0.01- >1.0	0.05-1.0 mg/l in Ichakhali and Bamansundar Khal, low dispersion in Sandwip Channel	Disperse up to 3.85 km from Ichakhali and Bamansundar Khals	Impact during low tide time

Considering the above issues, the impact of the operation of the EZ on surface water quality is evaluated to be **Medium Low**.

5.3.2.4 Impacts on Groundwater

According to the discussion with BEZA, during the operation, the economic zone will not extract any groundwater and fully rely on surface water (Feni and Meghna rivers), desalination plant, CETPs, and rainwater harvesting for industrial operation. Accidental spillage or leaks of chemicals, hydrocarbons (oil, fuel, or other substances), and leachate from the landfill site could percolate into the subsurface and potentially contaminate the groundwater. Any leachate in the groundwater would have adverse impacts on the groundwater hydrology in the region.

It is unlikely that the surface infrastructure associated with the desalination facility, pump stations, water reservoir, and water pipelines will pose a significant risk to the groundwater resources in the EZ by discharging high-salt concentration brine (brine includes toxins like chlorine and copper) and chemicals (e.g., FeCl_3 , NaOCl , AlCl_3 , H_2SO_4) in the environment. Solid waste management facilities including landfill sites may impact the regional groundwater quality. A groundwater monitoring program will be required particularly for the waste management facilities.

According to the discussion with BEZA and master plan of the EZ, four central wastewater treatment plants have been considered and operated to treat wastewater from industries. It is planned that initial screening and treatment will be done by individual industries that are highly polluting (such as Asian Paints and Modern Modern Syntex Ltd.)/ having hazardous substances, including toxic chemicals, heavy metals, and solvents, etc. and sent to the CETPs for further treatment. Wastewater effluent shall be well within the standard, and discharged to the river, no untreated wastewater is allowed to seep into the groundwater source.

The project activity that might impact groundwater quality is the waste management facilities where sanitary landfills and secure landfill sites will be located. A groundwater monitoring program will be required particularly for the waste management facilities.

Good design and construction practices of industries and manufacturing facilities can prevent contamination of groundwater by using impervious material for drainage systems and tanks. However, it is recommended that a systematic groundwater monitoring program should be established to monitor overall contaminants that may be released into groundwater due to project activities. A conceptual hydro-geologic setting of the area should be formulated in order to propose a monitoring program in the long-term program. This will be one of the feasible tools for preventing future groundwater contamination from the developed industrial zones. Possible groundwater pollution sources and pollutants in the economic zone and its surrounding area during the operation are given in Table 5-27.

Table 5-27: Groundwater Pollution Sources and Pollutants

Pollution Sources	Potential Pollutants
Domestic activities (leakage from sewage systems, sewage water drains, septic tanks)	Nitrate, ammonia, phosphate, heavy metals, organic micro compounds, bacteria, etc.
Agricultural activities (excessive use of fertilizers and pesticides, irrigation with wastewater)	Nitrate, phosphate, pesticides, bacteria (from wastewater irrigation), etc.
Industrial activities - chemical industry	Aromatic hydrocarbons, chlorinated hydrocarbons, Heavy metals (Zn, Cd, Cu, etc.)
Industrial activities - textile industry	Aromatic hydrocarbons, Heavy metals (Zn, Cd, Cu, etc.), Acids, Mineral oils
Industrial activities - metal and machinery	Aromatic hydrocarbons, Heavy metals (Zn, Cd, Cu, etc.), Acids, Mineral oils
Industrial activities - food production	Ammonia, vegetable oil products, Nonchemical hydrocarbons
Industrial activities - construction industry	Mineral oils

Pollution Sources	Potential Pollutants
Industrial activities - small-scale service (gas stations and garages)	Aromatic hydrocarbons, Mineral oils

Considering the above issues, the impact of the operation of the EZ on groundwater is evaluated to be **Medium Low**.

5.3.2.5 Impacts on Topography and Soil

During the operation, impacts on topographic conditions are expected to be very small, limited to each plot of the land where individual industries or factories may adjust the elevation and level of their land plot. Potential impacts on the soil environment are envisaged due to hazardous and non-hazardous wastes generated due to the operation of various industries in the economic zone. Process waste, including sludge and residues, chemical waste, including toxic waste, used/waste oil, oil slurry, spent solvents, CETPs & WTPs sludge, etc., are the sources of hazardous waste. Poor management of such waste from the operations is a potential risk of soil contamination. The waste management facility is another area where potential soil contamination may occur.

The operation activities will require that individual manufacturers and factories have appropriate chemical storage areas with secondary containment on impervious ground. Industries with a higher risk of chemical release, such as garment and textiles, and electronics industries, will need to conduct specific environmental assessments that will include identifying the risk of spill and preventive measures. The individual industry and factory should develop a spill and emergency response plan. Potential contamination of soil can be limited through these measures.

Considering the above issues, the impact of the operation of the EZ on topography and soil is evaluated to be **Medium Low**.

5.3.2.6 Impacts on Sediment

The operation of industries in the economic zone will produce various types of waste. If not properly handled, the waste can contaminate water and sediment quality in the internal khals and Sandwip Channel. The wastewater from individual industries that are highly polluting (such as Asian Paints and Modern Modern Syntex Ltd.) will be pretreated. Wastewater from the industrial industry will be collected and transferred to the central treatment plant, designed with appropriate treatment techniques.

The wastewater from industries will be pretreated to meet the requirements according to the national regulatory requirements (Schedule-3 and Schedule-4 of ECR 2023). The pretreated wastewater will then be combined and transferred to the central effluent treatment plants of the economic zone. According to the Master Plan, wastewater after treatment will be recycled to meet various industrial water usages (viz. steel plant) as well as other usages to meet non-domestic demand including gardening, cleaning, car washing, etc. Efforts shall be given to recycle about 70% of the wastewater after treatment to meet various industrial usages". The rest of the treated wastewater will then be transferred through the drainage system and discharged into the Sandwip Channel.

Solid waste that will be generated at the jetty facility should be collected and managed properly. Waste disposal from ships/vessels may impact sediment quality if proper management is not done.

Considering the above issues, the impact of the operation of the EZ on sediment quality is evaluated to be **Medium Low**.

5.3.2.7 Impact due to Changes in Land Use

Potential negative impacts on land use are predicted to affect the surrounding area of the economic zone. One of the major concerns is the unplanned land use in EZ's surrounding areas as a result of the increasing demand for social infrastructures by the influx of a large number of workers. As the industries in EZ will start operation, there will be a need for services other than those day-to-day services that can be provided within the township zone. Naturally, it can be predicted that the EZ surrounding area, with

a certain level of infrastructure and social services, will rapidly grow to accommodate the requirements of project personnel such as residences for the supervisors or higher officials who prefer not to stay within the industrial estate, business clients, and guests who visit the economic zone shortly for specific purposes, or other workers who perform services to the project personnel but are not allowed to stay in the township zone.

The major negative impact due to land use changes around the EZ is the problem of uncontrollable use. Currently, the locals are facilitating workers by providing food, services, and even temporary shelters for additional income. Therefore, they are developing their houses and markets haphazardly and in an unplanned way. Without proper control, at the time of the EZ operation, the surrounding area will become permanent communities over time at the location unfitted and even endangering both efficient and safe operations of the project and also the residents themselves. Urban Development Directorate (UDD) under the Ministry of Housing and Public Works is the only physical planning agency of the GOB to advise the government on matters of policy relating to urbanization, land use, and land development and to prepare and co-ordinate regional plans, master plans and detailed layout and site plans for the existing as well as the new urban centers excluding the areas covered by the present town development authorities of Dhaka, Chittagong, and Khulna. Their vision is to augment the quality of life of the people by improving the environment through planned development activities for adequate infrastructure, service, and utility provisions, to make optimum utilization of resources, especially land, and to ensure geographically balanced urbanization. UDD already prepared the Mirsharai Upazila Development Plan (MUDP) in 2020 which will help to reduce unemployment and poverty problems and socio-economic development by creating employment opportunities by protecting agricultural land and building an industrial and tourism-based city²⁴.

The National Housing Authority (NHA) is also working in the area to select a suitable site and develop a township for the workers and officials. At present, there is no specific authority to exercise the land use planning practice in the whole total EZ area, therefore, participants during the stakeholder consultation raised their concerns and proposed to establish a “Development Authority” for the EZ surrounding area.

Considering the above issues, the impact of the operation of the EZ on land use changes is evaluated to be **Medium High**.

5.3.2.8 Impact due to Solid Waste Generation

During the operation, it is likely to generate a substantial volume of solid waste which can be broadly categorized as municipal waste, hazardous waste, and non-hazardous waste. Further, the generated solid waste generated may include biodegradable, recyclable, reusable, and inert compounds from municipal and nonindustrial occupants and industrial occupants. Solid waste will be generated from the canteen, office, workers facilities, medical, maintenance workshop, etc.

According to the Master Plan, total 777,084 tons/year of solid waste will be generated including 245,644 tons/year of industrial solid waste and 531,440 tons/year of municipal solid waste from the EZ in the year 2040. The area required for municipal solid waste landfill will be 184.0 acres considering possible maximum landfill height is 20m. The landfill has enough land area to accommodate the projected waste.

Considering the location of the landfill site and water level in the area, the proposed landfill site should require provisions for an impermeable liner, a leachate collection & treatment system, and a suitable cover that is resistant to rainwater infiltration. In addition, a groundwater quality monitoring system should be implemented.

Depending on the characteristics of the waste, different types of disposal methods can be used for waste management. The most predominant and widely practiced methods for waste disposal are landfill, incineration, and composting. In addition, the waste-to-energy concept can be introduced.

²⁴ <https://www.mudp.gov.bd/about.php>

Apart from those listed, e-waste from both domestic and industrial segments is also expected to be generated in the EZ. If the solid waste generated is not properly managed and disposed of in an unauthorized manner, it will impact the air quality, soil quality, and groundwater quality.

Wastes originating at the jetty may include inert solid waste from administrative offices, as well as hazardous or potentially hazardous waste associated with vehicle and equipment maintenance operations (e.g. used lubricating oils and engine degreasing solvents). Wastes originating from ships may include oily sludge, inert materials such as food packaging, and food waste. These wastes will generate odor and health impacts and ground and surface water contamination, if not managed properly.

Apart from domestic and electronic waste, solid waste will be generated from a CETP includes various types such as sludge (e.g., residues from primary treatment processes containing coarse materials like sand, grit, and organic debris), chemical residues (e.g., coagulants and flocculants such as alum, ferric chloride, or polymers), heavy metal contaminants, oil and grease residues, filter residues (e.g., solids from filter presses during sludge dewatering), non-biodegradable materials (e.g., plastic, glass, and inert debris), hazardous waste, salt residues, microbial biomass (e.g., from activated sludge systems or biofilm reactors), and construction and maintenance debris. These will produce some environmental impacts like

- Surface and deep layer soil and groundwater aquifer contamination through pollutant leaching
- Air pollution through methane, a potent greenhouse gas emission
- Microbial and terrestrial habitat disruption
- Increase in toxicity and potential for bioaccumulation
- Increase the contamination potential of groundwater through natural recharge
- Improperly managed sludge and waste can attract pests and rodents, increasing the risk of disease transmission
- A landfill can negatively affect the landscape, reducing the area's aesthetic value, and making a societal impact

According to the master plan, about 10 acres of land have been allocated for biomedical waste management and 40 acres for industrial hazardous waste storage/management. Medical waste will contain both general and infectious waste. This constitutes a public health hazard, if not managed properly. This type of waste needs to be managed according to Medical Waste Management Rules, 2008. According to the consultation with the local municipality, currently, they have no capacity to handle medical waste as well as industrial hazardous waste. Therefore, NSEZ should develop a medical waste management system in the EZ region with the help of the Ministry of Health and industrial hazardous waste management through DOE-licensed vendors.

Considering the above issues, the impact due to solid waste generation and disposal from the operation of EZ is evaluated to be **Medium High**.

5.3.2.9 Impacts of Liquid Waste Generation

EZ is anticipated to generate various forms of wastewater. According to the discussion with BEZA and master plan, an estimated volume of 118.32 MLD of sewage wastewater is projected by the year 2040. Therefore, two STPs have been proposed having a total capacity of 125 MLD (45+80 MLD) and 60 acres of land area have been allocated. In addition, an estimated volume of 350 MLD of industrial wastewater is projected by the year 2040. Therefore, four CETPs have been proposed having a total capacity of 350 MLD (50+50+100+150 MLD) and 155 acres of land area have been allocated. This is bearing in mind that there is no existing wastewater treatment plant in the EZ area. As such this high volume of wastewater might be a major health hazard if proper measures are not put in place.

The source of wastewater generation from EZ operational activities is industrial process wastewater/effluent, domestic wastewater/sewage, equipment cleaning, floor washings, etc. The facilities in the

industrial sectors proposed in the EZ can be considered a series of unit processes that will generate liquid waste, such as:

- Apparel and textiles will involve de-sizing, scouring, mercerizing, bleaching, neutralizing, dyeing, printing, and finishing.
- Automobile and electronics industry will involve melting, die casting, cutting, shearing, forming, welding and soldering, heat treatment, forging, dressing/grinding, machining, non-destructive testing, surface preparation, surface coating, etc.
- Non-metallic minerals industries will involve crushing/grinding, classifying/separating, wet/dry product mixing/blending, firing/curing/cooling, melted products manufacture, resin-coated sand & foundry cores, stone, and monument working processes.
- Food and agro-processing industries will involve grinding, sieving, mixing, fluidization, sedimentation, flotation, filtration, rectification, absorption, extraction, adsorption, heat exchange, evaporation, drying, fermentation, sterilization, pasteurization, enzymatic peeling, refining, chemical peeling, and aquaculture.

Also, sewage will be generated from the sanitary and domestic blocks at the industrial units of the clusters, mixed-use & residential, and common facilities such as amenities and utilities. The untreated wastewater, if discharged into nearby surface waters may affect the surface water and/or if disposed of land without treatment may pollute the ground and surface water.

There are four CETPs proposed in NSEZ, where the CETP-1 will be established in Precinct F (2A, 2B), CETP-2 will be establish in Precinct F (2A, 2B, 3, 4 and 5), CETP-3 will be established in Precinct G and F, and CETP-4 in Precinct I, respectively. The proposed CETP locations in the NSEZ are suitable based on the proximity to natural drainage, strategic placement within industrial zones, protection from coastal hazards via super dyke, etc. The site designated for CETPs and STPs will remain flood-free due to the presence of the protective super dyke along the seaside. This super dyke will serve as a barrier against tidal surges and flooding, shielding the CETPs and STPs, and other precincts of the NSEZ from the adverse impacts of inundation and waterlogging. A summary of key suitability factors is given below:

- *Proximity to Industrial Units:* CETPs are located near zones that are likely to host clusters of industrial units, allowing for efficient connection and centralized treatment. This can minimize pipeline length and pumping costs.
- *Proximity to water bodies:* nearest drainage channels (khals) can support treated effluent outfall after quality control. This can reduce the need for long-effluent conveyance pipelines, minimizing cost, leakage risk, and pumping energy.
- *Buffer Zones:* maintain a safe distance from residential areas and agricultural land to prevent contamination.
- *Elevation and flood protection:* all CETPs are located in the countryside of the super dyke, which has a +90 m MSL crest elevation, protecting them from storm surges, coastal flooding, cyclone events, etc.
- *Accessibility for operation & maintenance:* the proposed CETP sites are accessible via planned internal roads within NSEZ. This will support smooth O&M activities, chemical delivery, sludge management, and monitoring.

According to the discussion with BEZA, the design period for the CETPs is planned to meet the requirements up to the project horizon of 2040. The development works for CETPs are planned to take into consideration a phased increment in demand. According to BEZA, the capacity requirements for the CETPs are given in Table 5-28.

Table 5-28: Capacity Requirements for the CETPs

CETP No.	Proposed CETPs Capacity (MLD)		
	2025	2030	2040
CETP-1	-	50	50
CETP-2	-	50	50
CETP-3	-	-	100
CETP-4	-	-	150

Source: BEZA, August 2025

According to the discussion with BEZA, the total wastewater generation by 2040 will be an estimated amount of 343 MLD, and the total treatment capacity is 350 MLD. Considering the volume generated and proposed capacity it could be said that the facilities are adequate.

Considering the above issues, the impact due to liquid waste generation and disposal from the operation of the EZ is evaluated to be **Medium High**.

5.3.2.10 Impacts on Drainage

During the operation, surface water flow would be the same as the flow at the end of the development phase because the drainage system and structures on the surface during this phase would undergo no change since they will be completed in the previous phase. According to the EZ master plan, stormwater drains shall be provided on either side of the proposed road network of the area to collect the storm runoff generated from the catchment and get it discharged to the drainage channel for ultimate disposal to the Sandwip Channel. Indicative command area (catchment area) for each of the existing drainage channels passing through EZ, with locations of the pumping stations proposed at the location close to its outfall to the sea.

From the stakeholder consultation, it was revealed that currently, the local community is constructing their structures haphazardly and without keeping adequate drainage facilities in the EZ surrounding area. Heavy and continuous rainfall during the monsoon and cyclones may expose the risk of rapid flooding locally, including cumulative flooding in regional areas. The flood control infrastructures, if not well-maintained, will be subject to negative impacts such as local flooding due to inadequate maintenance of the drainage system. In addition to that, the natural drainage canals are not properly excavated every year, which is required to maintain sufficient drainage conveyance capacity and reduce the flooding impacts during extreme monsoon and climate change conditions.

Different road networks are developing in the EZ surrounding area by the local community without considering proper drainage or water-passing provisions. In such cases, there is a possibility of drainage congestion or flooding in the surrounding area of EZ. Moreover, erratic rainfall will make more worsen conditions in the drainage system in the whole area, mainly during the rainy season (April-September). The prolonged local flooding may directly and indirectly affect the living conditions of people and workers, cause poor environmental sanitation, and pose potential sources of communicable diseases. According to the master plan, a stormwater drainage facility has been considered for a design of short-term return periods, which might not support extreme monsoon and long-term climate change conditions. Moreover, chute drains can be constructed.

As per the discussion with BEZA and review of the Master Plan, it has been observed that without a comprehensive and resilient drainage strategy, the NSEZ remains vulnerable to severe and prolonged waterlogging, especially during high rainfall events, cyclones, or tidal lock conditions. The drainage capacity and design outlined in the master plan are primarily based on short-term climate change considerations, such as a 5-year design return period. However, recognizing the potential long-term impacts of climate change, the associated drainage challenges have been addressed through proposed mitigation measures aimed at enhancing the system's resilience.

To address these concerns, the master plan prescribes both structural and non-structural measures to ensure long-term drainage sustainability. Structurally, storm drains will be constructed as rectangular RCC sections, with covered drains in residential and commercial zones and open channels in industrial zones for easier maintenance. Sluice gates and flap gates will be installed at all drainage outfalls to control tidal backflow, while strategically located pumping stations are planned to evacuate stormwater during high tide lockage. Non-structurally, plot-level drainage responsibilities have been assigned to individual plot owners, requiring them to design internal drainage systems that connect to the main network, which can enhance the proper sanitation conditions during flooding conditions.

For future resilience, improvements in the drainage system must include regular desilting of natural khals, construction of stormwater retention basins to reduce peak discharges, and real-time pump operation management. Furthermore, the NSEZ planning authority should enforce land use zoning and regulate infrastructure development in the adjacent areas to avoid encroachment on drainage paths.

For the area immediately outside of the EZ, not only should land use be controlled, but also other infrastructure that will enable setting up structures and services, such as local roads, electricity, gas, water supply, telephone, internet line, and drainage, should be well planned and controlled. The strategic locating or prohibiting of these basic infrastructures will induce and encourage early settlers and services outside the designated township zone into the area planned by the organization to provide temporary services in the early stage of development.

The EZ site is currently dominated by natural vegetation. The implementation of the EZ master plan will hence lead to a reduced rate of water infiltration rate due to increased concrete coverage in the area. In view of this, the volume of runoff will accumulate from the current volumes leading to a strain on the existing drainage channels. This will lead to flooding downstream if proper measures are not put in place. This will in turn lead to an increase in soil erosion in the area.

In the EZ, when the floodwater will come from the river and khals upstream and meets the strong sea tides, the water level will rise, the water will drain slowly, and flood time will be prolonged. In such cases, the risks of flooding can be minimized by popular technical mitigation measures such as pumping.

Considering the above issues, the impact of the operation of the EZ on drainage is evaluated to be **Medium High**.

5.3.2.11 Impacts of Traffic

Traffic volume on the improved roads is predicted to increase significantly during the operation of EZ, specifically during the morning and afternoon peaks. According to the EZ master plan, it is assumed that the maximum one-way passenger traffic by 2040 towards Dhaka-Chattogram Road and Sonagazi will be around 9,000 passenger car units/hour and 3,200 passenger car units/hour respectively. Improvement of regional road networks may prompt high-speed driving, which is likely to cause accidents for pedestrians unless adequate road safety measures are adopted. In addition to the risk of accidents, increased traffic will lead to inconvenience to the local public, and road users, and increase the potential for nuisance in the region.

During the operation, a huge number of workers will be moved on the access road at a time; therefore, there will be a risk of traffic congestion on access roads as well as the Dhaka-Chattogram Highway. Traffic congestion will not only waste precious time and fuel of commuters but also cause air and noise pollution, along with causing stress and anxiety, leading to impatience and accidents.

The increased traffic volumes will increase the potential of incidents on the internal road as well as access roads within the region, specifically at intersections and passing through busy (market, schools, etc.) areas, resulting in serious injuries or even fatalities.

Existing road networks in the region are not adequate to support additional traffic volume due to the operation of industries in the EZ. There is an urgent demand for up-gradation and expansion of the provision of additional transport systems with the increase in the capacity of roads to scoop up the upcoming requirements of transportation and communication. The existing secondary roads in the

region that are linked between EZ and Dhaka-Chattogram Highway need to be constructed/strengthened the roads for the workers and public to use. A service lane should be introduced for walking and slow vehicle movement along the main road network. In addition, adequate drainage provision for rainfall water should need to be considered in road design.

Considering the above issues, the impact of the operation of the EZ on traffic is evaluated to be **Medium High**.

5.3.2.12 Loss of Ecosystem Services

Ecosystem services are the benefits that people receive from healthy natural systems. These include direct resources such as food and water (provisioning services), functions like air and water purification and climate regulation (regulating services), recreational and cultural values (cultural services), and basic ecological processes such as nutrient cycling and habitat provision (supporting services). As per the NSEZ Master Plan, the landscape surrounding the EZ is expected to provide a range of these services during its operation phase. Agricultural lands, natural and planted vegetation, wetlands, and surface water bodies will support food production, maintain biodiversity, regulate microclimates, and offer open spaces for recreation. These services play a critical role in maintaining both ecological balance and human well-being.

The operation of EZ is likely to hamper these services in different ways. One of the most pressing concerns is the possible decline in water quality, stemming from industrial effluents and urban runoff can enter surface and groundwater sources, threaten aquatic ecosystems and reduce the availability of clean water for drinking, irrigation, and other uses directly affecting provisioning and regulating services.

Habitat loss and biodiversity decline are also a concern. Continued development and infrastructure expansion may lead to the loss and degradation of the few remaining natural habitats in the area, limiting space for wildlife. This may also disrupt regulating services such as flood control and pollination, and also reduces cultural services like recreation and aesthetic enjoyment.

A healthy ecosystem contributes to natural air filtration and pollutant absorption through vegetation and soil processes. However, industrial emissions and traffic associated with EZ can lead to air pollution which is closely linked to the degradation of regulating ecosystem services. This degradation can negatively affect both wildlife and human health in the surrounding areas.. Pollutants like particulate matter, nitrogen oxides, and volatile organic compounds can contribute to respiratory problems of the surrounding living organisms.

Increased industrial activities and urbanization associated with EZ are likely to lead to elevated levels of noise and light pollution. These disturbances, while often considered independently, have direct and significant implications for supporting ecosystem services, which form the foundation for biodiversity and ecosystem functioning. Noise from machinery and transportation disrupts wildlife habitats, interfering with communication and breeding. Light pollution can disrupt natural light cycles, impacting nocturnal wildlife. These disruptions compromise key supporting services such as habitat provision, species reproduction, and ecological balance ultimately affecting the integrity and resilience of the entire ecosystem.

The accidental spills, leaks, and improper waste disposal can contaminate soil, affecting fertility and ecosystem health. Accumulation of heavy metals, chemicals, and other pollutants can pose risks to human health, wildlife, and agricultural productivity, impacting provisioning services like food production.

Continued urbanization and industrial expansion can exacerbate pressure on natural resources like land, water, and energy, leading to further depletion and degradation. This reduces the overall capacity of ecosystems to provide services.

Exposure to pollutants and environmental stressors can impact community health, leading to increased respiratory illnesses, allergies, and other health problems. Disruption of ecosystem services and loss of access to natural environments may also affect community resilience and economic stability.

Considering the above issues, the impact on ecosystem services during the operation of EZ is evaluated to be **Low**.

5.3.2.13 Impacts on Terrestrial and Mangrove Flora

The majority of land use conversions will have already occurred during the development phase. However, the remaining terrestrial and mangrove habitats within the adjacent area will still be subject to environmental pressures related to ongoing industrial and urban activities. However, BEZA allocated a total of 40.37% (13,646.28 acres) of land as mangroves, green areas, vegetation, and open spaces which is a significant increase compared to the existing coverage.

Terrestrial vegetation, particularly in preserved green spaces and roadside or buffer plantings, may also be impacted by soil compaction, vehicular emissions, and deposition of airborne pollutants (e.g., dust, heavy metals). These factors can reduce plant health, photosynthetic activity, and regeneration capacity. In addition, mangrove habitats within the designated preserved and green space areas are expected to remain in place. However, they may still face indirect operational impacts such as air and water pollution from industrial activity, increased human presence, and altered hydrological patterns due to infrastructure use and stormwater discharge. These stressors could affect mangrove health, growth rates, and resilience, even without direct clearance. Mangroves, being sensitive to changes in salinity, sedimentation, and water quality, may decline in ecological function if not carefully protected through operational management practices.

Additionally, invasive plant species may spread due to increased transport and human activity. These species can outcompete native flora, reduce plant diversity, and degrade habitat quality over time. Without active vegetation management, even preserved areas could gradually shift in composition.

The remaining habitats including secondary vegetation, green belts, and preserved planted mangrove patches are expected to support some native wildlife such as birds, reptiles, insects, and small mammals. However, continued disturbance from noise, light, and human presence during operations may limit their use as effective wildlife habitat. Wildlife reliant on intact vegetative cover or low-disturbance environments may decline or shift range.

Considering the above issues, the impact of the operation of the EZ on terrestrial and mangrove flora is evaluated to be **Low**.

5.3.2.14 Impacts on Terrestrial Mammals

The operation of the EZ can have long-term impacts on terrestrial mammals. A fully developed industrial zone, buildings, and infrastructure, and the creation of new transportation networks can further fragment existing mammal habitats. This can disrupt breeding, foraging, and dispersal patterns, hindering mammal movement and potentially leading to population decline in the long run.

Modified and converted habitats for industrial purposes can lead to a permanent reduction in the availability of food resources for herbivores. This can have cascading effects on carnivore populations that rely on herbivores for prey. Roads, railways, and other transportation infrastructure can act as barriers, restricting mammal movement and isolating populations. This can disrupt gene flow and hinder adaptation to changing environmental conditions.

Operational activities such as traffic, maintenance work, and industrial processes can cause ongoing disturbance to mammals in the surrounding areas. This can lead to chronic stress, disrupt breeding behavior, and reduce the overall fitness of mammal populations.

Artificial lighting from industrial facilities, streetlights, and other operational activities can disrupt the behavior of nocturnal mammals. This can affect their foraging efficiency, predator-prey interactions, and navigation patterns. As human activity and infrastructure expand with the operational EZ, the likelihood

of encounters between humans and mammals increases. This can lead to conflicts, injuries, and even fatalities for both humans and wildlife.

Accidental spills of oil, lubricants, or other hazardous materials can contaminate the environment and harm mammals. Industrial activities may also generate air and water pollution, impacting mammal health and reproduction success.

Considering the above issues, the impact of the operation of the EZ on terrestrial mammals is evaluated to be **Low**.

5.3.2.15 Impacts on Birds/Avifauna

BEZA allocated a total of 40.37% (13,646.28 acres) of land as mangroves, green areas, vegetation, and open spaces which will provide important shelter and breeding habitat for various bird species. These green zones may support both residents and migratory birds. Additionally, the nearby Sandwip Channel and its mudflats serve as critical foraging grounds for waterbirds. However, ongoing industrial activity, lighting, and increased infrastructure use may disturb bird behavior, particularly during breeding and migration. Risks include displacement due to noise and light pollution, and bird collisions with buildings or structures within EZ.

As human development encroaches on natural habitats, there is an increased likelihood of human-avifauna conflict. This can occur when avifauna species are attracted to urban areas in search of food and shelter, leading to encounters with humans and potential conflicts. The establishment of new infrastructure and increased human activity can facilitate the introduction and spread of invasive species. These invasive species may outcompete native fauna for resources, disrupt ecosystem dynamics, and threaten the survival of native species.

Operational activities within EZ will generate air and noise pollution. Air pollutants can affect respiratory health in birds, while noise pollution can disrupt communication and breeding behavior. Artificial lighting from industrial facilities, streetlights, and other operational activities can disrupt the nocturnal behavior of birds, impacting their feeding, breeding, and navigation patterns. Excessive artificial lighting can also affect the behavior, reproduction, and migration patterns of migratory birds.

During the operation, continuous industrial activities such as traffic movement, maintenance, and equipment operation may disturb nearby bird populations through noise and human presence, potentially causing displacement from shelter and foraging sites. Accidental leakage of oil, lubricants, or fuels could contaminate soil and water bodies, including runoff into the nearby Sandwip Channel. Such pollution may degrade the mudflat ecosystem, which serves as an important foraging ground for resident and migratory waterbirds. Reduced prey availability, particularly of aquatic invertebrates and insects, may affect insectivorous and carnivorous birds, leading to a decline in their health, breeding success, and local abundance.

Considering the above issues, the impact of the operation of the EZ on avifauna is evaluated to be **Low**.

5.3.2.16 Impacts on Herpetofauna

The EZ operation phase may create various challenges for terrestrial fauna, including reptiles and amphibians (herpetofauna). Land conversion for residential, commercial, and industrial zones will fragment and reduce available habitat for herpetofauna. This can disrupt breeding, foraging, and migration patterns, isolating populations and hindering their survival.

During the operation phase of the NSEZ, increased human activity, vehicular movement, and noise may disturb remaining habitats, potentially displacing reptiles and amphibians from preserved green areas. Ongoing light and noise pollution can alter their natural behaviors, affecting breeding, foraging, and sheltering patterns. Some species, particularly snakes, may be drawn toward operational zones in search of food or refuge, increasing the risk of human-wildlife encounters. These disturbances can lead to chronic stress, reduced reproductive success, and gradual population declines among local herpetofauna.

The new infrastructure and increased human activity can facilitate the introduction and spread of invasive species. These invaders may compete with native herpetofauna for resources, disrupt ecosystem dynamics, and threaten the survival of native species.

Industrial activities within EZ may result in air, water, and soil pollution. Pollutants can contaminate food sources, degrade habitats, and compromise the health of herpetofauna populations. Some amphibians, with their permeable skin, are particularly vulnerable to pollutants. The operation of EZ infrastructure can alter natural ecological processes like nutrient cycling, water flow patterns, and disturbance regimes. These alterations can disrupt the balance of ecosystems and negatively impact the abundance and distribution of herpetofauna species.

Effluent discharge and accidental leakage of oil, lubricants, and fuel during the operation phase can introduce toxic substances into the soil and water bodies, disrupting ecological balance and contaminating important habitats. Such pollution poses significant risks to herpetofauna, particularly amphibians with permeable skin and reptiles that depend on clean soil and aquatic environments. Of particular concern is the nearby Sandwip Channel and its associated charland, which provide habitats for species such as the Asian water monitor lizard and the Dog-faced water snake. Contamination in these areas could degrade habitat quality, reduce prey availability, and threaten the survival of these sensitive species.

Considering the above issues, the impact of the operation of the EZ on herpetofauna is evaluated to be **Low**.

5.3.2.17 Impacts on Aquatic Mammals

The operation of the EZ could potentially have an effect on dolphin populations in the Sandwip Channel, particularly impacting species such as the Irrawaddy Dolphin and the Indo-Pacific Humpback Dolphin. The operation of the jetty and increased shipping activity may result in heightened vessel traffic within the Sandwip Channel, thereby increasing the risk of collisions with dolphins. Additionally, the continuous noise generated by vessels and jetty activities has the potential to disrupt dolphin communication and echolocation, and even cause hearing damage.

The discharge of untreated or inadequately treated industrial wastewater can introduce pollutants such as heavy metals, organic compounds, and toxins into the water, directly harming dolphins or indirectly through the bioaccumulation of these contaminants in their prey. Furthermore, spills of oil, lubricants, or other pollutants during operational activities can lead to water pollution, posing a threat to dolphins. Maintenance dredging activities carried out within the jetty or for channel expansion purposes may alter the seabed, thereby reducing the availability of prey for dolphins.

During operations, discharge brine effluent from the desalination facility may lead to elevated levels of salinity in the direct vicinity of the discharge. Effluents may also contain biocides, chlorine, and lower levels of dissolved oxygen, which will influence water chemistry and quality. Furthermore, the desalination process removes particulate matter from the water column, where it is a food source for various marine biota.

The pollution and habitat alteration resulting from operational activities can also negatively impact fish populations, upon which dolphins rely for sustenance. Exposure to vessel noise and collisions can cause physical injuries and permanent hearing damage in dolphins. Consequently, dolphins may avoid noisy or polluted areas, potentially leading to shifts in their distribution patterns and displacement from crucial habitats. Moreover, the increase in tourism activities within the Sandwip Channel could exacerbate these issues. Chronic stress induced by noise pollution and habitat disturbance may further impact dolphin reproductive success and calf survival rates.

Considering the above issues, the impact of the operation of the EZ on aquatic mammal populations is evaluated to be **Medium High**.

5.3.2.18 Impacts on Ichthyofauna (Fish)

The operation of the EZ will pose a significant challenge to the aquatic ichthyofauna (fish populations) of the surrounding water bodies. Discharge of untreated or inadequately treated industrial wastewater can introduce pollutants such as heavy metals, organic compounds, and toxins into the water bodies, adversely affecting fish health and reproduction. Furthermore, increased stormwater runoff from upstream areas may carry pollutants like fertilizers, pesticides, and oil residues into waterways, leading to the degradation of water quality. Spills of oil, lubricants, and other materials during jetty operations can also contaminate the water, posing risks to fish populations.

The operation of infrastructure, including jetty, industrial areas, and residential zones, will result in habitat loss, degradation of aquatic habitats, and alteration of aquatic ecosystems where fish species reside and breed. This can hinder fish migration routes and access to spawning grounds. Moreover, improved access to waterways through ports may attract more fishing vessels, potentially leading to the overexploitation of fish stocks if not managed sustainably.

Habitat loss, degradation, and pollution from operational activities may contribute to a decline in fish species diversity in affected water bodies. Leakage or spills of construction materials, such as oil, lubricants, and concrete, can contaminate waterways, posing toxicity risks to fish and other aquatic life. Increased sedimentation from surface runoff can suffocate fish eggs, impede fish respiration, and disrupt fish development. Furthermore, pollutants from industrial activities and urban runoff may bioaccumulate in fish tissues, posing health risks to humans who consume these fish.

Impacts on fish populations can have cascading effects on aquatic food webs, affecting other aquatic organisms like birds and mammals that rely on fish for food. Additionally, increased vessel traffic associated with operational activities may disturb fish behavior and heighten the risk of collisions with vessels. Operational activities may also facilitate the introduction and spread of invasive species into water bodies, further disturbing the balance of the aquatic ecosystem.

Improper disposal of industrial waste, food waste, cardboard, paper, packaging, plastic, etc., in the water body not only degrades the aesthetic value of the Sandwip channel but may also potentially cause health hazards to fish ichthyofauna in the form of water and soil sediment contamination. Therefore, stringent measures for waste management and pollution control are imperative to safeguard the health and sustainability of aquatic ecosystems in the EZ operational phase.

Considering the above issues, the impact of the operation of the EZ on Ichthyofauna (fish) is evaluated to be **Medium Low**.

5.3.2.19 Impacts on Hilsa Fisheries

While the construction phase presents significant threats, the operation of the EZ can also negatively impact the Hilsa fish of the Sandwip channel and their spawning grounds near Mayani Point.

Untreated or inadequately treated industrial wastewater discharge can introduce pollutants like heavy metals, organic compounds, and toxins into the water bodies, harming Hilsa health and reproduction. Spills of oil, lubricants, and other materials during port operations can contaminate the water and harm fish populations, including Hilsa.

Increased stormwater runoff from urban areas within the EZ can carry pollutants like fertilizers, pesticides, and oil residues into waterways, degrading water quality. Clearing vegetation along riverbanks for development purposes can reduce shade and food sources for Hilsa, impacting their growth and survival. The continued presence of jetties and other structures can fragment migration routes and hinder access to spawning grounds.

The development of the jetty might attract more fishing vessels, leading to overexploitation of Hilsa stocks if not managed sustainably. Increased fishing activity can result in the unintentional catching of Hilsa during the targeting of other fish species.

Underwater noise from vessel traffic and operations, along with artificial light from the port and surrounding areas, can disrupt Hilsa communication and spawning behavior.

Degradation of water quality, habitat alteration, and disruption of spawning activities can significantly reduce the spawning success of Hilsa in the affected area. Reduced spawning success can lead to a decline in the number of Hilsa juveniles recruited into the population, impacting future fish stocks. Pollutants from industrial activities and urban runoff can bioaccumulate in Hilsa tissues, posing a health risk to humans who consume these fish.

Increased human activity associated with the operation of EZ may facilitate the introduction and spread of invasive species into the water bodies. These invasive species could compete with hilsa fish for resources, further threatening their population.

Considering the above issues, the impact of the operation of the EZ on hilsa fish is evaluated to be **Medium Low**.

5.3.2.20 Impacts on Plankton and Benthos

The operation of the EZ may also pose some threats to the plankton and benthos population of the Sandwip channel. Continued operation of infrastructure within EZ, such as ports and industrial facilities, may lead to ongoing habitat alteration in the Sandwip Channel. Dredging for port maintenance and industrial activities could disrupt benthic habitats and alter sediment dynamics, affecting benthic organisms. Operational activities within EZ, including industrial processes, shipping, and urban runoff, may contribute to ongoing pollution and contamination of the Sandwip Channel. Chemical pollutants, such as heavy metals and industrial effluents, could adversely affect planktonic and benthic communities, leading to reduced biodiversity and compromised ecosystem health.

Effluent discharge from industrial facilities and urban areas within the EZ could continue to degrade water quality in the Sandwip Channel. Elevated nutrient levels and organic matter from wastewater discharge may promote algal blooms, altering planktonic communities and potentially leading to hypoxic conditions harmful to benthic organisms.

Ongoing maritime traffic associated with the port and logistics hub within EZ could continue to pose a physical disturbance to planktonic and benthic organisms in the Sandwip Channel. Ship traffic, including dredging operations and vessel movements, may cause habitat disturbance, sediment resuspension, and noise pollution, impacting both planktonic and benthic communities. The cumulative effects of ongoing operational activities within EZ, combined with other anthropogenic stressors in the Sandwip Channel, may exacerbate impacts on planktonic and benthic organisms over time. Continued pressure from multiple sources of disturbance could lead to further declines in species diversity and ecosystem resilience.

The operation of industrial facilities within EZ may contribute to greenhouse gas emissions and exacerbate climate change impacts on the Sandwip Channel ecosystem. Changes in temperature, precipitation patterns, and ocean acidification associated with climate change could further stress planktonic and benthic organisms, compounding existing threats to their survival and reproductive success.

Considering the above issues, the impact of the operation of the EZ on plankton and benthos is evaluated to be **Medium Low**.

5.3.2.21 Community Health, Safety, and Security

Industrial and gas emissions from industries may cause direct impacts: increasing pollution levels of SO₂, NO₂, PM₁₀, and VOC in the surrounding environment. Disposal of waste, hazardous waste, and effluent discharge will cause certain impacts on the local environment, including soil and water, resulting in deterioration of the community's health status. Materials, machinery, and associated infrastructure items are required; therefore, the volume of transportation may escalate significantly and may lead to an increase in road accidents and injuries.

The increase in accommodation and growth of supporting industries in the surrounding areas will create pressure on the adequacy of infrastructure amenities, public health services, public health facilities, as

well as sanitation, especially around the EZ area. Improper management of sewage, wastewater, and solid waste may lead to poor sanitation and environmental health stresses. Currently, the public health services of the local authorities are limited; therefore, the EZ should closely collaborate with the local authorities to create mitigation measures to prevent the consequences that may occur.

The increase of foreign labor may lead to the emergence of various diseases, possibly spreading to the residents, especially in areas with poor hygiene practices. Sexually transmitted diseases, HIV/AIDs, and communicable diseases are associated with the mobility of workers.

Considering the above issues, the impact of the operation of EZ on Community Health, Safety, and Security is evaluated to be **Medium Low**.

5.3.2.22 Occupational Health and Safety

During the operation of EZ, reckless work and accidents may become significant causes of injuries and fatalities among workers, particularly among unskilled workers. Depending on the type of industry, accidents may be caused by various activities, for example, electrical machines/devices, rotating and moving equipment, working at height, high temperature working conditions, confined space, and traffic at the site. A wide range of injuries may be found from minor and medical aid only to disabling injuries and/or death.

There will be diversified industries in EZ. Each type of industry will have different environmental, health, and safety risks. Working environment and safety, including accidents, may become significant causes of injuries and fatalities for workers. Pollution due to emissions from industries to the environment may affect the health of workers, especially in the long term. Industries will use chemicals that pose flammable, reactive, or toxic properties. The release of these chemicals may cause significant adverse impacts, including fire, explosion, and toxic gases. Major hazards, fire explosions and toxic chemical leaks, may occur in crucial industries, particularly steel mills, power plants, and petrochemical plants, resulting in large-scale adverse effects, including loss of properties, injuries, disabilities, and death.

The NSEZ is expected to accommodate a wide range of industrial sectors, including steel manufacturing, paint production, textile processing, and other light industries such as plastics, electronics assembly, food processing, and packaging. Each of these industries introduces specific occupational health and safety (OHS) concerns arising from the nature of raw materials used, production processes, operational practices, and the working environment.

In the steel industry, the primary sources of OHS risks include high-temperature operations involving furnaces, casting of molten metals, welding, and the use of large mechanical equipment. These processes expose workers to extreme heat, molten splashes, and the danger of mechanical injuries from cranes, rollers, or presses. Confined spaces in kilns or gas tanks also create risks of toxic gas accumulation, fire, or asphyxiation. These hazards can lead to severe injuries such as burns, heatstroke, crush injuries, or even fatalities.

The paint manufacturing industry presents risks largely due to the handling, storage, and mixing of hazardous chemicals such as volatile organic compounds (VOCs), solvents (e.g., toluene, xylene), and flammable substances. The main sources of impact include poorly ventilated mixing areas, unsafe storage of flammables, and inadequate handling procedures, which may result in chemical inhalation, skin contact, fire, or explosion. Workers may suffer from respiratory illnesses, chemical burns, dermatitis, and, with chronic exposure, organ damage.

In the textile industry, the sources of impact include the mechanical processes of spinning, weaving, dyeing, and finishing, which often generate high levels of airborne fibers and dust, particularly in cotton-based units. Long working hours on noisy machinery and repetitive tasks are also common. These working conditions pose risks such as byssinosis (lung disease), hearing loss due to continuous exposure to noise, musculoskeletal disorders due to poor ergonomics, and skin irritations from exposure to dyes and finishing agents.

Other light industries expected in the EZ also pose significant OHS risks. In plastics and packaging, the heating of polymer resins, cutting and molding machinery, and chemical adhesives used in production are key sources of impact. These may result in thermal burns, inhalation of toxic fumes, and repetitive strain injuries. In electronics assembly, the use of lead-based solder, solvents, and minute component handling in repetitive cycles creates health risks including lead poisoning, nerve damage, and ergonomic stress injuries. In food processing units, sources of impact include exposure to hot surfaces, sharp tools, biological contaminants, and allergens. This can lead to cuts, burns, foodborne illnesses, and allergic reactions.

Across all industries, general OHS risks stem from inadequate use of personal protective equipment (PPE), poorly maintained machinery, insufficient training, lack of emergency preparedness, and weak enforcement of safety standards. Physical hazards (e.g., noise, vibration, extreme temperatures), chemical exposure, and poor ergonomic conditions are expected to be widespread. These can cause both short-term injuries and long-term occupational diseases such as respiratory issues, nervous system disorders, reproductive health impacts, and cancers. Poor sanitation, overcrowded accommodation, and limited health services increase the vulnerability of workers particularly migrant and foreign laborers to infectious diseases, including sexually transmitted infections and vector-borne illnesses like malaria and dengue.

Furthermore, psycho-social risks are expected to be significant, especially for workers separated from families, working in unfamiliar environments, and subjected to high workloads. Sources of psycho-social stress may include long working hours, lack of recreational facilities, job insecurity, and poor grievance redress systems. As a result, issues such as stress, anxiety, depression, insomnia, substance abuse, interpersonal violence, and other mental health conditions may become more prevalent.

Considering the above issues, the impact of the operation of the EZ on Occupational Health and Safety is evaluated to be **Medium Low**.

5.3.2.23 Labor Influx

Large-scale industrial operations in the NSEZ will attract skilled, semi-skilled, and unskilled workers from across Bangladesh and possibly neighboring countries. These workers will relocate to the region, either individually or with their families, leading to increased pressure on local housing, services, and infrastructure in the region.

Employees who relocate for work are likely to bring family members, which will further increase the demand for residential housing, education, health care, and community facilities. This extended migration places additional burdens on already limited public services in adjacent towns and communities.

To meet the daily needs of the growing workforce, service providers such as vendors, shopkeepers, tea stall owners, rickshaw pullers, transport operators, mechanics, and food vendors will migrate to the area. This secondary migration often happens rapidly and in an unregulated manner, contributing to informal settlements.

Entrepreneurs seeking to capitalize on increased consumer demand often move in to establish small businesses (e.g., food carts, grocery shops, phone recharge stalls, barber shops, etc.). Without appropriate zoning and space planning, this can lead to overcrowding, poor sanitation, and conflicts over space and services.

Even during the operation phase, continued infrastructure development, expansion, and maintenance work will require short-term and rotating laborers. These temporary workers often live in makeshift camps or rented rooms with minimal oversight or support facilities.

A segment of migrants may include individuals or groups seeking to buy or hold land, anticipating future value appreciation due to industrial growth. This speculative behavior can distort local real estate markets, inflate land prices, and exclude local populations from affording property or housing.

Many industries and infrastructure components in the NSEZ will rely on contractors for logistics, facility management, waste handling, security, transportation, and catering. These contractors often bring their own labor force from other regions, who may not be familiar with the local culture and environment.

The promise of daily wages or informal employment can attract transient laborers from poorer or disaster-affected regions of the country. These individuals typically have no permanent settlement and may live in unsafe, unhygienic, and temporary accommodations, increasing the risk of social and health-related challenges.

In rural or underdeveloped areas adjacent to the NSEZ, local businesses and service providers may lack the scale, capacity, or competitiveness to meet the demands of the growing population. This creates space for external actors to move in, pushing local vendors out of the market and deepening inequalities. Considering the above issues, the impact of the operation of the EZ on labor influx is evaluated to be **Medium High**.

5.3.2.24 Child Labor, Forced, and Bonded Labor

The operation of the EZ will require a significant labor force, expected to generate approximately 1.4 million employment opportunities by 2040. The majority of the workers who will be recruited locally and regionally will be unskilled and semi-skilled laborers. Considering the number of employment opportunities and involvement of many investors in the EZ, the child and forced labor risk cannot be ruled out. In the case of the absence of policies and procedures regarding labor and working conditions, they can potentially be the cause of issues related to the risk of child labor, bonded, and forced labor. A combination of poor living standards in urban settings and an influx of cheap labor from children perpetuates both poverty and the use of child labor. Oftentimes, families rely on the extra income produced by their children to sustain their livelihood. Many children are forced to work to help support their families. In other cases, children are forced to work for a living themselves because their families are abandoned or cannot take care of them.

Moreover, in the absence of a robust, transparent, and regulated recruitment system, many employers may resort to informal labor contractors or middlemen (locally known as dalals) who often prioritize cost-cutting over compliance. These intermediaries can facilitate the employment of underage workers or vulnerable individuals under exploitative conditions, especially during the early development phases of the NSEZ when regulatory oversight may still be weak.

Many nearby areas, including parts of Chattogram and Feni districts, are marked by poverty, low literacy rates, and limited employment opportunities. Families struggling with economic hardship may be compelled to send their children to work, particularly if wages are offered informally and in cash. Children are more likely to be employed in labor-intensive sectors such as construction, packaging, waste sorting, light manufacturing, and food services—all of which are expected to proliferate in the NSEZ.

Bonded labor can arise when workers, often migrants from poorer regions, accept advance payments or loans from employers or labor agents to cover relocation, housing, or other costs. These advances could trap workers in exploitative conditions if they are forced to work long hours or under poor conditions to repay debts, often without written contracts. This is practiced in some South Asian labor markets and may be particularly pronounced in the early stages of the NSEZs or surrounding labor market formation, where worker protections and grievance mechanisms may be underdeveloped.

In order to protect children from jeopardy to their health, safety, or morals, it should be ensured that children under the age of 18 are not employed for work on the projects in EZ. As per the Labor Act 2006, no one below the age of 14 (minimum age) will be employed as labor. A child over the minimum age (14) and under the age of 18 may be employed or engaged in connection with the project only if the work is not likely to be hazardous or interfere with the child's education or be harmful to the child's health or physical, mental, spiritual, moral, or social development. During the operation period, there is a risk of engaging child labor in different tasks. Investors should be prohibited from employing anyone under 18 years for employment. Forced employment of laborers, especially of local laborers, is a serious

offense and must be prohibited. Sudden and random inspection by BEZA needs to be done on a regular basis to ensure compliance.

Considering the above issues, the impact of the operation of the EZ on child labor and forced labor is evaluated to be **Medium High**.

5.3.2.25 Gender Based Violence and Sexual Exploitation and Abuse/Sexual Harassment

During the operation phase of the National Special Economic Zone (NSEZ), significant demographic and social changes are expected due to the influx of a large, predominantly male workforce, accompanied by their families, informal workers, and service providers. This shift in population composition, combined with the expansion of industrial, commercial, transport, and residential activities, creates multiple sources of gender-based violence (GBV), sexual exploitation and abuse (SEA), and sexual harassment (SH).

Industrial and factory operations, including manufacturing, assembly, food processing, and logistics, will employ thousands of women in labor-intensive roles. These settings may expose female workers to workplace harassment, coercion, and discrimination, with male supervisors or colleagues often acting as perpetrators. Commercial and service sectors, such as retail shops, restaurants, banking, and health facilities, will similarly expose women and adolescent girls to harassment and exploitation, especially in informal employment arrangements or unregulated service provision.

Transportation and logistics activities, including freight movement, internal road networks, bus terminals, and cargo handling areas, will further increase exposure to harassment, intimidation, and unsafe conditions during commuting, disproportionately affecting female workers and dependents. Worker accommodations and housing settlements, often crowded and inadequately secured, will heighten the risks of domestic violence, sexual exploitation, and abuse, particularly in informal settlements where privacy, sanitation, and security are insufficient.

Public spaces, marketplaces, and recreational areas, dominated by male populations, will increase the likelihood of verbal harassment, intimidation, and social exclusion of women and girls. Contracted or subcontracted workers, especially females in informal arrangements, may experience higher vulnerability to exploitation, poor working conditions, and harassment due to the lack of formal oversight.

These impacts are further amplified by the interaction of migrant populations with host communities, which can intensify competition over limited resources, exacerbate social tensions, and increase the risk of domestic violence, psychological abuse, and exploitation of marginalized groups, including children. As such, the convergence of industrial, commercial, residential, and community activities during the NSEZ operation phase presents multiple pathways through which GBV/SEA/SH risks may materialize, affecting women, adolescent girls, and other vulnerable populations both within the zone and in surrounding host communities.

Considering the above issues, the impact of the operation of the EZ on gender-based violence and sexual exploitation and abuse/sexual harassment is evaluated to be **Medium Low**.

5.3.2.26 Violence Against Children

During the operation of the EZ, children may become involved in operational activities by running errands or doing simple tasks. These activities could keep the children away from school, in addition to the risk of being exposed to accidental and other injuries. In addition, increased opportunities for the host community to sell goods and services to the incoming workers can lead to child labor to produce and deliver these goods and services, which in turn can lead to enhanced school dropout rates.

Considering the above issues, the impact of the operation of the EZ on violence against children is evaluated to be **Medium Low**.

5.3.2.27 Impact on Social Infrastructures

During the operation phase of the National Special Economic Zone (NSEZ), a significant demographic transformation is expected due to a large-scale population influx. This migration will not be limited to just the employed workforce within the EZ; it will also encompass their families, dependents, informal workers, and a wide range of service providers. The projected increase in population by 2040 indicates not just a quantitative change, but a qualitative shift in the socio-economic and spatial dynamics of the region, particularly in and around the Mirsharai and Sonagazi area.

Housing and Settlement Patterns: The most immediate and visible source of impact derive from the increased demand for housing. Stakeholders repeatedly expressed concern during consultations about the insufficient housing infrastructure in the surrounding Upazilas. These areas are not currently prepared either in terms of planning or service delivery capacity to accommodate the anticipated population surge.

Due to the lack of affordable and formal housing options, the trend of informal settlements is already emerging in peri-urban areas such as Magadia and Ichakhali, where workers are settling due to lower costs and better accessibility. These unregulated developments are often initiated by small-scale local entrepreneurs who respond quickly to market demands, yet in the absence of any planning authority or regulatory oversight. This unplanned settlement pattern is likely to accelerate, leading to “slumification,” or the growth of informal and substandard housing clusters, resulting in land-use conflicts, disruption of drainage patterns, and increased vulnerability to waterlogging during monsoon seasons.

Such changes to local settlement patterns risk creating segregated communities, with newcomers and informal settlers occupying marginal or hazard-prone lands, leading to deepened social divisions and spatial inequality. Without timely intervention, these issues could spiral into larger socio-political challenges, including increased crime, exploitation of undocumented laborers, and tensions between host communities and migrants.

Strain on Education Infrastructure: Another significant source of impact will be felt in the education sector. While existing schools and colleges are currently functioning within their limited capacities, they will struggle to cope with the rapidly increasing number of school-age children arriving with the migrant workforce. The demand will not only be for more academic buildings and facilities but also for trained teachers, administrative staff, and specialized support services such as student counseling and inclusive education for children with disabilities.

Moreover, stakeholders have expressed a strong need for the establishment of higher educational institutions—including technical and engineering colleges and universities—in the NSEZ vicinity. The absence of such institutions will force families to either relocate or face limitations in their children's education and career development, adding further to the social burden.

Healthcare Service Deficiencies: The existing healthcare facilities are already inadequate to meet current demand. With the exponential growth in population, there will be an increased incidence of both communicable and non-communicable diseases due to overcrowding, inadequate sanitation, and limited access to clean water. The influx of laborers and their families will overwhelm local health centers, which lack both infrastructure and trained personnel.

Stakeholders have called for the establishment of new healthcare facilities, equipped with modern medical infrastructure and staffed with qualified doctors, nurses, and support staff. Mobile health units, maternal and child healthcare services, mental health counseling, and emergency medical response systems will become essential to prevent public health crises and ensure the well-being of both new and existing residents.

Transportation and Mobility Challenges: Currently, the road networks and public transportation systems in and around the NSEZ are inadequate, both in terms of coverage and quality. With the increasing population and commercial activity, the pressure on these systems will multiply, leading to congestion, road safety hazards, and inefficiencies in commuting.

The trend of workers settling in peripheral areas with affordable transport access has already emerged. However, without the development of integrated public transport systems and road upgrades, the transportation infrastructure may collapse under pressure, leading to decreased productivity, increased travel times, and greater environmental pollution.

Sanitation and Waste Management: Sanitation systems in the surrounding communities are rudimentary and will be severely strained by the influx. The operation of the NSEZ will produce significant amounts of solid and liquid waste, both from residential and commercial activities. Without proper planning and investment, this can lead to the proliferation of informal dumping sites, clogged drains, environmental pollution, and public health hazards.

In addition, many of the informal settlements being developed lack connection to basic sanitation networks, such as septic systems or waste collection services. This contributes directly to environmental degradation and poses risks of disease outbreaks.

Commercial Facilities and Local Markets: While the increase in population and economic activity may create opportunities for local entrepreneurs, it will also place substantial pressure on existing market infrastructure. The traditional hat-bazars are unprepared for the scale of demand that will be created. The lack of space, basic services, and infrastructure in these markets will hinder the ability of the local economy to support the growing population.

Moreover, the absence of formalized commercial zones or market regulation may lead to chaotic growth of street vendors, illegal shops, and unregulated food markets, which could impact food safety, hygiene, and the general public order.

Religious and Social Institutions: Places of prayer, community centers, and social service institutions are vital for maintaining social cohesion and cultural identity. However, these institutions are not currently designed to serve a significantly larger population. The lack of investment in expanding and modernizing these institutions could lead to overcrowding, exclusion, and social tensions among diverse cultural and religious groups.

Lack of Institutional Capacity and Governance: A core underlying issue is the lack of regulatory oversight and institutional preparedness. Although the Urban Development Directorate (UDD) has developed the “Mirsharai Development Plan,” its implementation remains pending. Stakeholders have expressed an urgent need to establish a local urban development authority, such as a “Mirsharai Development Authority,” to coordinate and regulate urban growth, infrastructure development, and service delivery.

Without such governance mechanisms, efforts to manage housing, transportation, utilities, and social services will remain fragmented and reactive rather than proactive and strategic.

Risk of Social Conflict and Resource Competition: The scale of migration and the pressure on limited resources could lead to increased competition between local residents and newcomers over access to housing, land, water, education, healthcare, and jobs. This could result in social stratification, discrimination, and even violent conflicts if not carefully managed through inclusive planning and equitable service delivery.

Need for Inclusive and Universal Access of Infrastructure Design: Lastly, a critical source of impact is the failure to incorporate universal design and inclusive planning in infrastructure development. Infrastructure must be designed to serve all segments of society, including persons with disabilities, older adults, children, and marginalized groups from the outset. Design principles must ensure:

Equitable use: Infrastructure should be accessible and beneficial to people with diverse abilities, ensuring equal access for persons with disabilities and other marginalized groups.

Flexibility in use: Facilities should support a wide range of individual preferences, needs, and abilities, enabling all users to interact with the infrastructure comfortably.

Simple and intuitive use: The design and operation of infrastructure should be easy to understand, regardless of the user's experience, knowledge, language skills, or concentration level.

Perceptible information: Information necessary for the use of infrastructure should be communicated clearly and effectively, through multiple modes, so that it can be understood regardless of the user's sensory abilities.

Low physical effort: Infrastructure should be usable efficiently and comfortably with minimal fatigue, supporting use by persons with disabilities and the elderly.

The absence of such design principles risks the systematic exclusion of vulnerable populations and further exacerbates social inequality.

Considering the above issues, the impact of the operation of the EZ on social infrastructure is evaluated to be **Medium High**.

5.3.2.28 Impacts on Fishermen's Livelihood and Fishery Activity

Increased shipping activities during the operation phase may impede fishermen's livelihood activities and increase safety hazards. Firstly, it may be considerably more difficult to observe the activities of artisanal fishermen from the decks of larger vessels. Secondly, while these vessels may travel more slowly than high-powered motorboats, large ships also have large bow waves and large washes that may affect the safety of fishermen. Thirdly, where there are established shipping channels, the increased number of vessels may impede local communities' ability to cross the channel safely. Finally, where construction, production, and general operational schedules involve lengthy waiting periods, the vessels may anchor outside the project's designated footprint, thereby considerably increasing the actual affected area. During this period, the project footprint and potential impact on fisheries may be expanded. In addition, associated fishing activities, such as boat building and repair, net and fish trap manufacture and repair, marketing and transportation, employment, and business and trade, will also be impacted.

Operation of the EZ may entail modifying coastlines, development of infrastructure such as jetties, ensuring operational access for shipping (e.g., establishment and maintenance of access khals, turning basins, breakwaters, and safe mooring), development of offshore facilities, and the enforcement of exclusion zones, all of which may reduce the area of fisheries and/or people's access to and use of these resources. An exclusion zone will be designated to ensure the safety of local people, avoid accidental damage to or loss of fishing equipment, ensure the protection of the project infrastructure against damage or sabotage by local people, and meet national security requirements covering jetty facilities, waterways, and particular types of vessels while loading or unloading.

In addition to posing threats to the habitats and fish resources in the region, the presence of project activities can also cause direct, increased risks to people and equipment involved in the fishing sector. Without an understanding of local fishing practices, the transit of speedboats and larger ships through common access channels and across fishing grounds is often associated with accidental damage to equipment, most commonly damage to lines, fish traps, and nets. Considering the above situation, the EZ will provide job opportunities and a community support program in order to improve the situation regarding living and livelihood of the fishermen.

Besides, there are no good facilities for resting, sanitation, drinking water, etc., for the fishermen in the newly shifted locations, as well as no safe boat parking area. The project proponent may develop a resting facility for the fishermen and a safe boat parking area, considering the Cyclone disaster in the region.

Based on consultation findings and contextual analysis, several targeted livelihood support strategies are recommended to help restore and enhance the living standards of fishermen, who are among the most affected by the development of the NSEZ. One promising avenue is the promotion of green and blue jobs in the periphery of the NSEZ. Fishermen, with their knowledge of the aquatic and coastal environment, can be trained and engaged in environmental monitoring, waterway maintenance, and

other roles that support sustainable environmental management. They could also contribute meaningfully to eco-tourism, mangrove restoration, and the development of nature-based enterprises. Furthermore, there is considerable potential for agribusiness development across Mirsarai, Sonagazi, and Sitakunda. Fishermen can be integrated into these sectors through training in climate-resilient agriculture, integrated farming techniques, and the operation of fish hatcheries, feed production, and fish health services. In addition, enterprise development linked to the NSEZ presents another opportunity. Training and support could enable vulnerable members of the fishing community to establish small-scale businesses such as fish stalls, food kiosks, or mobile vending services targeted at NSEZ workers. Community-run canteens and local food delivery ventures may also offer sustainable income sources. These livelihood strategies, if effectively implemented, can play a critical role in restoring incomes, diversifying employment options, and improving the long-term resilience of fishery-dependent communities. Moreover, other reskilling options for livelihood restoration for the Fisherfolk and farming communities are as follows, but not limited to:

- Mechanized boat repairing
- Training in fish handling, drying, and value-added processing to improve market price
- Eco-tourism guiding (youth)
- Automobiles (motorcycles, cars, and other vehicles repairing)
- Plumbing
- Home appliance repairing (AC, Refrigerator, etc.)
- Masonry
- Driving (light and heavy)
- Office Management/computer literacy
- Welding/lade machine/workshop
- Security services
- Handicraft making and marketing

To restore the livelihoods of fisherfolk and gazers, BEZA has initiated two programs: the Skill and Social Development Program and the Enterprise and Skill Agency (nominally Skills Voucher Programme). During the preparation of the RESA report, the evaluation and selection of NGOs and firms to implement these programs are currently underway. Considering the above issues, the impact of the operation of the EZ on fishermen's livelihood and fishery activity is evaluated to be **Medium High**.

5.3.2.29 Impacts on Livestock Population and Dependent Community

During the full operation of NSEZ approximately 33,805 acres of land will be developed, involving extensive industrial, infrastructural, and utility projects. This includes dredging of 450.89 million m³, establishment of four central effluent treatment plants (50+50+100+150 MLD), two sewage treatment plants (45+80 MLD), construction of internal and external road networks, stormwater networks, gas and water pipelines, electricity distribution lines, waste management facilities (CETP/CSTP/biogas), and plantations inside and outside the zone. Additional regional infrastructure such as the Feni-Noakhali Highway upgrade, Chattogram-Cox's Bazar rail link, Dhaka-Chattogram highway, Matarbari power hub, Karnaphuli Tunnel, and Chattogram airport expansion will further enhance industrial activity and connectivity. Collectively, these developments will fully restrict access to natural grazing areas, drastically affecting livestock-dependent communities.

Livestock, particularly buffalo, sheep, cows, and goats, constitute a primary source of food, nutrition, and income for rural households. Prior to NSEZ development, approximately 20,000 buffalo and sheep were managed by 700 owners and 400 grazing boys (Rakhal). Due to progressive development activities, the livestock population has already reduced to 8,000 animals, managed by 300 owners and 150 grazing boys. During operation, the erection of boundary fencing, complete industrial activity, and loss of open-access grazing lands will further eliminate opportunities for traditional grazing, forcing many households to sell livestock or shift operations to marginal or distant areas, often restricted by local authorities.

The reduction of grazing lands will directly affect livestock productivity, including milk and meat output, thereby diminishing household income and food security. Livestock-dependent livelihoods—comprising buffalo owners, grazing boys, dairy vendors, and other associated actors—face heightened vulnerability. The disruption will also negatively impact the dairy value chain in the region, reducing supply to local and regional markets. Loss of grazing areas, compounded by the cumulative effects of industrial operations, road networks, pipelines, and utility infrastructure, is projected to significantly strain traditional livestock practices.

Furthermore, the intensity of NSEZ operations will attract workforce migration and associated commercial activities, creating additional pressures on peri-urban and rural communities. These pressures exacerbate the economic and social stress on livestock households, as they compete for diminishing natural resources. Without complementary interventions, the socio-economic consequences include income loss, reduced household nutrition, and erosion of traditional livestock-based occupations.

Considering the above issues, the impact of the operation of the EZ on the livestock population and the dependent community is evaluated to be **Medium High**.

5.3.2.30 Tourism

During the operation of the EZ, the increase in population attributed to the number of workers to be engaged in the EZ will translate to more visitors to the EZ's surrounding tourist spots. This will create extra pressure on the existing infrastructures and local resources, i.e., energy, food, fuel, road, accommodation, water resources, health facilities, waste management, etc. Tourist activity can cause the same forms of pollution as any other industry, i.e., air emissions, noise, solid waste and littering, releases of sewage, oil, and chemicals, and even architectural/visual pollution. Water, specifically groundwater, is one of the most critical natural resources in the region. The use of water for hotels, swimming pools, and personal use of water by tourists can result in water shortages and degradation of water supplies, as well as generate a greater volume of wastewater. More solid waste will be generated from the tourist facilities, and there will be a possibility of impact on the environment if adequate measures are not taken. In addition, tourist activity can put enormous stress on local land use and can lead to soil erosion, increased pollution, natural habitat loss, and more pressure on wildlife.

Considering the above issues, the impact of the operation of the EZ on tourism is evaluated to be **Low**.

5.3.2.31 Impacts on Community Dynamics

During the operation phase, a rapid and continuous influx of outside population may lead to an assimilation of social and cultural practices and beliefs. Outsiders and locals will represent their own community dynamics in terms of festivals, social practices, etc. With the possibilities of assimilation, a negative impact is also anticipated, as there is a chance of decreasing social cohesion. It may lead to competition over common resources, community conflict, or disharmony. It may also contribute to an increased number of crimes in society as outsiders have less integration in the local community and lack empathy for the community and surroundings.

Considering the above issues, the impact of the operation of the EZ on community dynamics is evaluated to be **Medium Low**.

5.3.2.32 Impacts due to Disasters

If an earthquake occurs during the operation phase, the damage would be extended in the NSEZ, including industries/buildings of individual industries and infrastructure such as roads, railways, jetties, gas pipelines, electricity transmission lines, water treatment plants, central sewage treatment plant, central effluent treatment plant, etc., which will be constructed. To minimize the damage, the project proponent and investors should design and construct their structures properly to meet the required standards, such as the Bangladesh National Building Code (BNBC) 2020. An emergency response plan for earthquakes should be established by individual industries, and emergency drills should be implemented by the investors to minimize the negative impact of earthquakes.

For cyclones and their associated disasters, like storm surges. Thus, safety and prevention measures should be included in the EZ design to minimize the damage due to these events.

Tsunamis are a series of waves produced by the displacement of a large volume of water, generally generated by earthquakes or volcanic eruptions. Considering the state of tsunami vulnerability and potential seismic sources, the coastal belt is classified into three tsunamigenic zones. As per the tsunamigenic zones map of Bangladesh, the coast is divided into three tsunamigenic zones, i.e., zones I, II, and III. Zone-I is the most vulnerable, and zone-III is the lowest vulnerability zone. According to this classification, the EZ site falls within zone-I, which is reportedly the most vulnerable belt. Though the Indian subcontinent is in a seismically active region, tsunamis along the coastline of India and Bangladesh have been rare, but not unprecedented.

All the interventions will be developed along the shoreline of the Bay of Bengal thus are highly vulnerable to coastal floods caused by tidal surges. According to the Upazila Disaster Management Plan of Mirsharai and Sitakunda, both upazilas are flood-prone areas, specifically vulnerable to flash floods. According to the consultation with BEZA, the whole EZ site will be filled with an elevation of 6.5 m. The finished level of both the offshore and onshore structures should be above the high flood level of the sea and rivers/khals to prevent flood hazards. At the Mirsharai site, an embankment/super dyke having approximately 22.5 km in length has already developed along the Sandwip Channel; thus, the site is not prone to flooding. Further, a 12.5 km embankment will be constructed along the coastline from Domkhali in Mirsharai to Guliyakhali in Sitakunda.

Considering the above issues, the impact on the EZ due to disaster is evaluated to be **Medium High**.

5.3.2.33 Climate Change and Greenhouse Gas Emissions

Increasing greenhouse gases (GHGs) due to the implementation of industries in the EZ will result in global warming and climate change. Its consequences are devastation for the environment, such as the rising temperature, sea level change, impacts on the ecosystem, etc. The activities and sectors associated with the EZ, which include transportation, industry, commercial, and residential, will emit greenhouse gases into the atmosphere. One of the most significant of these gases is carbon dioxide (CO₂), which will be generated when fossil fuels, such as oil and natural gas, are burned (e.g., in industry, electricity generation, and automobiles) and changes in land use (i.e., deforestation). In the long run, the accumulation of CO₂ and other GHGs in the atmosphere can cause global climate change.

Transportation will be one of the major sources of GHGs in the region. GHGs from transportation will be carbon dioxide (CO₂), Carbon monoxide (CO), Non-Methane (CH₄), Organic compounds (VOCs), Oxides of nitrate (NO_x), Sulphur dioxide (SO₂), and Hydrocarbons. The total amount of GHGs will depend on the number of population and transportation activities, types of vehicles/vessels, choices of fuel, and condition of vehicles (e.g., level of maintenance). The operation of equipment and machinery will lead to GHG emissions.

The operation of heavy industry within the EZ, including cement, iron/steel, chemicals, fertilizer, minerals, paints, or similar, will emit GHGs. The type of energy input or fuels used in the industries is an important factor that will contribute to the amount of GHG emissions. It is recommended to keep a record of resource utilization to analyze greenhouse gas emissions in each industry and report to the EZ authority.

Greenhouse Gases (GHGs) Estimation

The total amount of GHG emission potential is calculated following the scenario where the EZ is implemented in full operation in the year 2041. For calculation, all factories are considered running 16 hours daily throughout 300 days in a year.

The total electrical energy to be consumed is estimated, keeping the maximum demand in mind, whereas for natural gas consumption, total gas demand per day (m³/day) values are used. The GHG estimation is demonstrated in Table 5-29.

Table 5-29: GHG Estimation for EZ Operation

Consumption Type	Demand**	Operation Time Considered	Yearly Demand	Emission Factor	GHG Emission (million tons CO ₂ e)
Electricity	3248.17 MW	300 days, 16 hours/day	15591216 MW-h	0.648 tons CO ₂ eq/ MW-h	10.103
Natural Gas	4675467.96 m ³ /day		1402640388 m ³	1.885 kg CO ₂ eq/ m3	2.643
Total GHG Emission Estimated for 2041					12.746

** Electricity and Natural Gas demand values are taken from the EZ Master Plan

Note: Emission Factors used in GHG Calculation

1. Natural Gas: EF = 1.885 kg- CO₂ eq /m³ [GHG Protocol]
2. Bangladesh Grid Electricity: EF = 0.648 kg CO₂ eq /kWh [GEF of Bangladesh (SREDA)]

To minimize GHG emissions, mitigation measures shall be taken by the investors and contractors, such as management of the operation time of construction machinery, avoidance of excessive loading operations, and education of construction workers/drivers about the idling stop practice for machinery and vehicles. In order to reduce GHG emissions, the usage of solar light and the usage of LED in the EZ area is planned. In addition, energy-saving equipment and fuels that emit less GHG will be recommended to be installed in all industries for their operations as much as possible.

Besides, the utilization of commuter buses and/or industrial electric vehicles for workers to reduce traffic GHG emissions shall be initiated by the industries. Gas-based fuels tend to emit lower amounts of GHGs than liquid fuels and solid fuels. Thus, clean fuel alternatives or low-emission GHG fuels and technologies that will be established in the EZ shall be promoted. In order to reduce GHG as part of the carbon footprint incentive program, energy conservation, recovery of heat, or power-efficient consumption shall be implemented. Therefore, this issue is recommended in GHG mitigation measures or as an alternative option for future development of the EZ.

The operation of industrial facilities within EZ may contribute to greenhouse gas emissions and exacerbate climate change impacts on the Sandwip Channel ecosystem. Changes in temperature, precipitation patterns, and ocean acidification associated with climate change could further stress planktonic and benthic organisms, compounding existing threats to their survival and reproductive success.

The NSEZ itself may be vulnerable to changes in the environment due to climate change. The EZ is located on the coastline of Bangladesh, which is highly vulnerable to cyclone disasters and their associated tidal surges. The frequency of Cyclones has already increased in the Bay of Bengal. To meet the water demand, EZ is planning to take saline water from the Sandwip Channel/Sea and establish a desalination plant. The seawater intake of the desalination plant would need to be designed to account for changes in sea state that may become worse because of higher-intensity storm (Cyclones) events. The location of the desalination plant should consider sea-level rise and its possible implications. Any change in ocean temperatures and circulation patterns may also change the frequency of tide events that may impact the water intake of the operations of the desalination plant.

Considering the above issues, the impact of the operation of the EZ on climate change and greenhouse gas emissions is evaluated to be **Medium High**.

Summary of Environmental and Social Impact Significance During the Operation of the EZ

Final Report

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A summary of environmental and social impact significance during the operation of the EZ has been provided in Table 5-30.

Table 5-30: Summary of Environmental and Social Risks and Impacts During Operation Phase

Aspects/Issues/Impacts	Nature	Extent & Location	Duration	Intensity/Severity	Irreplaceable	Probability	Significance
Impacts on Air Quality	Direct	Regional	Permanent Mitigated	Medium	Medium	High	Medium High
Impacts from Noise	Direct	Regional	Permanent Mitigated	Medium	Low	High	Medium Low
Impacts on Surface Water	Direct	Local	Permanent Mitigated	Medium	Medium	Medium	Medium Low
Impacts on Groundwater	Direct	Regional	Permanent Mitigated	High	Medium	Medium	Medium Low
Impacts on Topography and Soil	Direct	EZ Site	Long Term	Medium	Medium	Medium	Medium Low
Impacts on Sediment	Direct	Local	Long Term	Medium	Medium	Medium	Medium Low
Impact due to Changes in Land Use	Indirect	Regional	Permanent Mitigated	High	Medium	High	Medium High
Impact due to Solid Waste Generation	Direct	Local	Permanent Mitigated	High	Medium	High	Medium High
Impacts of Liquid Waste Generation	Direct	Local	Permanent Mitigated	High	Medium	High	Medium High
Impacts on Drainage	Induced	Regional	Permanent Mitigated	High	Medium	High	Medium High
Impacts of Traffic	Induced	Regional	Permanent Mitigated	High	Medium	High	Medium High
Loss of Ecosystem Services	Direct	Local	Short Term	Low	Low	Medium	Low
Impacts on Terrestrial and Mangrove Flora	Direct	Local	Long Term	Low	Low	Low	Low
Impacts on Terrestrial Mammals	Direct	Local	Long Term	Low	Low	Low	Low
Impacts on Birds/Avifauna	Direct	Local	Long Term	Low	Low	Low	Low

Aspects/Issues/Impacts	Nature	Extent & Location	Duration	Intensity/Severity	Irreplaceable	Probability	Significance
Impacts on Herpetofauna	Direct	Local	Long Term	Low	Low	Low	Low
Impacts on Aquatic Mammals	Direct	Local	Long Term	Medium	High	High	Medium High
Impacts on Ichthyofauna (Fish)	Direct	Local	Long Term	Medium	Medium	High	Medium Low
Impacts on Hilsa Fisheries	Direct	Local	Long Term	Medium	Medium	High	Medium Low
Impacts on Plankton and Benthos	Direct	Local	Long Term	Low	Low	High	Medium Low
Community Health, Safety, and Security	Direct	Regional	Permanent-mitigated	Medium	Medium	Medium	Medium Low
Occupational Health and Safety	Direct	Project site	Long-term	High	Medium	High	Medium Low
Labor Influx	Direct	Regional	Long-term	High	Medium	High	Medium High
Child Labor and Forced Labor	Direct	Regional	Permanent-mitigated	Medium	Medium	High	Medium High
Gender Based Violence & Sexual Exploitation and Abuse/Sexual Harassment	Direct	Regional	Long-term	Medium	Medium	Medium	Medium Low
Violence Against Children	Direct	Regional	Long-term	Medium	Medium	Medium	Medium Low
Impact on Social Infrastructures	Direct	Regional	Long-term	High	Medium	High	Medium High
Impacts on Fisherman and Fishery Activity	Direct	Regional	Long-term	High	Medium	High	Medium High
Impacts on Livestock Population and Dependent Community	Direct	Regional	Permanent Mitigated	High	Medium	High	Medium High
Tourism	Indirect	Regional	Long-term	Low	Low	Low	Low
Impacts on Community Dynamics	Direct	Regional	Long-term	Medium	Medium	Medium	Medium Low
Impacts due to Natural Disasters	Induced	Regional	Permanent Mitigated	High	Medium	High	Medium High

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Aspects/Issues/Impacts	Nature	Extent & Location	Duration	Intensity/Severity	Irreplaceable	Probability	Significance
Climate Change and Greenhouse Gas Emissions	Induced	National	Permanent Mitigated	High	Medium	High	Medium High

6 IMPACT ASSESSMENT CONSIDERING UNCERTAINTIES

This chapter describes three development scenarios for the NSEZ (Table 6-1) to address the uncertainty associated with the availability of land.

Table 6-1: Different Scenarios for the NSEZ Considering Land Availability

Development Scenario	Possible List of Projects and Activities
Scenario-1 (50% area development)	- Land acquisition, resettlement, and land development (partial). It is expected that approximately 16,900 acres of area will be developed. - Dredging requirements - approximately 225.33 million m³ - Central Effluent Treatment Plant establishment - no - Sewage Treatment Plant establishment - no - Construction of external road - NSEZ Saroni (Barotakia-Bamonsundor Road) (2 lanes) - Construction of internal roads inside of NSEZ (zone 2A and 2B) (partial) - Super dyke/embankment - 22.5 km at Mirsharai section - Construction of boundary wall - 23 km - Establishment of groundwater deep tubewell - 10 MLD water extraction and distribution line at Mirsharai site - Establishment of HFO based Power plant at Mirsharai site - Electricity transmission line and substation (partial) at Mirsharai site - Electricity distribution line - different zones in NSEZ (partial) at Mirsharai site - Establishment of a gas pipeline (partial) at the Mirsharai site - Water transport/jetty – 1 jetty under BIWTA - Waste management facility (partial) at Mirsharai site - Stormwater network/khal/canal excavation (partial) at Mirsharai site - Telecommunication network - 22 km optical fiber cable (partial) at Mirsharai site - Plantation inside of NSEZ and outside of NSEZ (partial) - Dredging and landfill/land development (partial) for Mirsharai site - Projects in operation - 7 nos. (Asian Paints Ltd., Bashundhara Ready Mix, Nippon & MacDonald Steel Industries Ltd., MacDonald Steel Building Products Ltd., Marico Bangladesh Ltd., Samuda Construction Ltd., Bashundhara Chemical Industries Ltd.) - Upcoming projects/investors/industries (approximately 132 investors have been allocated land in the NSEZ)
Scenario-2 (75% area development)	- Land acquisition, resettlement, and land development (partial). It is expected that approximately 25,350 acres of area will be developed. - Dredging requirements - approximately 338.08 million m³ - Central Effluent Treatment Plant establishment - 2 nos. (50+50 MLD) - Sewage Treatment Plant establishment - no - Expansion of internal road - NSEZ Saroni (Barotakia-Bamonsundor Road) (2 lanes) - Construction of external roads – other roads (NSEZ Sarani North, NSEZ Sarani South, and EZ site to Sonagazi-Feni Road) to connect the Dhaka-Chattogram Highway and local roads for worker's mobility (partial) - Expansion of internal roads – inside of different zones in NSEZ (partial in phase 2 area) - Super dyke/embankment at Feni site

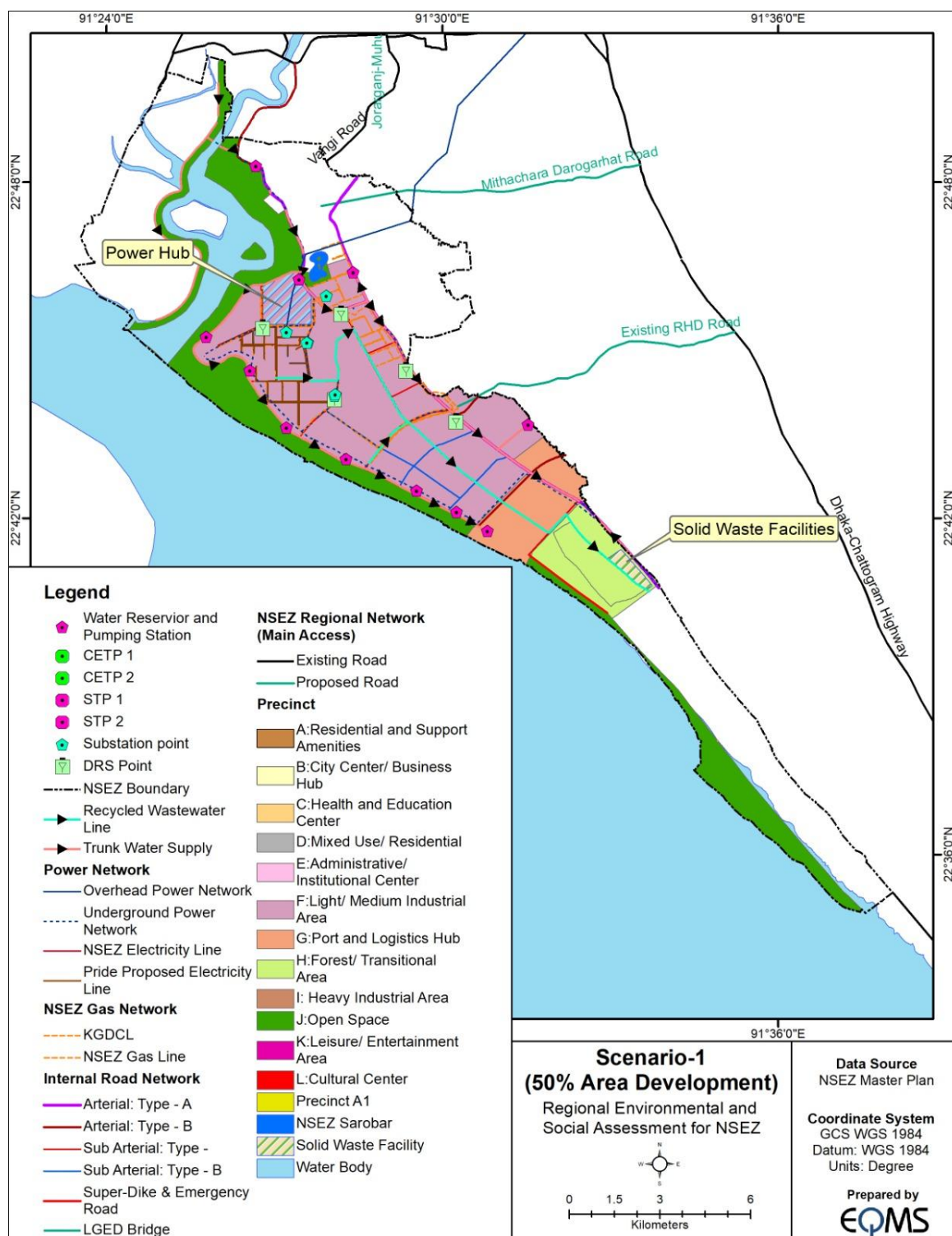
Development Scenario	Possible List of Projects and Activities
	• Railway transport - 13.4 km length, 6 new bridges, 11 culverts, and 1 station building in Mirsharai area • Water transport/jetty - 1 under BEZA, 2 under private sector (Bashundhara and Samuda) • Establishment of water treatment plant - 100 MLD from Feni reservoir and distribution line at Feni site • Surface water from Meghna River - 250 MLD • Establishment of Solar Power Plant at Feni site • Electricity distribution line - different zones in NSEZ (partial in phase 2 area) at Feni site • Establishment of gas pipeline - different zone in NSEZ (partial in phase 2 area) at Feni site • Waste management facility (partial) • Township development at the Feni and Mirsharai site (accommodation facilities for the workers, investors, etc.) • Telecommunication network - 15 km of optical fiber cable will be laid from Sonagazi of Feni to Mirsharai EZ through Dasherhat (Char Chandia) • Stormwater network/khal/canal excavation (partial in phase 2 area) • Plantation inside of NSEZ and outside of NSEZ (partial in phase 2 area) • Dredging and landfill/land development (partial) for the Feni site • Upcoming projects/investors/industries in Mirsharai and the Feni site (approximately 132 investors have been allocated land in the NSEZ)
“Scenario-3” (100% area development)	• Land acquisition, resettlement, and land development (Complete). It is expected that approximately 33,805 acres of area will be developed. • Dredging requirements - approximately 450.89 million m³ • Central Effluent Treatment Plant establishment - 4 nos. (50+50+100+150 MLD) • Sewage Treatment Plant establishment - 2 nos. (45+80 MLD) • Super dyke/embankment (12.5 km from Domkhali in Mirsharai to Guliyakhali in Sitakunda, 27 meters high with a 60-meter base and 9.8-meter top, with hosting a two-lane road). • Construction of external roads - other roads (complete in phase 3 area) in the Sitakunda site • Construction of internal roads - different zones in NSEZ (complete in phase 2 area) in Sitakunda site • Establishment of gas pipeline - different zone in NSEZ (complete in phase 2 area) in Sitakunda site • Electricity distribution line - different zones in NSEZ (complete in phase 2 area) in Sitakunda site • Water supply pipeline at the Sitakunda site • Stormwater network/khal/canal excavation (complete) in Sitakunda site • Waste management facility (complete) • Plantation inside of NSEZ and outside of NSEZ (complete in phase 3 area) • Establishment of a desalination plant • Dredging and landfill/land development (complete) in the Sitakunda site • All committed/planned projects (complete) (including heavy industries in the Sitakunda area)

Development Scenario	Possible List of Projects and Activities
	Other development projects/infrastructures in the region including Feni-Noakhali National Highway to 4-Lanes at Begumgonj to Sonapur, Chattogram - Cox's Bazar Rail Link project, Dhaka-Chattogram Highway - providing easier access to the Chattogram region including a better connection with the Chattogram Sea Port, Karnaphuli Tunnel, Bay Terminal project, Matarbari Port Development, Power hub in Matarbari area, Flyover and Elevated Expressway in Chattogram, Chattogram Airport Development Project, Bayezid-Faujdarhat Link Road, Sonadia Ecotourism, Sabrang and Naf Tourism Park, S Alam Banshkhali EZ, 900 MLD Water Pipeline from the estuary of Padma Meghna Dakatia Estuary, Economic zones are in the Chattogram and Cox's Bazar region (Anowara (Gohira) EZ, Anowara-2 EZ, Cox's Bazar Free Trade Zone, Moheshkhali/Dhalghata EZ, etc.), Hazardous waste Treatment Storage and Disposal Facility at Sitakunda area for waste from the ship-breaking industry, Construction of Jetty in Sandwip and Teknaf (Sabrang and Jaliar Island), Bangladesh Regional Waterway Transport Project 1 (Dredging of the river routes on the Chattogram-Dhaka-Ashuganj corridor).

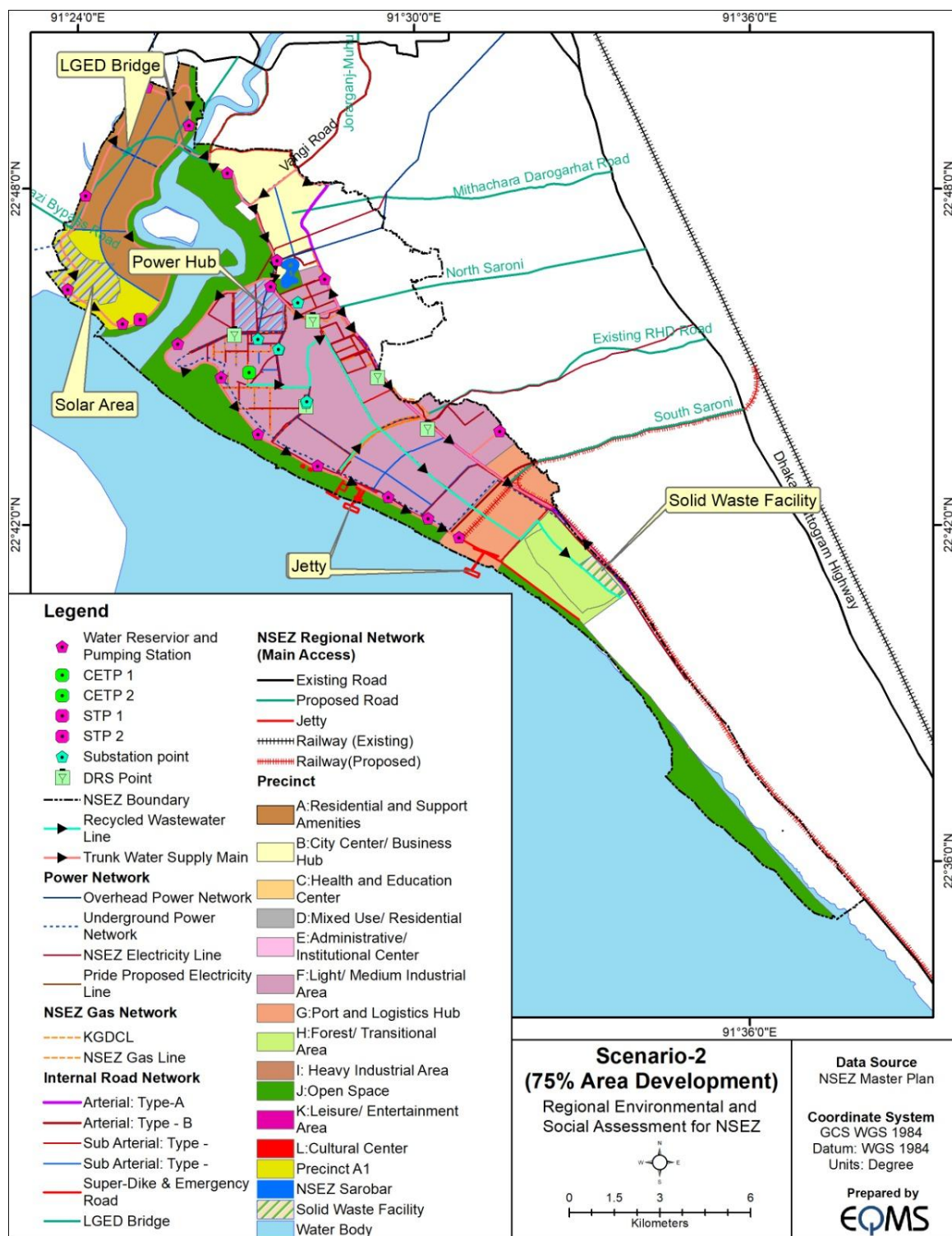
Each scenario incorporates indicators and projections of the developments/activities that will be likely to arise over the next 20 years, including, for example, new/upgraded infrastructure, new industrial facilities, changed environmental and social management regimes, changes in activities, etc.

Different infrastructures and facilities in the NSEZ will be developed based on the availability of land. A map considering each development/implementation scenario has been prepared and given in Figure 6-1.

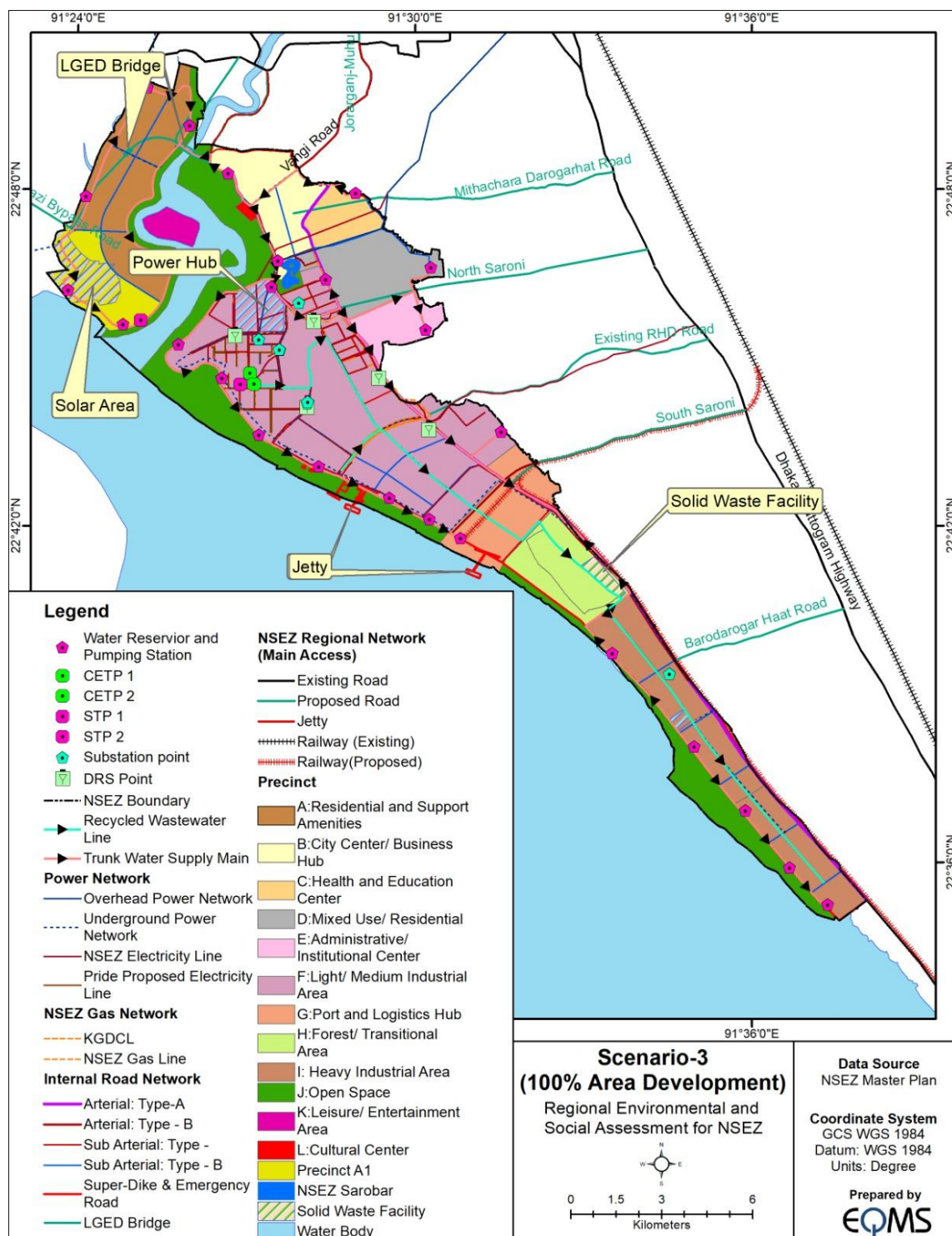
Figure 6-1: Development Scenario of the NSEZ Master Plan



Scenario-1 (50% area development)



Scenario-2 (75% area development)



Scenario-3 (100% area development)

Source: Data provided by BEZA

6.1.1 Assumptions and Uncertainties that Might Influence the Future

There are a number of assumptions and uncertainties that have been taken into account that might influence the future:

- To date, BEZA has received approximately 11,002 acres of land in the Mirsharai area. In addition, approximately 5,768 acres are in process in the Sonagazi area. Moreover, the rest of the required land in the Sitakunda area is uncertain.

- Local communities are fully dependent on groundwater resources and already there is a groundwater crisis in Sitakunda and Mirsharai areas due to use in different industries. Different studies also indicated that the groundwater crisis will be severe after the implementation of the EZ and the future increasing demand for household uses in the Mirsharai township area.
- Due to the increasing number of industries in EZ the power demand will be increased. It is assumed that increasing power demand will be covered by existing power plants as well as upcoming and planned projects.
- An uninterrupted gas supply for the industries will be ensured by importing from other countries.
- Currently, there is a worker crisis in the NSEZ area due to the unavailability of better transportation and accommodation facilities. It is expected that the workers will be available by improving the accommodation and development of the local transportation network.
- The number of investors and the types of industries are uncertain.
- NSEZ is a climate change and natural disasters vulnerable area. The most important disasters are cyclones, tidal surges, earthquakes, sea level rise, salinity intrusion, etc. These disasters may impact the EZ region.
- Bangladesh will continue to enjoy internal and external peace and security under the dynamics of international and regional geopolitics.
- All existing national policies and associated environmental and socioeconomic measures will be implemented.
- Other countries and lenders will also invest in economic zones.

6.2 Scenario Narratives

6.2.1 Impact Assessment on Scenario 1

A detailed impact assessment of master plan development scenario 1 has been conducted considering the physical environment (air, noise, surface water, groundwater, topography and soil, sediment, land use, solid water, liquid waste, drainage, disasters, visual impacts), biological environment (ecosystem services, terrestrial and mangrove flora, terrestrial mammals, birds/avifauna, herpetofauna, aquatic mammals, fish, Hilsha fish, plankton and benthos, dredging on marine ecosystem, ECA, PA, CHA), and socioeconomic economic (land acquisition, resettlement, rehabilitation and speculation, community health and safety, occupational health and safety, labor influx, child labor, forced labor an bonded labor, gender based violence, sexual exploitation and abuse and sexual harassment, violence against children, social infrastructure, livelihoods, tourism, cultural heritage, UNESCO heritage, community dynamics) aspects and included in Appendix K (volume III). In addition, the salient feature of impact is shown in Table 6-2.

6.2.2 Impact Assessment on Scenario 2

A detailed impact assessment of master plan development scenario 2 has been conducted considering the physical environment (air, noise, surface water, groundwater, topography and soil, sediment, land use, solid water, liquid waste, drainage, disasters, visual impacts), biological environment (ecosystem services, terrestrial and mangrove flora, terrestrial mammals, birds/avifauna, herpetofauna, aquatic mammals, fish, Hilsha fish, plankton and benthos, dredging on marine ecosystem, ECA, PA, CHA), and socioeconomic economic (land acquisition, resettlement, rehabilitation and speculation, community health and safety, occupational health and safety, labor influx, child labor, forced labor an bonded labor, gender based violence, sexual exploitation and abuse and sexual harassment, violence against children, social infrastructure, livelihoods, tourism, cultural heritage, UNESCO heritage, community dynamics) aspects and included in Appendix K (volume III). In addition, the salient feature of impact is shown in Table 6-2.

The information for the three scenarios has been described in a table for easier comparison of the scenarios. Key features of the different scenarios are given in Table 6-2.

Table 6-2: Summary of Impact in Different Scenario

Factors	Scenario-1 (16,900 acres of land development)	Scenario-2 (25,350 acres of land development)	Scenario-3 (33,800 acres of land development)
Air Quality	- No significant change in ambient air quality. There was more green area in the region. - Limited increase in greenhouse gas emissions from the burning of fossil fuels.	- Increased air pollution by transport and industrialization. - Moderate increase in greenhouse gas emissions from industrial activities and the transportation sector.	- Increased air pollution by transport, power generation, industrialization, waste management facilities, etc. - Large increase in greenhouse gas emissions from industrial activities and the transportation sector. - Partially compensated for by energy efficiency measures and increased use of renewables.
Noise Level	- Noise increases in highly populated areas due to the traffic. - Major sources of noise will be construction activity, vehicle movement, and operation of limited light and medium industries.	- A moderate increase in ambient noise level in highly populated areas due to increased traffic intensity and industrial activity. - Major sources of noise will be construction activity, vehicle movement, and the operation of more light and medium industries.	- Moderate to high increase in noise in highly populated areas due to increased traffic intensity and industrial activity. - Major sources of noise will be vehicle movement and the operation of all industries, including light, medium, and heavy.
Surface Water Quality	- No surface water will be extracted for the EZ construction and operational activities. - Surface water quality mainly in the internal khals will be impacted due to the disposal of untreated sanitation wastewater and very limited sewage treatment facilities at the	- About 100 MLD surface water from Feni Reservoir will be extracted for the EZ construction and operational activities. - Moderate pollution due to the establishment of wastewater treatment facilities in operating industries and facilities for the workers. - A significant volume of wastewater will be generated from the township area/ accommodation facilities. - Dredging activities will moderate-high impact on marine water quality, specifically the increasing turbidity, considering the	- About 429 MLD surface water (100 MLD from Feni Reservoir, 250 from Meghna River, 50 MLD from desalination plant, 5 MLD from rainwater harvesting system, and 24 MLD from CETPS recycling) will be extracted for the EZ construction and operational activities. - Low pollution due to the establishment and operation of all wastewater treatment facilities. - Dredging activities will very high impact on the marine water quality, specifically the increasing turbidity.

Factors	Scenario-1 (16,900 acres of land development)	Scenario-2 (25,350 acres of land development)	Scenario-3 (33,800 acres of land development)
	construction sites, as well as workers' temporary facilities. • Untreated wastewater discharge from the operating industries may impact surface water quality. • Dredging activities will significantly impact marine water quality, specifically the increasing turbidity, considering the land development area and the required volume of dredge soil.	land development area and the required volume of dredge soil.	
Groundwater Availability and Quality	• Pressure on groundwater resources in the region was started by establishing different heavy industries in the Sitakunda area. • About 10 MLD groundwater will be extracted for the EZ construction and operational activities. • Groundwater availability - currently the local community is facing a	• Pressure on groundwater resources in the region will gradually increase due to the establishment of new industries, operation of existing industries, development of the township area, and increasing demand of the influx population. • About 30 MLD groundwater will be extracted for the EZ construction and operational activities. • Salinity intrusion - the local community will face salinity issues in the region, specifically in Mirsharai and Sitakunda areas.	• Extraction of groundwater for different increasing industrial activities in the region may cause an extreme groundwater crisis and conflict with the community. • Withdrawing groundwater more than the rate of recharge may result in the lowering of the water table, land subsidence, salinity intrusion into the groundwater aquifer, and decreased water quality. • No Groundwater will be extracted and used in the EZ operation. • Withdrawing groundwater in excess of the rate of recharge may result in the lowering of the water table, land subsidence, salinity intrusion into the groundwater aquifer, and decreased water quality.

Factors	Scenario-1 (16,900 acres of land development)	Scenario-2 (25,350 acres of land development)	Scenario-3 (33,800 acres of land development)
	groundwater crisis in the region specifically in Mirsharai and Sitakunda areas. Salinity intrusion in freshwater is less and mainly due to the effect of tidal surges during cyclones.		
Topography and Soil	- Topography of approximately 16,900 acres will be changed. - Approximately 225.33 mm³ of dredging spoil will be required to develop the EZ site land, having a height of 6.5m.	- Topography of approximately 16,900 acres will be changed. - Approximately 338.00 mm³ of dredging spoil will be required to develop the EZ site land, having a height of 6.5m.	- Topography of approximately 16,900 acres will be changed. - Approximately 450.67 mm³ of dredging spoil will be required to develop the EZ site land, having a height of 6.5m.
Land Use/Cover Change	- Approximately 16,900 acres of land area will be changed directly and converted into an industrial area. - Change in land converted to industrial area, transportation infrastructures, etc.	- Approximately 25,350 acres of land area will be changed directly and converted into an industrial area. - A moderate increase in the extent of land converted to industrial and urban development.	- Approximately 33,800 acres of land area will be changed directly and converted into an industrial area. - Increase in the extent of land converted to industrial area, transportation infrastructures, township development, urban area expansion, etc.
Waste (Liquid, Solid, and Hazardous)	Pollution management is poor due to ineffective implementation of pollution reduction measures and regulations.	Pollution management is improved through the partial implementation of pollution reduction measures and regulations. Establishment of effluent treatment plants in most industries.	- Big improvement in the implementation of waste collection mechanisms and waste treatment facilities. - A large increase in capacity to convert waste to usable resources through recycling.

Factors	Scenario-1 (16,900 acres of land development)	Scenario-2 (25,350 acres of land development)	Scenario-3 (33,800 acres of land development)
	Establishment of effluent treatment plants in only a limited number of industries. - Poor waste collection mechanisms and the adoption of waste treatment facilities. - Limited or no capacity to convert waste to usable resources. - Waste collection remains basic, and recycling is minimal. Poor infrastructure leads to overfilled landfills and illegal dumping, creating public health hazards. - Limited resources result in inadequate collection and treatment. Improper disposal methods pose risks to workers and local communities. - Little improvement in handling hazardous waste, leading to growing contamination risks due to poorly	- A moderate increase in the capacity to convert waste to usable resources. - Steady improvement in waste collection and recycling, but growth is slower due to limited resources. New facilities are being introduced but may struggle to keep up with increasing waste generation. - Some upgrades to medical waste handling, but gaps remain in collection and treatment capacity. Manual handling increases risks to workers and the environment. - Expansion of hazardous waste treatment facilities is modest. Although basic management systems are enforced, they may not be sufficient for new industrial activities, leading to risks of spills and soil contamination.	- Significant improvement in waste collection and processing. Advanced recycling systems and waste-to-energy projects are established, reducing landfill dependency and maximizing resource recovery. - Strict regulations ensure proper disposal. Modernized medical waste treatment facilities are set up, and new technologies reduce infection risks and environmental contamination. - Dedicated treatment and disposal facilities are constructed, and regulations are enforced, particularly for industrial zones. Advanced methods are employed for handling and recycling hazardous materials, minimizing environmental impacts.

Factors	Scenario-1 (16,900 acres of land development)	Scenario-2 (25,350 acres of land development)	Scenario-3 (33,800 acres of land development)
Drainage, Waterlogging, and Flooding	managed facilities and insufficient monitoring. - Five khals including Ichakhali, Daborkhali, Bamansunda, Hoania, and Saherkhali will be impacted in the Mirsharai area. - Approximately 22.5 km of the embankment/super dyke and 9 nos. of sluice has been constructed. - A 30 km re-excavation of khal has been done. It is assumed that the impact on drainage, waterlogging, and flooding will be insignificant.	- No additional khal will be impacted in the Sonagazi, Feni area. - Embankment/super dyke will need to be constructed in the Sonagazi area. - Impact on drainage, waterlogging, and flooding may occur considering the unplanned township development of the surrounding area by the local community.	- Five khals and an additional one khal i.e., Domkhali khal will be impacted. - Additionally, a 12.5 km embankment/super dyke including 6 to 8 sluice gates will need to be constructed in the Sitakunda area. - Impact on drainage, waterlogging, and flooding may occur if the khals are not excavated and periodic maintenance is not done in super dyke and flood control structures including sluice gates.
Traffic and Transport	- Traffic and transportation systems will start to develop in the area. Traffic volume will be increased due to the movement of construction vehicles and equipment. - Traffic data between Borotakia and NSEZ indicates a high volume	- A significant volume of traffic will be increased due to the developed road network in the region as well as the operation of industries, specifically the labor-intensive BEPZA industries and other industries. - Traffic volume for Borotakia to NSEZ will increase from 3,997 PCUs/day to approximately 8,954 PCUs/day by 2030.	- A significant volume of traffic will be increased due to all developed road networks and townships in the region, as well as the operation of all industries. - Traffic volume for Borotakia to NSEZ will increase from 3,997 PCUs/day to approximately 20,053 PCUs/day by 2040. - Traffic volume for NSEZ to Borotakia will increase from 3,848 PCUs/day to approximately 19,299 PCUs/day by 2040.

Factors	Scenario-1 (16,900 acres of land development)	Scenario-2 (25,350 acres of land development)	Scenario-3 (33,800 acres of land development)
	of daily vehicular movement, with a total of 3,997 PCUs/day traveling from Borotakia to NSEZ and 3,848 PCUs/day in the reverse direction.	Traffic volume for NSEZ to Borotakia will increase from 3,848 PCUs/day to approximately 8,620 PCUs/day by 2030.	
Ecosystem Services	- In a low-growth scenario, there will be minimal loss of agricultural land and a localized impact on food crops and livestock resources. - Limited vegetation will be cleared, leading to localized losses of wood and non-timber forest products. - Minor disruptions to aquatic ecosystems will occur, with minimal impacts on fish populations. - There will be a limited reduction in carbon sequestration due to partial vegetation loss. - Minimal loss of wetlands and floodplains will occur, potentially	- In the medium growth scenario, there will be a moderate loss of agricultural land, reducing food and fodder availability. - Moderate deforestation will occur in the developed 75% area. - Partial degradation of aquatic ecosystems will occur due to dredging and water infrastructure. - A significant reduction in carbon storage capacity will occur due to 75% land development. - Moderate disruption of natural flood control mechanisms will occur, especially near developed zones. - Moderate alteration of surface and groundwater systems will occur, reducing natural water regulation. - Significant habitat degradation and loss will occur in 75% of the area, reducing biodiversity. - Moderate loss of pollinator habitats will occur, affecting nearby agricultural zones. - A moderate reduction in natural recreational and ecotourism potential will	- In the high-growth scenario, significant loss of agricultural land will occur, severely reducing food production potential. - Extensive deforestation will occur across 33,800 acres of land, leading to a near-complete loss of forest resources. - Severe disruption of aquatic habitats will occur, significantly affecting fish and other aquatic resources. - A drastic reduction in carbon sequestration capacity will occur, exacerbating local and regional climate impacts. - Severe loss of floodplains and wetlands will occur, increasing flood risks significantly. - Extensive alteration of hydrology will occur, causing significant disruption to water regulation. - Extensive habitat destruction will occur, leading to near-total loss of biodiversity in the area. - Significant loss of pollinator habitats will occur, leading to reduced ecosystem resilience and crop yields. - Near-total loss of natural recreational areas will occur, with industrial landscapes dominating. There

Factors	Scenario-1 (16,900 acres of land development)	Scenario-2 (25,350 acres of land development)	Scenario-3 (33,800 acres of land development)
	leading to some localized increases in flood risk. - Minimal disruption to natural water flow is expected, with localized impacts near dredging or canals. - Limited (50%) habitat loss will occur, resulting in localized impacts on flora and fauna. - Limited impacts on pollinator habitats are anticipated, with localized effects near cleared areas. - Minimal loss of natural recreational spaces is expected, with some disturbance near developed zones. There will also be limited alteration of natural landscapes, resulting in localized visual changes.	occur. There will be a significant reduction in scenic value across developed areas.	will also be a complete transformation of the landscape, with significant aesthetic degradation.
Trees/Vegetation	Vegetation clearing from the 16,900 acres of land for industrial, residential, and infrastructural	The development of approximately 25,350 acres will necessitate the clearing of more vegetation cover and the removal of more	The complete transformation of 33,800 acres will involve large-scale clearance of natural vegetation, including forests, shrubs, and grasslands, to

Factors	Scenario-1 (16,900 acres of land development)	Scenario-2 (25,350 acres of land development)	Scenario-3 (33,800 acres of land development)
	purposes will lead to the removal of fewer trees than in the medium and high-growth scenarios. • Still, natural habitats, including forests, shrubs, and grasslands, will be affected depending on the original land use and vegetation density in the area. • Construction of roads will require clearing vegetation along the alignment and may result in the loss of roadside trees. This loss is expected to be lower than in the medium and high-growth scenarios. • Construction of internal roads will involve vegetation clearance and soil excavation, leading to localized deforestation within the zones. • Vegetation along the alignment of the super dyke/embankment will	trees for roads, industrial zones, housing, and other infrastructure. • Natural habitat along the bank of the Feni River will be affected more, and vegetation density of the area will be decreased as well than the previous scenario. • Dredging and landfill processes at the Feni site will disturb vegetation, particularly riparian and aquatic plants along the Feni riverbank. • Surface water extraction and reservoir development could lead to changes in hydrology, potentially affecting plant ecosystems reliant on natural water. • The construction and expansion of roads, including the Barotakia-Bamonsundor Road, internal and external roads, and railway transport, will lead to the removal of roadside vegetation and trees. • The laying of 15 km of optical fiber cable and railway infrastructure (13.4 km) will have localized vegetation loss along the routes. • Setting up waste management facilities, desalination plants, and industrial buildings will require clearing existing vegetation in these areas. • If agricultural lands are converted for industrial or infrastructural use, it may lead to a reduction in cultivated plants and associated vegetation.	accommodate industrial zones, roads, and residential areas. • Natural habitats for trees and planted mangrove vegetation will be permanently converted into urban and industrial landscapes, significantly reducing mangrove tree density in the region. • The construction of a 12.5 km super dyke with a two-lane road will require substantial land clearing, removing trees and vegetation in the Sitakunda and Mirsharai sites. Riparian and coastal vegetation along the embankment areas may be destroyed during construction. • Vegetation clearing for internal and external road construction in Sitakunda will lead to the removal of roadside vegetation and the loss of shade-providing trees. Additional roads for connectivity will fragment the existing natural landscapes. • The establishment of industrial plants and hazardous waste treatment facilities, including the one for ship-breaking industry waste, will displace vegetation in the Sitakunda region. • Dredging activities in Sitakunda and associated landfill development will disrupt aquatic and riparian vegetation, with potential downstream impacts on plant ecosystems. • The development of ecotourism parks and jetties may disturb planted mangroves and other coastal vegetation in areas. • While compensatory plantation activities are planned within and outside the NSEZ, these may not fully offset the ecological functions provided by the

Factors	Scenario-1 (16,900 acres of land development)	Scenario-2 (25,350 acres of land development)	Scenario-3 (33,800 acres of land development)
	be cleared for construction. - Changes in hydrology due to the dyke may also affect vegetation outside the embankment by altering water availability. Trees and vegetation in the designated path of the boundary wall will be removed. - Laying pipelines, optical fiber cables, and electricity distribution lines will require trenching and clearing vegetation along their routes. Construction of deep tube wells and distribution lines may disturb existing vegetation. - Dredged material disposal and landfill processes may cover vegetated areas, reducing natural green cover. - Land allocated for industrial units (current	Stormwater network development and canal excavation will disturb vegetation, especially in wetland areas, potentially affecting the ecological balance.	original vegetation, particularly mature forests and diverse habitats.

Factors	Scenario-1 (16,900 acres of land development)	Scenario-2 (25,350 acres of land development)	Scenario-3 (33,800 acres of land development)
	and upcoming projects) will replace natural vegetation with industrial infrastructure, further reducing green cover.		
Wildlife Habitat and Biodiversity Conservation	- Minimal loss of wildlife habitats, with localized impacts near NSEZ sites. - Wildlife corridors will be minimally affected, allowing for natural migration and connectivity. - Most natural habitats (e.g., wetlands, forests) will remain intact, ensuring the survival of key species. - High species richness will be maintained, as most habitats remain intact. - Ecosystem balance will be largely maintained, with predator-prey dynamics and biodiversity interactions intact.	- Habitat loss will be significant in 75% of the area, causing degradation. - There will be a partial disruption of wildlife corridors due to infrastructure development and land conversion. - Partial loss of natural habitats, particularly wetlands and mangrove ecosystems, affects species reliant on these areas. - There will be a significant reduction in species richness in developed zones (75% of the area). - There will be a partial disruption of ecosystem balance; the loss of key species affects ecological functions.	- Extensive habitat destruction across 100% of the area, leaving minimal undisturbed land. - Natural wildlife corridors will be severely fragmented, isolating wildlife populations and disrupting ecological processes. - Nearly complete destruction of natural habitats, leading to high risks for species dependent on these ecosystems. - There will be a severe reduction in species richness, with many species unable to adapt to habitat loss. - Natural ecosystem balance will be severely disrupted; keystone species and ecological functions will be at high risk.

Factors	Scenario-1 (16,900 acres of land development)	Scenario-2 (25,350 acres of land development)	Scenario-3 (33,800 acres of land development)
ECA/PA/ RAMSAR/ Sensitive Area	- Baraiyadhala National Park, a protected area, considered a major wildlife habitat in this region, is located 21 km from Phase-I. Therefore, no major impacts are predicted due to the establishment of the NSEZ. - No wildlife or fish sanctuary is located within this phase of the NSEZ. - Phase-I holds a very small portion of the Ganges-Brahmaputra-Meghna delta IBA. However, the area doesn't cover the Muhuri Dam IBA site. - This phase doesn't hold any ECA or RAMSAR sites.	- Baraiyadhala National Park is located far away (approximately 25 km) from Phase-II. Therefore, no impacts are predicted. - No wildlife or fish sanctuary is located within this phase of the NSEZ. - Phase-II development area will minimally affect the Muhuri Dam IBA site only. - No ECA or RAMSAR sites are located within this development phase of the NSEZ.	- Baraiyadhala National Park is located 7 km from Phase-III. The Park is isolated from the NSEZ by the Dhaka-Chattogram Highway. Therefore, no major impacts are predicted due to the expansion of the NSEZ in the Sitakunda region. - No wildlife or fish sanctuary is located within this phase of the NSEZ. - A small portion of the Ganges-Brahmaputra-Meghna delta IBA site is located within Phase-III of the NSEZ. - Does not hold any ECA or RAMSAR sites.
Green Belt, Forest Cover, and Vegetation	Limited focus on afforestation programs leads to increased vulnerability of coastal areas to erosion and tidal surges.	- Some afforestation and reforestation efforts continue, mainly focusing on maintaining existing green belts and minimizing deforestation. - Introduction of urban green spaces is driven by local initiatives but lacks comprehensive national planning.	- Implementation of extensive coastal afforestation programs to counteract sea-level rise and provide natural protection against tidal surges. - Nationwide campaigns to enhance forest cover and introduce more green zones in urban developments. This includes roadside plantations and dedicated green belts near industrial areas.

Factors	Scenario-1 (16,900 acres of land development)	Scenario-2 (25,350 acres of land development)	Scenario-3 (33,800 acres of land development)
	Weak conservation efforts and growing urbanization cause significant declines in forest cover and vegetation, affecting local biodiversity and ecosystems.		Protection and expansion of existing planted mangrove forests and conservation areas to safeguard biodiversity and stabilize coastal ecosystems against erosion and storm impacts.
Utilities (Water, Gas, Electricity)	- Water - approximate demand is 10 MLD. - Gas - approximate demand is 339.73 MMCFD. - Electricity - approximate demand is 1895.56 MW.	- Water - approximate demand is 130 MLD. - Gas - approximate demand is 448.76 MMCFD. - Electricity - approximate demand is 517.56 MW.	- Water - approximate demand is 429 MLD. - Gas - approximate demand is 584.03 MMCFD. - Electricity - approximate demand is 3,248.17 MW.
Land Acquisition and Resettlement	- A total of 16,900 acres of land in Mirsharai will be acquired for the development of NSEZ. - Approximately 76 households need to be displaced due to land acquisition for the development of the access road. - Till now, a total of ten (10) HHs have been resettled.	- A total of 25,350 acres of land will be required. - For the development of housing and accommodation (around 200-300 acres) and other infrastructures, including different access roads (653 nos. residential structures, 860 nos. commercial structures, and 43 nos. other structures), railways (around 89 acres of land, 990 residential and commercial structures, 1209 households, and some other assets), etc. - The project may have the potential to induce displacement and conflict among stakeholders, and landowners, particularly in the Sonagazi areas with contested	- A total of 33,805 acres of land will be required. - Both private and public land will be required, especially in the Sitakunda area of NSEZ. - No major physical displacement is expected, but building the access roads (Barodarogar Hat road - 80 nos. residential structures, 500 nos. commercial structures, and 16 other structures) might cause some physical and economic displacement in certain areas.

Factors	Scenario-1 (16,900 acres of land development)	Scenario-2 (25,350 acres of land development)	Scenario-3 (33,800 acres of land development)
		ownership or inadequate compensation frameworks.	
Safety and Security	- Security infrastructure will be under-resourced, with fewer investments in emergency services and law enforcement. A lack of trained personnel and limited resources could delay response times, reducing the effectiveness of public safety measures. - Disaster preparedness efforts may struggle with underfunding, leading to insufficient early warning systems, shelters, and rescue teams. Low investment in disaster response mechanisms could leave them vulnerable to both natural and manmade hazards. - With economic constraints, workplace safety improvements might be deprioritized. Compliance with safety standards could be	- There will be a moderate focus on building a more efficient and responsive emergency service network, including police, fire departments, and medical emergency teams. Enhanced law enforcement will gradually expand to areas experiencing significant growth in population or industries. - The emphasis will be on improving community awareness and preparedness for natural and manmade hazards. The gradual establishment of local disaster management units and a moderate increase in shelters and first responder capacity will help manage risks. - Standards for workplace safety will slowly be enhanced in new and existing industries, with compliance being moderately enforced. Industrial zones and economic hubs will experience gradual improvements in safety protocols, reducing risks to workers and nearby communities.	- Increased emphasis on implementing security measures like enhanced surveillance systems, safe public transport, and improved lighting in streets and public spaces. Community policing initiatives are expanded to strengthen law enforcement at the local level. - A robust disaster management plan includes modernized early warning systems for natural hazards such as floods, cyclones, and earthquakes. New regulations ensure buildings are constructed using disaster-resilient designs and materials. - Health and safety standards are strictly enforced in industrial zones to minimize workplace accidents. Community awareness programs on emergency response and first aid are launched in collaboration with local governments and NGOs. - Upgraded fire safety systems within densely populated urban areas to mitigate risks from fire hazards and accidents.

Factors	Scenario-1 (16,900 acres of land development)	Scenario-2 (25,350 acres of land development)	Scenario-3 (33,800 acres of land development)
	inconsistently enforced, particularly in industries and informal workplaces, increasing risks for workers and local communities.		
Education	- The existing education facilities in terms of the number of educational institutes and manpower in the Mirsharai area are inadequate. - The influx of labor is likely to place additional pressure on existing educational facilities. - Vocational training centers are also inadequate to address the current labor demand effectively.	- Investment in primary, secondary, and higher education institutions, along with training centers, will be increased to meet the future demands of the workforce, their families, and dependents. - Some progress in education with better funding and efforts to improve schools, teacher training, and learning materials. - The private sector will play a dominant role in delivering tertiary education and skill training, while the public sector remains dominant in delivering primary and secondary education.	- Significant improvements in the education system across the region, driven by substantial investment and comprehensive reforms. - Access to quality education at all levels will be expanded, with a strong emphasis on secondary education, vocational training, and technology integration to ensure a sustainable education system in the region.
Health and Sanitation	- The existing health facilities of the region are inadequate. - Additional pressure on health and sanitation facilities will be increased due to the labor influx in the region.	- Significant improvement in the health and sanitation sector as different health services will be established and rehabilitated in the region. - Improved health and sanitation services will lead to greater life satisfaction, empowerment, and social cohesion. - Impact on health and sanitation will be more significant compared to the low-growth scenario.	- Expanded infrastructure can improve access to healthcare, education, and essential services. - Healthcare facilities may face overcrowding, reducing service quality. - Densely populated areas may experience a higher spread of communicable diseases.

Factors	Scenario-1 (16,900 acres of land development)	Scenario-2 (25,350 acres of land development)	Scenario-3 (33,800 acres of land development)
		Potential risks include the overburdening of healthcare facilities due to rapid population growth, challenges in maintaining service quality, inadequate waste management systems, the spread of communicable diseases in densely populated areas, and disparities in access to health services among marginalized groups.	
Employment	- As per masterplan it was estimated that approximately 0.7 million employments would be created. - The focus remains on light and medium industries and limited service sectors. - The provision of vocational training will enhance the skills of local people.	- As per masterplan it was estimated that approximately 1.05 million employments would be created. - A significant share of jobs will go to local communities, with a focus on upskilling unskilled labor. - Moderate demand for semi-skilled labor from regional markets. - Access to vocational training and skill development for local youth and women. - Decline in people employed in agriculture, fisheries, and livestock. - Moderate increase in job opportunities in the service and industrial sectors.	- As per masterplan it was estimated that approximately 1.4 million employments would be created. - Large-scale industrialization and diversification into advanced manufacturing, logistics, and global value chains. - A wide range of opportunities in logistics, manufacturing, education, healthcare, entertainment, financial services, retail, and transportation. - Advanced roles in technology-driven industries require highly skilled labor. - Long-term economic upliftment with significant contributions to national GDP. - Local businesses thrive due to increased consumer demand and investment in infrastructure.
Infrastructure, Transport, and Connectivity	- Limited expansion of infrastructure development. - Limited improvement in inter-regional	- Moderate expansion of infrastructure development. - Moderate improvement in inter-district and inter-regional connectivity for passengers, goods and services.	- Major expansion of infrastructure development. - Strong inter-district and inter-regional connectivity with neighboring countries for passengers, goods and services.

Factors	Scenario-1 (16,900 acres of land development)	Scenario-2 (25,350 acres of land development)	Scenario-3 (33,800 acres of land development)
	connectivity for passengers, goods and services. - No rail line will be constructed to connect the EZ port and the existing Dhaka-Chattogram rail line. - One temporary jetty in the Sandwip channel will be constructed.	- A new rail line will be constructed to connect the port of EZ and the Dhaka-Chattogram existing line. - One permanent Jetty in the Sandwip channel will be constructed by the BIWTA having a capacity of 2,500 to 3,000 tons for carrying the materials/goods. - Two Jetties under the private sector (Bashundhara and Samuda) and one jetty under BEZA will be constructed in the Sandwip channel for carrying the materials/goods.	- High growth in motorized traffic, with non-motorized traffic on highways. - No rail lines are proposed. - No Jetty is proposed.
Urbanization	- An urban-based industrial economy along with the poor harmonization in urban ecosystem management, sewerage treatment, and solid waste management. - Initiatives to achieve a balance between environmental requirements and the needs of the people stagnate or cease, with no improvement of sewerage and waste management systems and poor maintenance of existing systems.	An urban physical environment where there are growing initiatives to achieve a balance between environmental requirements and the needs of the urban people. There is a mix of traditional and modern sewerage systems and partial development in waste management.	- An urban physical environment where there is a balance between environmental requirements and the needs of the urban population. - Effective drainage, modern sewerage, and a fully functioning waste management system. - Much of the rural population will enjoy facilities similar to those available in urban areas.

Factors	Scenario-1 (16,900 acres of land development)	Scenario-2 (25,350 acres of land development)	Scenario-3 (33,800 acres of land development)
Housing, Residence, and Public Amenities	- Due to economic constraints, housing development will be slower. Expansion of residential areas may lag behind demand, potentially leading to the growth of informal settlements and slums. Urban sprawl could occur without adequate planning, resulting in poorly connected residential areas. - Investment in public amenities such as parks, recreational areas, and community centers will be limited. Existing public infrastructure might face pressure due to increasing population density without corresponding improvements in public services like waste management, healthcare, and education facilities.	- Steady but not overly rapid development of housing infrastructure, with a focus on affordable and mixed-income housing. Urban and semi-urban zones will develop with moderate density, providing essential services such as clean water, electricity, and waste management facilities. - The focus will be on essential public services such as parks, playgrounds, community centers, and healthcare facilities. Public amenities will be built alongside residential expansions to ensure an integrated urban environment. - Public infrastructure improvements will be gradual, emphasizing sustainable city planning with improved connectivity, roads, transport facilities, and walkable urban spaces. However, resource constraints could limit the scale of improvements, leading to gradual but steady progress in enhancing livability.	- Rapid urbanization and industrial growth lead to a boom in housing projects. The government and private developers invest heavily in modern residential complexes to cater to the growing population and workforce. New townships are planned, emphasizing sustainable urban design with efficient land use and integration of green spaces. - Policies promoting affordable housing are prioritized to support low and middle-income families. Residential areas include amenities like parks, educational institutions, healthcare centers, and recreational facilities, ensuring a high quality of life. - Large-scale investment is made in developing public services and amenities such as reliable public transport, healthcare facilities, schools, and marketplaces. Well-planned urban fabric with sufficient public utilities, including clean water supply, efficient sewage systems, and electricity. - Advanced technology is integrated into urban planning, focusing on smart city initiatives like e-governance, digital infrastructure, and automated traffic management systems to ensure efficient and safe living conditions.

Factors	Scenario-1 (16,900 acres of land development)	Scenario-2 (25,350 acres of land development)	Scenario-3 (33,800 acres of land development)
	- Limited resources and slow growth in infrastructure investments may lead to inadequate road networks, public transport, and services in newly developing residential areas. - Water supply and sanitation facilities in semi-urban and rural regions might see only modest improvements.		
Labor Influx	- As per masterplan it was estimated that approximately 0.7 million employments would be created. - Approximately 10,000-12,000 laborers have already been engaged, which creates additional pressure on the region. It is estimated that approximately half a million employment opportunities will be created depending on the project's requirements.	- As per masterplan it was estimated that approximately 1.05 million employments would be created. - Development of infrastructure facilities including housing and township will enhance the condition of the region. - Limited land availability in the Sonagazi area could impede the development of adequate housing, potentially leading to unplanned and chaotic urbanization in the region. - Increased demand for both skilled and unskilled workers. - Lower employment levels may reduce the demand for extensive infrastructure development.	- As per masterplan it was estimated that approximately 1.4 million employments would be created. - The region is projected to accommodate an additional 3.92 million individuals, including family members, dependents, and indirectly affected beneficiaries, due to the development. - The region is projected to accommodate an additional 5.6 million individuals, including family members, dependents, and indirectly affected beneficiaries, due to the development. - Large-scale development projects require high numbers of workers, including skilled and highly skilled labor, leading to a high percentage of outsider workers.

Factors	Scenario-1 (16,900 acres of land development)	Scenario-2 (25,350 acres of land development)	Scenario-3 (33,800 acres of land development)
	- Increased demands may arise in housing, education, health and sanitation, and utility consumptions of the region. - Utility requirements including water, electricity, gas, etc. will be less if labor influx is less.	- Increased tensions and conflicts may arise between local communities and incoming workers due to cultural, lifestyle, and economic differences. - The social impact will be more significant due to labor influx compared to the low-growth scenario. - Utility requirements will be high due to the influx of workers, followers, investors, etc.	- Massive influx of workers from national and international markets due to rapid construction and industrial activities. - Conflicts between local communities and outsiders will be heightened, particularly due to differences in culture, lifestyles, and income. - Local and regional businesses benefit from increased demand for goods and services. - Regional economies could experience rapid growth will ensure the overall country's sustainable development goal.
Fisherman Livelihoods	- Approximately 2,557 registered and 700 unregistered fishermen in the Mirsharai area will be impacted due to the development of the land area and access restrictions in the Khals. - Modifying and upgrading the embankment restricts access to the area's fishing grounds. - Impact on fish industry-related livelihoods such as boat owners, fish vendors, day laborers, boat building/repair, fishing net repair, marketing, and	- Fishermen in the Mirsharai area (2,557 +700), plus an additional 1,200 registered and 1,000 unregistered fishermen in the Sonagazi (Char Khandakar and Sonagazi) area, will be impacted. - More substantial impacts on fishing livelihoods due to land development and construction of infrastructure (embankments, super-dykes, sluice gates). - A moderate increase in marine traffic damages fishing nets, leading to economic pressure. - Moderate decline in fishermen's socioeconomic conditions due to loss of access to fishing grounds and damaged infrastructure. - Market access improves slightly through cooperative efforts.	- Fishermen in the Mirsharai area (2,557+700), the Sonagazi area (1,200+1,000), plus an additional 1,500 registered and 500 unregistered fishermen in the Sitakunda (Saidpur, Muradpur, and Bariardhala) area will be impacted. - Additionally, two more khals will be impacted in the Sitakunda area which may impede access to the fishing grounds. - Major disruption to fishing-related livelihoods due to rapid construction and land development in the Sitakunda area. - High level of socioeconomic distress for the fishing community, especially for unskilled workers. - Substantial increase in marine traffic damaging nets and fishing boats, creating severe economic pressure on the community. - Social impact will be substantial in terms of fisherman livelihood compared to the medium growth scenario.

Factors	Scenario-1 (16,900 acres of land development)	Scenario-2 (25,350 acres of land development)	Scenario-3 (33,800 acres of land development)
	transportation will take place for the development of 1st phase of the EZ. - Conflicts in overfishing areas increase as resources become more limited. - Relocation of fish landing station's long-term effects on access will disrupt the livelihoods of fishermen.		
Fish Landing Station	Fish landing stations/ghats/boat parking areas including Saherkhali, Hoania, Bamon Sundar, Daborkhali, and Ichakhali Ghat will be impacted.	Fishermen in the Sonagazi area will be impacted. There are no khals inside the proposed area at the Sonagazi Site.	Fish landing stations/ghats/boat parking areas including Domkhali, Khutakhali, and Donakhali will be impacted.
Livestock Dependent Community	- Char areas and khals within the EZ were previously used for grazing in the Mirsharai area. - Livestock-related livelihoods include buffalo owners, grazing boys (<i>Rakhal</i>), dairy vendors, and other	- More grazing land will be required for the development of the EZ in both the Mirsharai and Sonagazi areas. This will significantly reduce available grazing areas. - Substantial reduction in grazing areas, leading to a shift in grazing locations to less ideal spots. - Many buffalo owners, grazing boys, and others in the cattle-related business may	- Extensive land development for the EZ in Mirsharai, Sonagazi, and Sitakunda areas will drastically reduce the grazing land, leaving very few natural grazing areas for buffaloes, sheep, and cows. - Limited or no access to grazing areas within the EZ forces many to abandon traditional grazing practices. - Significant loss of livestock as many owners decide to sell off their buffaloes, and buffalo boys (<i>Rakhal</i>) are left without stable work.

Factors	Scenario-1 (16,900 acres of land development)	Scenario-2 (25,350 acres of land development)	Scenario-3 (33,800 acres of land development)
	cattle-related businesses that lose their livelihood. - Minimal reduction in grazing areas, with some grazing land being repurposed for the EZ, but the impact remains limited. - The reduction in livestock numbers is moderate.	need to sell livestock or shift to other income sources, resulting in moderate-income loss. Dairy businesses and related activities will experience some disruption, with fewer people involved in buffalo grazing and milk production.	Major economic hardship for livestock owners, grazing boys, and dairy vendors, leading to significant income loss for these communities.
Cultural and Natural Heritage Sites	No cultural and natural heritage sites fall within the boundary. Therefore, no impact is expected.	No cultural and natural heritage sites fall within the boundary. Therefore, no impact is expected.	No cultural and natural heritage sites fall within the boundary. Therefore, no impact is expected.
Tourism and Tourist Spot	- No tourist spot will be directly impacted. - Low growth in the number of tourists visiting different tourist spots in the region.	- No tourist spot will be directly impacted. - NSEZ Sarobar will be constructed having an area of 112 acres. - Moderate growth in the number of tourists visiting different tourist spots in the region.	- One tourist spot, namely Guliakhali Sea Beach, will be impacted. - A moderate to high rate of growth in the number of tourists visiting the different tourist spots in the region. Extra pressure on infrastructure and services, utilization of resources, generation of waste, etc.
Community Dynamics	Community dynamics will start to change due to the influx of workers from different regions of the country as well as abroad, economic growth of the area, infrastructure	Moderately change due to the increasing investors, workers, and their families and followers, urbanization, improved living standards, infrastructure development, education and skill development, equal opportunities or exacerbated social inequalities, etc.	Highly changed due to the introduction of new cultural elements by the immigrants, quality education and skills, boosting the local economy, and improved living standards, equal employment opportunities, economic growth, infrastructure development, including roads, railways, waterways, hospitals, housing, schools, markets, graveyards, playgrounds, etc.

Factors	Scenario-1 (16,900 acres of land development)	Scenario-2 (25,350 acres of land development)	Scenario-3 (33,800 acres of land development)
	development, and effects of outside forces including diseases, natural calamity, advances in the society, etc.		
Vulnerability to Climate Change, Natural Disasters, and Accidents	- Inadequate early warning systems and dissemination mechanisms (specifically for Cyclones and associated tidal surges) and an inadequate number of shelters, rescue teams, and equipment for the increasing population. - Inadequate adaptation and mitigation measures implemented (embankments/ super dyke strengthened, coastal afforestation, etc.). - Lack of substantial investment in emergency response systems leads to greater exposure to natural hazards, manmade	- Moderate improvement in later years due to the strengthening of embankments/super dyke. - Improved early warning systems, rescue teams, rescue equipment, and an increased number of shelters. - Adaptation and mitigation measures implemented (embankments strengthened, coastal afforestation, etc.). - Investment in disaster preparedness measures is moderate, covering priority zones and industries prone to risks like chemical hazards or oil spills. - Seismic-resistant construction is promoted but not mandated across all sectors, focusing primarily on essential facilities.	- Reduction in the extent of land inundated (due to the improvement of embankments/ super dyke) in the coastal belt, with a reduction in the number of households affected. - Substantial improvement of the natural disaster early warning system and an increased number of shelters and rescue teams. - Adequate adaptation and mitigation measures implemented (embankments/ super dyke strengthened, coastal afforestation, etc.). - Improved disaster management measures like early warning systems, evacuation plans, and increased investments in disaster shelters. - Infrastructure developments incorporate earthquake-resistant features in construction codes due to Bangladesh's vulnerability to seismic activities. - Establishment of stricter environmental controls to mitigate risks from hazardous chemicals in industrial zones. Enhanced monitoring systems and emergency response units stationed near critical industrial hubs.

Factors	Scenario-1 (16,900 acres of land development)	Scenario-2 (25,350 acres of land development)	Scenario-3 (33,800 acres of land development)
	industrial risks, and accidents. Weak enforcement of safety regulations and building codes increases the risks of industrial accidents and natural hazards like earthquakes.		

6.3 Impact Matrix

An impact matrix has been developed considering different land development scenarios of the NSEZ and provided in Table 6-3. The risks and impacts significance were determined considering the same scoring system used in Potential ES risk and impact assessment chapter (see Table 5.1 and Table 5.2). It is also to be noted that, during determining the risks and impacts significance for each scenario, both the development and operation phase activities were combined.

Table 6-3: Risk Matrix

Aspects/Issues/Impacts	Scenario-1 (50% area development)	Scenario-2 (75% area development)	Scenario-3 (100% area development)
Impacts on Air Quality	Medium Low	Medium Low	Medium High
Impacts from Noise	Low	Medium Low	Medium Low
Impacts on Surface Water	Medium Low	Medium Low	Medium Low
Impacts on Groundwater	Medium Low	Medium Low	Medium High
Impacts on Topography and Soil	Medium Low	Medium Low	Medium Low
Impacts on Sediment	Low	Medium Low	Medium Low
Impact due to Changes in Land Use	Medium Low	Medium Low	Medium High
Impact due to Solid Waste Generation	Medium Low	Medium High	Medium High
Impacts of Liquid Waste Generation	Medium Low	Medium High	Medium High
Impacts on Drainage	Medium Low	Medium Low	Medium High
Impacts of Traffic	Low	Medium Low	Medium High
Loss of Ecosystem Services	Low	Medium Low	Medium Low
Impacts on Terrestrial and Mangrove Flora	Low	Medium Low	Medium High
Impacts on Terrestrial Mammals	Low	Medium Low	Medium Low
Impacts on Birds/Avifauna	Low	Medium Low	Medium High
Impacts on Herpetofauna	Low	Medium Low	Medium High
Impacts on Aquatic Mammals	Low	Medium Low	Medium High
Impacts on Ichthyofauna (Fish)	Medium Low	Medium Low	Medium Low
Impacts on Hilsa Fisheries	Medium Low	Medium Low	Medium Low
Impacts on Plankton and Benthos	Low	Medium Low	Medium Low
Impact of Dredging on Marine Ecosystems	Low	Medium Low	Medium High
Impacts due to Land Acquisition, Resettlement, and Rehabilitation	Medium High	Medium High	Medium High

Aspects/Issues/Impacts	Scenario-1 (50% area development)	Scenario-2 (75% area development)	Scenario-3 (100% area development)
Community Health, Safety, and Security	Medium Low	Medium Low	Medium High
Occupational Health and Safety	Medium Low	Medium Low	Medium High
Labor Influx	Medium Low	Medium Low	Medium High
Child Labor and Forced Labor	Medium Low	Medium Low	Medium High
Gender Based Violence and Sexual Exploitation and Abuse/Sexual Harassment	Medium Low	Medium Low	Medium Low
Violence Against Children	Medium Low	Medium Low	Medium Low
Impact on Social Infrastructures	Medium Low	Medium Low	Medium High
Impacts on Fisherman and Fishery Activity	Medium High	Medium High	Medium High
Impacts on Livestock Population and Dependent Community	Medium High	Medium High	Medium High
Tourism	Low	Low	Low
Impacts on Community Dynamics	Low	Low	Medium Low
Changes of Landscape - Visual Impact	Medium Low	Medium Low	Medium Low
Impacts due to Natural Disasters	Medium High	Medium High	Medium High
Climate Change and Greenhouse Gas Emissions	Low	Medium Low	Medium High

7 ALTERNATIVE ANALYSIS

This chapter presents the analysis of NSEZ alternatives and compares between potential impacts and risks of these alternatives from environmental and social aspects. It also analyses the advantages and disadvantages of each of these alternatives to help decision-makers identify the environmental and social dimensions of potential alternatives for implementing the NSEZ and to compare the advantages and disadvantages of these options among other technical and economic factors.

7.1 No Go Alternatives

The “no-go alternative” implies that the development and operation of the proposed NSEZ will not be achieved. An impact matrix for the no-go alternative has been prepared and provided in Table 7-1.

Table 7-1: Impact Matrix for No Go Alternatives

Parameters	Positive Impacts (No-Go)	Negative Impacts (No-Go)
Ambient Air Quality	No ambient air emission from industry and traffic	Continue the pollution from existing sources
Ambient Noise Level	No ambient noise emission from industry and traffic	Continue the pollution from existing sources
Surface Water Quality	No effluent discharge, no industrial pollution of khals, rivers, and the marine environment.	Improvement of stormwater infrastructure; status quo of unmanaged runoff.
Groundwater Quality	No leaching or contamination from industrial operations. No groundwater extraction and crisis.	Continued risk from unregulated rural sanitation/septic systems.
Biodiversity (Terrestrial/Marine)	No vegetation removal, dredging, no habitat loss; marine life (e.g., Hilsha, Dolphin) undisturbed.	Ecosystem remains unprotected from natural degradation (no conservation investment).
Fisheries and Livelihoods	No restriction on fishing access; traditional fisheries are maintained. No restriction on livestock access and traditional livelihoods maintained. No displacement of fish landing stations.	No value chain modernization, limited income growth, or export potential.
Employment and Economy	Traditional livelihoods preserved. Approximately 1.4 million job opportunities will not be created.	No job creation from industrial development; missed opportunity for national/regional economic growth.
Land Use	Agriculture and rural land use are preserved.	Low productivity, underutilized coastal lands.
Coastal Flood Protection	No super dyke construction; vulnerable to tidal surges and cyclones.	Erosion from wave actions and tidal surges from cyclonic events.
Infrastructure Development	No roads, railways, jetty, utilities, CETPs, or housing, hospitals, schools; basic needs unmet.	Existing transportation and communication networks and infrastructure will continue.

The no-go alternative offers clear environmental and social benefits in terms of preserving the coastal and marine ecosystem, avoiding air, noise, water pollution, and maintaining traditional livelihoods.

However, it misses the opportunity for critical economic transformation, loss/slowdown of trade and cooperation with foreign countries, job creation, loss of infrastructure upgradation in the region, loss of revenue, climate resilience through the super dyke, environmental improvements that come from controlled and treated development (e.g., CETPs, STPs, green belt, drainage, etc.). While the No-Go Alternative has short-term ecological advantages, the proposed Master Plan provides a balanced and sustainable development path when environmental mitigation is effectively implemented. Therefore, the no-go alternative is not recommended, and the proposed Master Plan is preferable for long-term economic and environmental resilience.

7.2 Location Alternatives

Regarding the project location alternatives, it is always recommended by the World Bank that private lands should be avoided. Alternatively, if private land cannot be avoided, at least the land with the minimum socioeconomic impacts should be selected. Basically, in Bangladesh, there is a scarcity of suitable alternative land for establishing such a large industrial city covering approximately 33,805 acres of land.

The NSEZ location is selected in the coastal area of Bangladesh, considering the accessibility by road and waterways. The selected site is mostly reclaimed land from the sea and a very small amount of private land. One of the positive sides of this EZ is the availability of vast government barren land, and people's displacement is less. Environmentally sensitive areas/protected areas, as well as archaeological sites, cultural heritage sites, ancient monument sites, etc., are avoided. Additional advantages expected from the location are ease and low cost of transportation of raw materials using waterways, and a reduction in GHGs from transportation by burning less fuel. Thus, the location alternative is not considered in the alternative analysis.

7.3 Access Road

The NSEZ site is about 10 km from the Dhaka-Chattogram Highway and 67 km from the Chattogram sea port. According to the Master Plan, the connecting roads are mainly from Dhaka Chattogram Road and can be listed as Muhuri Project Road (Zorarganj - Muhuri Project), Bamonsundar Road, NSEZ Saroni Saroni North, NSEZ Saroni Main, NSEZ Saroni South, and Mohanagar-Barodarogarhat Road. At present, the capacity of the local access roads adjacent to NSEZ is quite limited and the number of existing links to NSEZ is inadequate to cater to the new volume of traffic likely to be generated by NSEZ. Hence, the road network will need to be upgraded and improved.

The access road development activities will have both positive and negative environmental and social impacts. A matrix showing the positive and negative impacts of access road development for the NSEZ, considering E&S aspects, has been given in Table 7-2.

Table 7-2: Impact Matrix for Access Roads alternatives

Aspects	Positive Impacts	Negative Impacts
Environmental	- Paved roads will decrease/reduce dust emissions and vehicle emissions compared to unpaved roads. - Better roads may reduce fuel consumption due to smoother traffic flow. - It can be designed to include proper drainage and reduce existing road-related environmental stress.	- Air and noise pollution during construction from construction equipment and increased vehicle movement during operation. - High noise levels during construction may disturb both wildlife and nearby communities. - Clearing vegetation for road development will impact flora and fauna. - Earthworks and land clearing can lead to erosion, especially during

Aspects	Positive Impacts	Negative Impacts
		monsoons, impacting nearby water bodies.
Social	- Increased accessibility for local communities (movement for jobs, education, healthcare, market, etc.). - Potential to stimulate local development (markets, housing, services, etc.). - Developed road networks will generate both short-term (construction) and long-term (logistics, service, trade) employment. - Reduces travel time and transportation costs for local residents. - Spurs' development of satellite towns, residential areas, and supporting services near road corridors.	- Possible land acquisition may cause physical and economic displacement or loss of livelihood. - Road alignment may pass through agricultural land that may reduce food production and local livelihoods. - Higher traffic volumes after construction can increase accident risk and road safety issues, especially in rural or unregulated areas. - Noise, dust, and access barriers during construction can disrupt daily life and social cohesion.
Economic	- Improved connectivity boosts trade and logistics efficiency. - Enhances access to the NSEZ, attracting investors and industries. - Reduces transportation cost and travel time. - Facilitates the timely movement of goods to/from Chattogram Port.	- High capital investment is required for construction and long-term maintenance. - Roads may trigger uncontrolled urban expansion, putting pressure on local resources and services. - While beneficial to some, rising land prices may make it harder for locals to afford property near the roads. - Traffic congestion risk if not properly expanded or maintained over time. - Economic displacement occurs if small businesses are affected by land acquisition.
Infrastructure	- Supports integrated regional development (electricity, water, gas, telecom lines along the road corridor). - Enables emergency response and disaster management, including firefighting and medical services to and from the EZ.	Stress on existing urban and rural infrastructure due to induced development.

The development of access roads is preferable considering the positive impacts of improved road connectivity to NSEZ area are significant for economic growth and accessibility. However, negative impacts, especially environmental degradation, social displacement, and construction-phase issues must be mitigated through proper route planning, environmental management, and stakeholder engagement. The long-term economic and social benefits clearly outweigh the negatives if mitigation is well-planned and implemented.

7.4 Source of Construction Materials

Possible sources of construction materials for the development of the NSEZ can be divided into categories such as national (Bangladesh) and international (other countries). The construction materials collection from different sources will have both positive and negative environmental and social impacts. A matrix showing the positive and negative impacts of construction materials sources considering E&S aspects has been given in Table 7-3.

Table 7-3: Impact Matrix for Construction Material Sourcing Alternatives

Aspects	Local Sourcing (Bangladesh)	International Sourcing
Environmental	Low transport emissions support sustainable sourcing.	High transport-related emissions and higher carbon footprint.
Social	Job creation, skill development, VAT/tax revenue.	Limited local involvement, lower tax contribution.
Economic	- Supports local industries, increases GDP, and boosts local income. - Lower logistics cost, local production advantage. - Shorter lead times, easier coordination with local suppliers.	- Limited local economic benefit; most payments go abroad. - Sometimes there are cheaper unit prices, but higher shipping/logistics costs. - Longer lead times, risk of port delays, and currency fluctuation.

Local sourcing offers significant advantages in terms of economic development, environmental benefits, and supply chain reliability. It also supports local employment and government tax revenue. International sourcing may offer some price advantages on specific high-tech or specialized materials, but it comes with environmental downsides, longer lead times, and reduced local economic contribution.

After assessing the two sourcing alternatives across key impact areas, local sourcing emerges as the preferred option for most materials due to its strong positive impact on the national economy, environmental sustainability (lower transport emissions), support for domestic industries and employment, reliable supply chain and lead times, and contribution to government revenues through taxation. While some specialized construction materials may still need to be imported due to quality or unavailability, the primary sourcing strategy for the NSEZ should prioritize local suppliers wherever feasible. This approach will maximize economic, social, and environmental benefits aligned with sustainable development goals.

7.5 Water Supply

The NSEZ is anticipated to have a water demand of 429 MLD by the year 2040. Based on this, a number of water sources have been considered for utilization in the EZ as highlighted below:

Groundwater

A groundwater survey was undertaken by IWM (BEZA 2020b) in the EZ site indicated that the drainable storage volume estimated is about 205 MLD, which can be obstructed from the deep aquifer, and a total of 100 nos of 1 cusec pumps, operating for 20 hours per day. The study also informed that salinity exists in shallow aquifers in most parts of the project area. Therefore, shallow aquifer (0-70m) needs to be avoided for a large quantity of water supply. The estimated aquifer volume is not adequate to cover the estimated daily water demand for the EZ. In addition, the Hydro-Geological Survey under Mirsharai Upazila Development Plan (MUDP) 2018 recommends that the aquifer condition in the EZ area is not suitable for the heavy groundwater withdrawal required for the EZ.

Surface Water (Feni and Meghna River)

Currently, the Feni reservoir is one of the surface (fresh) water sources in the EZ area. From the water demand and availability study report, the capacity of the intake (at Osmanpur, about 2.5 km upstream

of the Feni Regulator near the confluence of the Azampur Khal and the Feni River) will be 100 MLD, considering two-phase development of the surface water treatment plant. The water is used for domestic, commercial, irrigation for agriculture, and industrial uses. It is further designated as an Important Bird and Biodiversity Area (Muhuri Dam), plays a role in reducing saltwater intrusion, supports recreational activities, and is a critical source of fish in the area. In view of this, NSEZ should not consider meeting the EZ water demand from the Feni reservoir entirely.

Further, about 250 MLD of surface water from Meghna River, Chandpur, through 132 km long transmission lines is in consideration.

Rainwater Harvesting

About 5 MLD of water will be sourced from rainwater harvesting facilities in EZ. The average rainfall of the EZ area is about 3,300 mm, and 90% rainfall is received between the months of May to October.

CETPs

About 24 MLD of water will be sourced from CETPs in EZ.

Desalinization Plant

Additional water could be managed by using the treatment of seawater (desalination) from the Sandwip Channel/Bay of Bengal. A provision of a desalination plant to supply 50 MLD water among the total water demand of the EZ.

Groundwater, surface water (Feni and Meghna River), rainwater harvesting, desalination plant, and CETPs are the main water resources in the EZ area. As such, NSEZ has considered a hybrid of five water sources in meeting the EZ water demand. Thus, a further water supply alternative was not considered in the alternative analysis.

7.6 Gas Supply

The total gas requirement for the NSEZ is approximately 584.03 MMCFD, which will be ensured by the Karnaphuli Gas Distribution Company Limited/Gas Transmission Company Limited. The required gas for the NSEZ can be sourced in two ways such as trucking through tankers and pipelines. These sources will have both positive and negative environmental and social impacts. A matrix showing the impacts of gas sources considering E&S aspects has been given in Table 7-4.

Table 7-4: Matrix for Gas Supply Alternatives

Aspects	Trucking Through Tankers	Pipeline Supply
Environmental	- High emissions (dust and exhaust) from vehicles; risk of spills, explosions, and pollution. - Higher risks of accidents, explosions, and contamination due to mobile transport.	- Dust emission during the construction of the pipeline; risk of leakage minimized by safety systems. - Safer long-term solution with proper construction, inspection, and maintenance.
Social	- No land acquisition needed, minimal disruption to communities. - High impact due to increased heavy vehicle traffic; possible road congestion and accidents.	- Land acquisition required for the right-of-way may lead to displacement and social disruption. - Minimal impact after construction; no interference with surface traffic.
Economic	Low initial investment but high recurring operational and maintenance costs.	High initial capital cost for installation, but lower long-term operating costs.

Aspects	Trucking Through Tankers	Pipeline Supply
	Minor temporary jobs (drivers, logistics); little long-term economic benefit.	Can create skilled job opportunities during construction and maintenance.
Others	- Less reliable; vulnerable to traffic, road conditions, and logistic disruptions. - Limited scalability; increasing demand would mean more trucks and more traffic. - Requires continuous coordination, scheduling, and fleet management.	- Highly reliable and consistent supply, ideal for industrial-scale operations. - Easily scalable by upgrading pipe size or pressure to meet long-term gas demand. - Less complex post-construction; minimal manual intervention required.

Trucking through tankers offers a short-term, flexible option with lower upfront costs and no land acquisition needs, but comes with significant environmental, safety, traffic, and reliability risks, especially for large-scale industrial use. However, pipeline supply, although more expensive initially and socially sensitive due to land needs, offers superior reliability, environmental performance, safety, and scalability for long-term industrial development.

After assessing the two gas supply alternatives across key impact areas, pipeline supply emerges as the preferred alternative for ensuring consistent, safe, and scalable gas delivery to the NSEZ. Proper planning of pipeline routing and mitigation of social impacts (e.g., compensation, stakeholder engagement) should be integrated into project development to ensure sustainable implementation.

7.7 Electricity Supply

It is assumed that the NSEZ will largely depend on the electric power supply from the national grid because it is readily available and affordable. However, the power supply from the national grid is not fully reliable, as an evident power outages. In this regard, there is a need for emergency power sources on site. To be successful, a zone requires clean, consistent, and stable access to power and backup power in cases of emergency. For the residents in NSEZ, power will be obtained from a variety of sources. As such, a percentage of total demand may be met by on-site generation facilities. In the present scenario, NSEZ may take 2,000 MWh (without contingency) from the grid network against the demand of 3,248 MW through an existing, dedicated 400 kV transmission linked with the grid system.

According to the master plan, the NSEZ has adopted a hybrid electricity strategy e.g., combine national grid power, emergency backup generators, generation from fuel-based power plant, and renewable energy development (solar) to ensure energy security, environmental compliance, and long-term affordability for NSEZ. Therefore, the electricity supply alternative was not considered in alternative analysis.

7.8 Solid Waste Management

From the NSEZ development and operation, different types of solid waste will be generated, including municipal solid waste, industrial waste, biomedical waste, electronic waste, hazardous waste, etc. According to Master plan, total 777,084 tons/year of solid waste will be generated including 245,644 tons/year of industrial solid waste and 531,440 tons/year of municipal solid waste by the year of 2040. According to the master plan, about 185 acres are required only for the municipal solid waste landfill, and the total land requirement, considering other facilities like a composting plant, different infrastructure, an area for biomedical waste, and a separate area for hazardous waste storage and management, is about 274 acres.

Various methods of solid waste management are used globally based on the type of waste, local infrastructure, environmental regulations, and economic factors. The most common are landfilling, incineration, recycling, composting, waste-to-energy, and mechanical and biological treatment. All

these methods have both positive and negative environmental and social impacts. A matrix showing the impacts of different solid waste management methods, considering environmental and social aspects, has been given in Table 7-5.

Table 7-5: Matrix for Solid Waste Management Methods Alternatives

SWM Methods	Positive Impacts	Negative Impacts
Landfilling	- Simple disposal method and widely used - Temporary waste containment - Can capture methane for energy (if engineered well) - Low operational cost compared to other methods - Job creation in waste handling, sorting, transport, and landfill management	- Groundwater contamination risks from leachate - Methane emissions (a potential GHG) - Land degradation, air, water, and soil pollution - Health hazard for the nearby communities, bad odor, and nuisance - Long-term costs of remediation, land value degradation, and loss of usable land
Incineration	- Reduces waste volume significantly (up to 90%) - Destroys pathogens and toxic organics - Potential energy recovery reduces land use for waste disposal - Can supply electricity/heat - Creates skilled technical jobs	- Air pollutants (dioxins, furan, heavy metals, etc.) - Produces toxic ash - Health risks for the nearby communities from emissions - High GHG emissions if not controlled - High capital and operational costs, as well as disposal costs
Recycling	- Reduces raw material extraction, saves energy, and reduces pollution - Supports local economies and informal sectors - Reduce disposal costs over time - Generates revenue from the sale of recycled materials and reduces landfill costs	- Improper recycling may lead to contamination and waste - The informal recycling sector often faces poor working conditions - Energy use in recycling processes - Fluctuating market value of recyclables, high sorting cost
Composting	- Convert organic waste into natural fertilizer/compost, improve soil health, and reduce landfill burden. - Reduces methane emissions from landfills - Promote farming and green jobs - Produces biogas (renewable energy) and a clean energy supply	- Risk of odor if not managed properly - Attracts vermin if not contained - Leachate from improper operation - Requires waste segregation at source - Sensitive to feedstock quality - Digestate may require treatment - Requires technical knowledge - Higher initial costs
Waste-to-Energy	- Convert non-recyclable waste into energy and reduce waste volume. - Reduces landfill demand - It can be cleaner than landfilling if emissions are controlled - High-tech job creation in operation/maintenance	- The emission of air pollutants, if not properly filtered - Residual ash must be landfilled - Can discourage recycling if overused - High setup cost, sensitive to feedstock consistency
Mechanical and	- Reduces landfill volume, recovers recyclables, and compostables - Biologically treats organics	Residuals still need landfilling or incineration, with possible odor/leachate.

SWM Methods	Positive Impacts	Negative Impacts
Biological Treatment	• Reduces landfill burden • Create jobs in sorting and treatment facilities • Can operate in urban or industrial zones	• May produce low-quality compost or fuel • Requires skilled labor and a consistent waste stream • Community concerns regarding noise, smell, and traffic • High initial investment and operational complexity

Based on the solid waste types expected from NSEZ, an integrated solid waste management approach is the most preferable. For sustainability, a hybrid approach is often best: composting + recycling + controlled WTE or biogas for non-recyclable. EZ should invest in waste segregation, education, and cleaner technologies to minimize environmental harm and maximize social benefits.

7.9 Liquid Waste Management

According to BEZA, domestic wastewater will be collected in holding tanks and directed to NSEZ STP-1 and STP-2 with a proposed capacity of 45 MLD and 80 MLD respectively, while industrial wastewater will be collected and directed to NSEZ CETP-1, CETP-2, CETP-3, and CETP-4 with a proposed capacity of 50 MLD, 50 MLD, 100 MLD, and 150 MLD respectively via the installed wastewater network system.

As per the master plan, efforts shall be made to recycle about 70% of the wastewater after treatment to meet various industrial uses. This, in turn, will substantially reduce the quantum of water to be drawn from various sources to meet the water demand of EZ. The treated effluent from the STPs and CETPs will be reused in the irrigation of the greenbelt surrounding EZ, and reused for industrial purposes such as cooling, floor washing, etc. The stormwater runoff will be reused as greywater or for landscaping.

In case of discharging the surplus of the treated industrial or domestic effluent to the Sandwip Channel, the effluent quality from the STPs should comply with the national standards as mentioned in Schedule-3 of ECR 2023, while the effluent quality from the CETPs should comply with the national standards as mentioned in Schedule-4 of ECR 2023. These standards will be monitored regularly to ensure the appropriate function of the wastewater treatment systems. Considering the above issues, other liquid waste management options were not considered in the alternative analysis.

7.10 Phasing of Development

The total land area required for the NSEZ is 33,805 acres. According to BEZA, all the land within NSEZ has not yet been acquired and some land has been allocated to investors. Considering the above facts, the EZ area has been divided into three phases, and the master plan of the EZ has set phasing rules to maximize the land values and minimize capital costs. The major phasing rules are 1) develop land that has been already acquired and where investors want to construct their industries, 2) infrastructure/utility networks should never be constructed without demand, 3) develop core infrastructure and utility networks incrementally within EZ so that only the required networks/systems are built to support each phase of development, and 4) new phases should not begin until 70% of the first or previous phase of a project is sold out/leased. Since development following this phased and demand-driven approach, a separate alternative analysis for phasing was deemed unnecessary. Therefore, the phasing development alternative was not considered further in the alternative analysis.

7.11 Dredging and Land Filling Alternatives

7.11.1 Selection of Dredging Site

It is estimated that an approximate total amount of 450.89 million cubic meters of soil will be required for EZ site land development. According to BEZA²⁵, the proposed dredging site for land development of the NSEZ is the Sandwip Channel. However, a minimum distance of 1.5 km from the super dike should be maintained for dredging following the BWDB guideline for dredging activities to protect the super dike. The location of fish breeding and spawning areas, as well as IBAs, should be considered during the selection of dredging locations.

7.11.2 Dredging Methods and Techniques

There are two primary types of dredging equipment and methods presently being used for dredging. These are the mechanical dredgers (grab dredger, backhoe dredger, and bucket ladder dredger) and hydraulic dredgers (cutter suction dredger, trailing suction hopper dredger, and plain suction dredger). The difference between these types of operations is the mechanisms and methods by which the sediments are excavated, collected, and conveyed. This dredging equipment and methods will have both positive and negative environmental and social impacts. A matrix showing the impacts of dredging equipment and methods, considering E&S aspects, has been given in Table 7-6.

Table 7-6: Matrix for Dredging Equipment and Methods Alternatives

Aspects	Impact of Hydraulic Dredging	Impact of Mechanical Dredging
Environmental	- Water turbidity risk is high - it disturbs sediment, increases turbidity, especially in soft soil. - Aquatic habitat disturbance risk is high, affecting aquatic/marine flora and fauna. - Sediment control is lower, more dispersed, and difficult to control placement. - Fuel Use/GHG Emissions are high, pumps run continuously, energy intensive. - Spill risk is low; closed system (piped transport) reduces spill risk.	- Water turbidity risk is medium, localized turbidity, with less plume generation. - Aquatic habitat disturbance risk is medium, confined to specific points, but still disturbs bottom life. - Sediment control is higher, and more precise placement of sediment is possible. - Fuel Use/GHG Emissions is medium, intermittent operation can be more energy efficient. - Spill risk is higher; open transfer from the dredger to the barge may lead to spills.
Social	- Noise and vibration impact is high, continuous operation with engine noise underwater and onshore. - Impact on Fishing & Livelihood is high, disrupting larger areas of aquatic resource use. - Navigational safety is moderate; floating pipelines may obstruct nearby traffic.	- Noise and vibration impact is medium, mechanical noise, but often time limited. - Impact on Fishing & Livelihood is medium, confined operation allows fishers to adjust locations. - Navigational safety is high; equipment and barges can block channels temporarily.
Economic	- Operating cost is medium to high, expensive fuel, and the maintenance of pumps. - Suitability for large volumes is high, efficient for large-scale dredging and reclamation projects.	- Operating cost is medium; equipment may be cheaper, but it requires a barge fleet. - Suitability for large volumes is low - better suited for small to medium volumes.

²⁵ Environmental and Social Impact Assessment (ESIA) for the Land Development of Part of Precinct F (IMD Zone and Housing Facilities) and Precinct B of NSEZ-BEZA

Aspects	Impact of Hydraulic Dredging	Impact of Mechanical Dredging
	• Project time efficiency is high, and continuous dredging allows faster completion. • Maintenance needs are high; pumps, cutters, and pipelines are prone to wear.	• Project time efficiency is low to medium, more time-consuming due to manual lifting and transport. • Maintenance needs are medium, mechanical systems are simpler but require barge maintenance.

Mechanical dredging has some environmental benefits compared to hydraulic dredging such as localized turbidity, less plume generation, energy-efficient, less mechanical noise, etc. However, considering the high efficiency for large-scale dredging and reclamation projects, time efficiency (continuous dredging allows faster completion will help to avoid fish breeding and spawning time), the hydraulic dredging is preferable.

7.11.3 Disposal Techniques

The primary objective of the dredging activities is to utilize the dredged sediment for various development components within the economic zone, including land reclamation, road construction, jetty area development, stabilization of erosion-prone sites, etc. By reusing the dredged material on-site, the project can significantly reduce overall costs by avoiding the need to procure and transport fill material from external sources. Thus, other dredge sediment disposal alternative was not considered in the alternative analysis.

8 ES RISK MANAGEMENT

This chapter outlines the framework for assessing and managing environmental and social issues in different projects in the NSEZ as well as surrounding regions. It also provides necessary procedures and tools for screening and assessing environmental and social impacts. The environmental and social assessment of the development activities/projects in the region needs to be carried out based on the provisions of the Environment Conservation Act 1995 and its subsequent amendments and Environment Conservation Rules 2023 of the Government of Bangladesh as well as relevant World Bank's Environmental and Social Standards (ESSs).

8.1 General Principle

Due to the nature of some of the proposed activities in the region during the development and operation of the NSEZ and their potential environmental and social impacts, the different activities/projects will fall into different project categories (red, orange, yellow, green) according to Environment Conservation Rules 2023, which will require initial ES screening, EMP/ESMP, IEE, and in some cases detail EIA/ESIA. Therefore, the ES management procedures are prepared based on the following principles that can lead to the development and implementation of the activities/projects in the region.

- BEZA HQ at the national level and the Head of NSEZ at the site level are responsible for compliance with national policies, regulations, and guidelines.
- NSEZ management in coordination with the other institutions including RHD, LGED, BWDB, BIWTA, PGCB, BR, KHDCL, etc. as well as investors/industries in the NSEZ is responsible for obtaining environmental clearance from DOE, and local government agencies, as required.
- IEE, EIA/ESIA, and EMP/ESMP need to be prepared for activities upon screening. In case, the requirements of DOE's EIA guidelines differ from those of WB ESF, the more stringent standards and requirements will apply.
- Activities with significant environmental impacts, including those that significantly increase greenhouse gas emissions and impact on natural habitats and biodiversity will not be eligible for implementation in the region.
- Planning and design of any additional activities should ensure minimal assessment of cumulative impacts.
- Environmentally sensitive areas, cultural heritage sites, and restricted or disputed lands (if identified during project implementation) should be handled with appropriate mitigation or compensation measures during implementation following the chance find procedure.
- Participation of stakeholders (especially local communities) should be ensured by the HSE team of NSEZ in the planning, implementation, and monitoring of project activities.
- BEZA HQ as well as NSEZ management will ensure an appropriate institutional set up for implementing E&S management plans and inter-agency coordination. They will also ensure that bidding/agreement/contract documents for construction contractors, and PPP operators have specific clauses to ensure implementation of E&S management plans, as required.
- Contractors to be engaged in construction/renovation/expansion/repair and maintenance/operation workers under the NSEZ should be conversant with OHS standards, labor laws, SEA/SH issues, incidence response, and reporting mechanisms.
- NSEZ management will inform project stakeholders about project interventions and their potential impacts on the surrounding ES elements.

8.2 Environmental and Social Management System

The objective of this aspect of the framework is to establish an effective framework for the implementation and management of the measures for a better E&S performance of the NSEZ in the region. In essence, its focus is on institutional practices for implementing the measures as well as monitoring the implementation process. The goal is to ensure that the right policies and procedures, as well as capacity, exist to effectively execute the implementation and monitoring exercises.

8.2.1 Objective of Environmental and Social Management System

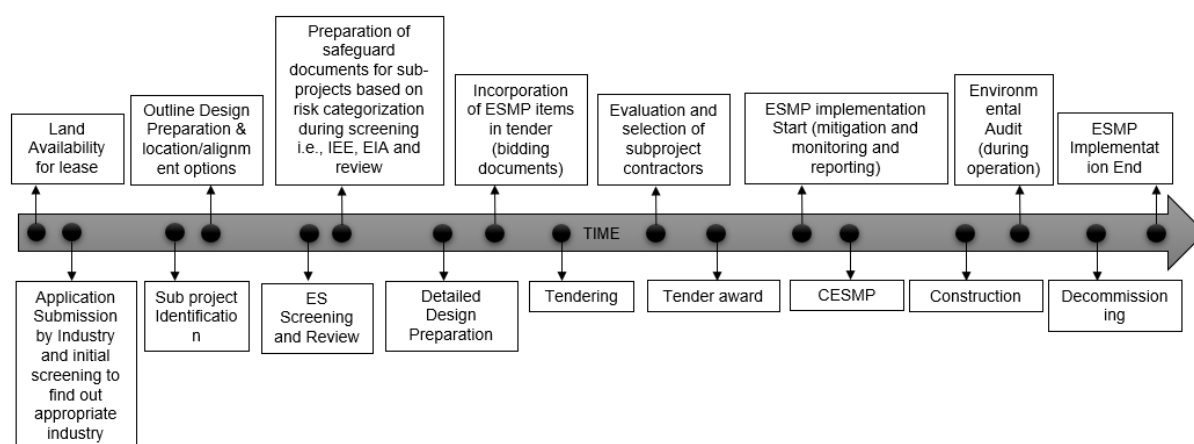
The primary objective of this ESMS is to guide the NSEZ in screening and selecting projects and assessing and managing environmental and social impacts. NSEZ will ensure that:

- All projects are screened against the negative/exclusion list of activities.
- All projects with potentially significant environmental impact are categorized as per DOE.
- All projects are reviewed and evaluated against all other national laws, regulations, and standards on environment, health, safety, involuntary resettlement and land acquisition, indigenous peoples, and physical cultural resources.
- All applicable existing policy frameworks are adequate for the implementation, monitoring, and reporting of the measures defined in the E&S safeguard documents/instruments.
- Capacity exists for the implementation, monitoring, and reporting of the measures defined in the E&S safeguard documents/instruments.
- Stakeholder engagement strategy is adequate to ensure all relevant affected and interested parties participate in the implementation of the E&S safeguard documents/instruments.

8.2.2 Environmental and Social Management Procedures

The overall environmental and social management procedure is shown in Figure 8-1. Based on the availability of land for lease and applications received from the investors, BEZA shall carry out an initial screening, which will help BEZA lease the land to an appropriate industry. After the sub-project has been identified with outline design and location/alignment options, screening of environmental and social risks can be done. It is expected that most of the sub-projects will require some form of feasibility study. This will help in the preparation of E&S documents such as IEE/EIA, ESIA, RAP, and ESMP. The recommendations from these E&S documents need to be incorporated by the detailed design team and also incorporated into the tender (bidding) documents. BEZA would then need to implement the proposed mitigation measures, monitor, and report compliance.

Figure 8-1: Overall Environmental and Social Management Procedure



8.2.2.1 Screening Criteria for Selection of Investment in NSEZ

The following types of projects or activities could be preferred during the initial section of investment in NSEZ, but are not limited to:

- Low pollution generating industries - textile accessory manufacturing uses closed loop production systems that will minimize the effluent e.g., button and zipper making units without dyeing operations. This will also help to reduce the consumption of water resources.
- Prefer low-carbon emission industries - electric vehicle assembly plants leveraging renewable energy for operations and promoting clean mobility. This will help to reduce greenhouse gas emission into the atmosphere.

- Low water-consuming industries - IT hardware assembly or electronics manufacturing, where water is mostly used for cooling rather than processing heavy cleaning. This will also help to reduce the consumption of water resources.
- Low impact on ecology and biodiversity - furniture manufacturing using engineered wood will reduce the tree cutting and maintaining environmental sustainability.
- Higher engagement opportunities, however, would be aligned with the actual requirements of the upcoming industries - training and skilling institutes focused on industrial automation, packaging, solar panel installation, etc. will help to prepare trained and skilled manpower.
- Green energy generation-related industries – utility scale floating solar on waterbodies or biogas to electricity plants using waste sourced from industries. This will help to better management of generated solid waste in the region and reduce the greenhouse gas emissions from the solid waste management facility.
- Exports-oriented or pure-play domestic market industry or a combination of both - ready-made garments (RMG), tailored for export, agri-processing/food processing, and pharmaceuticals will support both foreign exchange and inclusive market linkages.
- Contribution to national/regional economic development - agri-logistics and cold chain infrastructure improving market access and reducing post-harvest losses for farmers across the region.
- Contribution to social development - contribution to job creation - apparel component hub (collar, label, waistband manufacturers, etc.), typically labor intensive and ideal for creating high volumes of semi-skilled jobs, especially for women.
- Environment impact - avoid high environmental polluting industry i.e., Lithium-ion battery production and recycling. Lithium-ion batteries contain heavy metals such as lead, mercury, and cadmium, which can leach into the soil and water if not disposed of properly. Heavy metals are known to be toxic to humans and wildlife, and exposure to these pollutants can cause serious health problems such as kidney damage, respiratory issues, and even cancer. When these batteries end up in landfills, the heavy metals can seep into the ground and contaminate nearby water sources, making them unsafe for human and animal consumption, aquatic life, death of fish and other aquatic creatures. In addition, excessive amounts of lithium in soil can disrupt the balance of nutrients, making it difficult for plants to grow.
- Social impact – industries related to production of narcotics and weapon, etc. that can impact on internal social security and cultural sensitivity.
- Legal compliance to national environmental and social legislation - pharmaceuticals formulation units with ETPs, occupational health compliance, and DOE compliance.

8.2.2.2 Description of Negative/Exclusion List of Activities

The activities that are likely to pose high risks and severe negative impacts on the environment, society, health, and safety will not be established in the NSEZ. A list of such activities has been compiled as the “negative/exclusion list of activities” and presented below:

- Any activity that violates the provisions of applicable national laws and regulations, as well as international treaties, agreements, and conventions to which Bangladesh is a signatory.
- Any activity that has a high probability of serious adverse effects on human health and/or the environment.
- Any activity that impacts productive land and tourist spots due to the land acquisition under the Acquisition and Requisition of Immovable Property Act 2017.
- Involuntary land taking, irrespective of ownership, leads to loss of shelters, livelihood, or sources of livelihood, and loss of access to private and/or community property.
- Any project or activity within protected areas (e.g., wildlife sanctuary, National Park).
- Any activity that leads to the conversion of natural or critical habitats, legally protected areas of high biodiversity, and designated forest areas.
- Construction/works involving the use/installation of Asbestos Containing Materials/Items.

- Activities involved harmful or exploitative forms of forced labor or child labor.
- Production or trade of any product or activity deemed illegal under the law of Bangladesh or subject to international phaseouts or bans (e.g., ozone-depleting substances, wildlife or wildlife products, waste products, etc.).
- Production or trade in weapons and munitions, including paramilitary materials.
- Production or trade of alcoholic beverages, excluding beer and wine.
- Production or trade of tobacco.
- Gambling, casinos, and equivalent enterprises.
- Pornography (goods/stores/web-based).
- Production or trade-in, or use of unbounded asbestos fibers.
- Marine and coastal fishing practices, such as large-scale pelagic drift net fishing and fine mesh net fishing, are harmful to vulnerable and protected species in large numbers and damaging to marine biodiversity and habitats.

All activities/projects in the NSEZ will be checked to confirm that it does not include any activity listed on the negative/exclusion list of activities. This applies to all activities/projects including civil construction works in the NSEZ as well as related activities in the region. The contract documents between NSEZ and the project authority will include necessary clauses to exclude support for any activities in the negative/exclusion list of activities.

The responsibility for checking and ensuring that none of the activities listed in the 'negative/exclusion list of activities' lies with the Environment and Development Unit in BEZA HQ and the HSE team of NSEZ. The HSE manager/ESG manager of the NSEZ will check:

- All detailed project reports and contract documents of the project.
- All activities to ensure that they do not contain any activities on the negative/exclusion list of activities.

8.2.2.3 Environmental and Social Screening

Environmental and social screening would be undertaken for each project/activity. If the proposed project does not involve any activities in the negative/exclusion list of activities, then the environmental and social screening would be carried out to determine whether there are any potential environmental and social risks and impacts, involuntary resettlement impacts and risks, impacts on ecosystem and biodiversity, Indigenous people living in the area, etc. Screening would be carried out comprising proposed project information, locations, proposed interventions and activities, utility requirements and consumption (water, fuel, manpower, raw materials, gas, etc.), production process, generation of emission and effluent, solid waste generation, requirements proximity from settlements, forest, environmentally sensitive areas, national parks, wildlife statuary, marine protected areas, important birds and biodiversity area, wetlands, waterbodies, etc.; applicability of laws, regulations and clearances and permits to be required; identification of potential E&S risks and impacts (physical, biological, social and cultural); and to classify the project based on risk level and finally, presenting conclusion on risk category, need for the detailed environmental assessment, land acquisition and recommendations for preparation of environmental and social safeguard documents (e.g., IEE/EIA/ESIA/EMP and RAP).

The Environmental and Social Screening for all projects/activities in the EZ would be undertaken using project E&S screening templates prepared under the "Environmental and Social Management Framework (ESMF) for Private Investment and Digital Entrepreneurship (PRIDE) Project²⁶" to identify the nature and extent of E&S risks and impacts for different types of proposed activities. Environmental and social screening shall be carried out before the preparation of detailed project reports by the environmental & social experts of the project authority/investors through physical site visits/transect

²⁶ <https://documents1.worldbank.org/curated/zh/599071580345036563/pdf/Revised-Environmental-and-Social-Management-Framework-ESMF-Bangladesh-Private-Investment-and-Digital-Entrepreneurship-Project-P170688.pdf>

walks and will be made after a thorough understanding of environmental settings at and around the project sites.

Environmental and social screening will be carried out for all projects by Environmental and Social Experts of the project authority. They will identify major project activities and carry out a preliminary assessment of the impacts of these activities on the ecological, physio-chemical, and socio-economic environment of the project's surrounding areas. The HSE team of NSEZ will review the E&S screening checklists which will be sent to the World Bank through the BEZA HQ team for reviewing its completeness, correctness, compliance, and approval. The World Bank will review a selection of projects, through desk review/site visits and provide suggestions and guidance for improvements, if required. In the case of substantial risk categories of projects, the Bank will review and approve all E&S checklists.

8.2.2.4 Project Categorization as per Environment Conservation Rules 2023

The legislations relevant to environmental assessment in Bangladesh for all projects are the Environmental Conservation Act (ECA) 1995 and its subsequent amendments, and the Environmental Conservation Rules (ECR) 2023. DOE under the MOEFCC, is the regulatory body responsible for enforcing both ECA 1995 and ECR 2023.

According to the Environment Conservation Rules 2023, considering impacts on the environment and human health, locations and extension of impacts, etc., all the projects have been categorized into four categories, i.e., Green, Yellow, Orange, and Red. A list of projects or activities for each category has been provided in Schedule 1 of the ECR 2023. In case of projects or activities that are not mentioned in Schedule 1, then the projects or activities will be categorized as per the instructions provided in Schedule 14 of the ECR 2023. Based on the category of projects or activities, further, the level of the environmental assessment will be determined by whether a detailed IEE, site-specific EMP, or EIA is required or not.

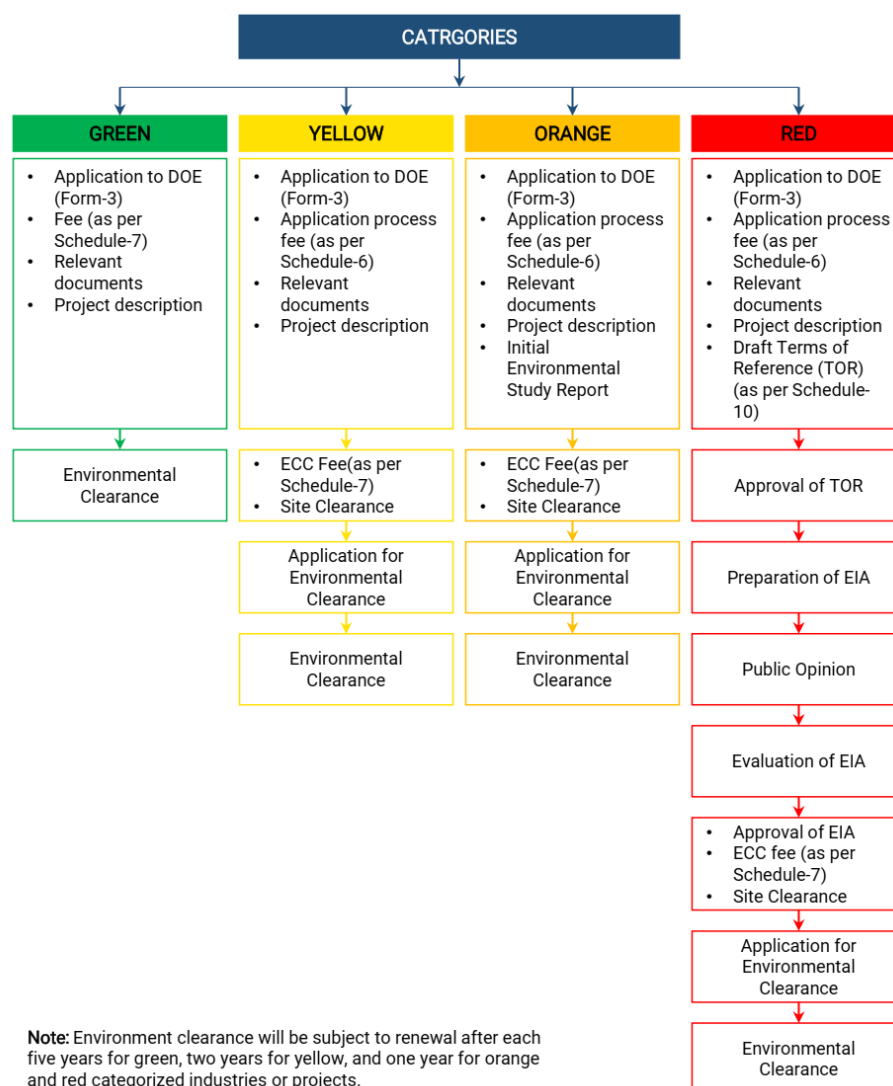
8.2.2.5 Preparation of the Safeguard Documents/Instruments

National Regulatory Requirements

- Red category projects will require a detailed Environmental Impact Assessment (EIA) including an Environmental Management Plan (EMP). Terms of Reference (TOR) for EIA approval from the DOE will be required.
- Orange category projects will require an Initial Environmental Examination (IEE) and application to DOE (form-3), fees, project descriptions, etc.
- Yellow category projects will require to submit an application to DOE (form-3), fees, project descriptions, etc.
- Green category projects will require to submit an application to DOE (form-3), fees, project descriptions, etc.

8.2.2.6 National Environmental Clearance Requirements of Projects/Activities

Steps to be followed for environmental clearance for different categories of projects/activities from the DOE are shown in Figure 8-2.

Figure 8-2: DOE Environmental Clearance Steps

Source: ECR, 2023

Exceptions for the Projects or Activities inside the EZs

According to Clause 6 for the ECR 2023, site clearance will not be required for any type of industries or projects located inside the Economic Zones, Public and Private Export Processing Zones, and Bangladesh Small and Cottage Industries Corporation area. Only the environmental clearance needs to be taken from the DOE.

8.2.2.7 Review and Approval of the E&S Safeguard Document and Dissemination

The Environmental and Social Experts of the project authority will submit the E&S safeguard documents (i.e., IEE/EMP/EIA/ESIA) to DOE and WB through One Stop Service at BEZA HQ. The report will be reviewed by a national regulatory authority (DOE) and the World Bank and provide technical advice on the conduct of assessments and related studies on undertakings and the reports submitted on them. Additionally, they will make recommendations on the adequacy of the assessment and any observed gap and advice on the seriousness of such gaps and the risks or otherwise to decisions required to be made recommend whether the undertakings as proposed must be accepted and under what conditions, or not to be accepted and the reasons, as well provide guidance on how any outstanding issue/areas may be satisfactorily addressed. Copies of all the final and approved versions of E&S safeguard documents will be shared with NSEZ, BEZA HQ, DOE offices (districts, division, and headquarters) as well as the World Bank.

8.2.2.8 Implementation, Supervision, Monitoring, and Reporting

Day-to-day implementation and monitoring of the E&S plan shall be done by the individual industries/ investors and their appointed contractor(s)/subcontractor(s) following the approved environmental and social management plan as well as any subsequent corrective measures prescribed by the HSE team of NSEZ and WB. In addition, they will maintain close communication with the HSE team of NSEZ and relevant stakeholders as necessary. The HSE team of NSEZ will regularly supervise works through site visits, review of documentation, and other available means. The HSE team of NSEZ will prepare regular semiannual monitoring reports on the environmental, social, health, and safety performance of the NSEZ, including but not limited to stakeholder engagement activities and grievance logs, and submit them to the DOE through BEZA HQ. It will help to assess the progress made in the implementation of E&S safeguards and the measures required for its improvement. It will provide the necessary feedback for the NSEZ management for timely decision-making and achieving the objectives. If appropriate, DOE and other local authorities may also monitor the implementation of the E&S measure during the development and operation of the NSEZ.

The HSE team of NSEZ through BEZA HQ will notify the World Bank within 48 hours of any incident or accident related to the NSEZ or that has an impact on it, and that has or could have a significant adverse effect on the environment, the affected communities, the public, or the workers included, for example, occupational accidents that could result in serious injury, minors, injuries, falls, vehicle accidents, larger spills of chemicals, oils, fuels, etc.

8.2.3 Environmental, Health, and Safety Standards for the Industrial City

Environment, health, and safety (EHS) standards will play a key role in the overall environment, health, and safety management in the NSEZ. NSEZ should comply with both national as well as World Bank environmental, health, and safety standards. The more stringent of these two, as required to meet lenders' requirements, will be adopted. BEZA shall adopt ISO 14001:2015 - Environmental Management Systems, ISO 45001:2018 - Occupational Health and Safety Management Systems Standards, and ISO 9001:2015 - Quality Management Systems in their management system as a good practice. It will ensure that BEZA's environment management system remains globally oriented and best in class. ISO certification will promote safe practices to reduce the chances of accidents and injuries in the workplace. ISO 14001:2015 will help to achieve the intended outcomes of its environmental management system, which provides value for the environment, the organization itself, and interested parties. In addition, ISO 45001:2018 will enable organizations to provide safe and healthy workplaces by preventing work-related injury and ill health, as well as by proactively improving their OH&S performance.

The World Bank Group/International Finance Corporation has developed General as well as sector-specific Environmental, Health, and Safety (EHS) Guidelines that can be used. In addition, other international guidelines, i.e., WHO guidelines, ILO labor standards, etc., should be used. In case of the absence of standards in national legislation in those cases, international standards should be used. For example: there are no national standards for soil and sediment quality analysis, therefore USEPA, Dutch or any other international standards should be adhered to in NSEZ.

8.2.4 Guideline for Long-term Environmental and Social Monitoring

To ensure effective implementation of the NSEZ, long-term monitoring will need to be done throughout the NSEZ life cycle. Monitoring will verify if predicted impacts have actually occurred and check that mitigation actions recommended in the RESA are implemented and their effectiveness. Monitoring will also identify any unforeseen impacts that might arise from the development and operation of NSEZ, and appropriate new actions shall be undertaken to mitigate any upcoming negative effects.

For the long-term environmental and social monitoring of environmental and social issues successfully in the region, close collaboration/coordination with the DOE and other relevant agencies is crucial. Regular meetings shall be organized with the DOE representatives and other relevant agencies to

discuss project progress, challenges, and compliance with environmental regulations. A joint monitoring team comprising members from DOE, local government representatives, and other stakeholders shall be formed to oversee the project's E&S impacts. In addition, different online-based monitoring systems, i.e., Continuous Air Quality Monitoring (CAQM) for ambient air quality, and Online Continuous Emission Monitoring System (CEMS) to monitor the effluent quality at the CETPs outlets, could be introduced in the NSEZ. A weather monitoring station could be installed to monitor long-term changes in the region.

An ESG data management tool that can be developed by BEZA, which will enable them to accurately, efficiently, and transparently track and report on their environmental, social, and governance performance in different economic zones as well as NSEZ. Digitalization can significantly improve operational efficiency, leading to a reduced environmental footprint. This digital tool will allow to the generation of reports based on specific parameters. These tools will make it easy to visualize and share data with their employees, customers, other stakeholders, and the general public. Graphs, charts, and dashboards can be easily generated using data visualization tools, which can then be shared with stakeholders. Analysis of ESG data over time, trends that point to areas for improvement, and use this information to make continuous improvements in ESG performance.

8.3 Managing ES Risk

8.3.1 Managing Air Quality

8.3.1.1 Development Phase

Key issues: the main pollutant will be the particulate matter, which will be generated during earthwork activities, including vegetation clearing, excavation works, dredging and reclamation, and transportation. In addition, gaseous emissions will occur due to the operation of diesel fuel generators, and exhaust emissions from transport vehicles such as material transport trucks and administrative vehicles. These will increase the concentration of particulate matter in the air and impact on community and occupational health and safety as well as terrestrial flora.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the development phase:

- Sprinkling water to suppress the dust at the construction sites, specifically on the dust-generating sites.
- Maintain the speed of a vehicle to 20 km per hour at the EZ site and internal road to reduce dust emissions to a large extent.
- Covered trucks are used to suppress dust from construction.
- Use fuel-efficient and well-maintained machinery and vehicles.
- Encourage electric or hybrid construction equipment where feasible.
- Design the offices and workers' township using appropriate "green building" methods.

Dust minimization and vehicle movement at the construction sites will be managed by investors, and the HSE team of NSEZ will supervise the activities. Designing the offices will be carried out by individual investors and supervised by the NSEZ management and the BEZA HQ team. The Worker's township development will be managed by NHA and supervised by the BEZA HQ and NSEZ management.

Monitoring mechanism:

The proposed scope of the air quality monitoring activities during the development phase is as follows:

- Conduct quarterly ambient air quality monitoring for PM_{2.5}, PM₁₀, NO₂, SO₂, CO, O₃, and VOC at the construction sites and surrounding receptors and compare with Bangladesh's Air Pollution (Control) Rules 2022, and WHO/WBG standards.

Individual investors will ensure the monitoring activities during the development phase as per their environmental management plan. The NSEZ HSE team will check and supervise the monitoring activities.

8.3.1.2 Operational Phase

Key issues: There will be an increase in the movement of traffic, and hence, emissions from the moving vehicles will also increase. The exhaust from the DG set in different industries, diesel-operated small boats, vessels, etc., will enhance the pollution load during operation. Methane gas, one of the greenhouse gas groups, will be generated from landfill sites and leachate treatment. These will increase the concentration of particulate matter and gaseous emissions to the atmosphere and impact on community and occupational health and safety, as well as terrestrial flora.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the operation phase:

- Develop an air quality management plan aligned with Bangladesh's Air Pollution (Control) Rules 2022.
- Maintain the speed of a vehicle to 20 km per hour at the EZ site and internal road to reduce dust emissions to a large extent.
- Develop a green belt in the NSEZ site, empty land, outside of the super dike, and surrounding access roads to increase the green area as well as trap dust and absorb pollutants.
- Promote electric vehicles and shared transport for workers.
- Consider cleaner technology for alternative production processes and power sources from solar and wind resources.
- Methane gas produced from landfill sites and other treatment units must be flared.
- Weather monitoring stations should be installed inside the EZ to gather real-time weather-related data.
- Set up and operation of continuous ambient air monitoring stations in EZ to monitor the real-time air quality data.
- Require industries to install continuous emission monitoring systems on chimneys and stacks.
- Conduct an annual energy audit and greenhouse gas inventory for each industry.

BEZA, in coordination with the Department of Environment (DOE), shall establish and monitor the ambient air quality of the region following the provision of Air Pollution (Control) Rules 2022. NSEZ management, with the help of investors, will establish and confirm the continuous emission monitoring system for their chimneys and stacks. NSEZ management shall establish a weather station, and the HSE team will maintain the station and keep a record of historical data for further reporting.

Monitoring mechanism:

The proposed scope of the air quality monitoring activities during the operation phase is as follows:

- The presence and validity of environmental permits for individual industries must be checked.
- Conduct annual ambient air quality monitoring at 10 locations for PM_{2.5}, PM₁₀, NO₂, SO₂, CO, Pb, O₃, NH₃, and VOC at the EZ site and surrounding receptors/settlements, and compare with Bangladesh's Air Pollution (Control) Rules 2022, and WHO/WBG standards.
- Continuous ambient air monitoring for PM_{2.5}, PM₁₀, NO₂, SO₂, and CO.
- Weather conditions include the parameters of air temperature, atmospheric pressure, humidity, precipitation, solar radiation, wind, etc.
- Availability of annual energy audit and greenhouse gas inventory report in each industry.

During operation, the NSEZ HSE team shall embed air quality management protocols into EZ's environmental management system and ensure ambient air quality monitoring in the EZ area. The availability of environmental permits for individual industries must be checked and confirmed by the HSE team of NSEZ. The individual industry shall conduct annual energy audits and greenhouse gas inventories for their facilities and share a copy with the NSEZ management. The HSE team of NSEZ, in collaboration with BEZA HQ, shall compile all the data/reports and prepare an annual report, and a copy of the annual report may be shared with the DOE.

8.3.2 Managing Noise Level

8.3.2.1 Development Phase

Key issues: The major sources of noise will be vehicular traffic and operation of heavy construction equipment like dozers, scrapers, concrete mixers, cranes, compressors, generators, pumps, pneumatic tools, saws, vibrators, etc. Dredging activities in the Sandwip Channel will generate noise from a variety of sources, including the dredger, associated pumps, generators, tugboats, etc. The increasing noise in the area will impact the community and workers' health and safety as well as the aquatic and terrestrial environment.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the development phase:

- Activities that will take place near residential or sensitive receptors should be carefully planned (restricted to daytime, taking into account weather conditions, etc.).
- Preferably, battery-operated, very low noise-generating vehicles should be used.
- Use of Personal Protective Equipment (PPE) such as earmuffs, earplugs, etc., should be strictly enforced for workers engaged in high-noise areas. Rotate shifts to limit prolonged exposure to high noise levels.
- Optimize dredging activity and duration. Underwater noise generation should be restricted with modified equipment, including modifying propellers and/or hulls, and performing regular maintenance, vibrationally isolating machinery, implementing vessels/ships speed restrictions, and incentivizing the use of fewer, larger vessels, etc.
- Ensuring that the noise level of operation of all facilities and structures is within the acceptable limit stipulated in the Noise Pollution (Control) Rules 2006 and WHO/WBG standards.

Noise minimization at the construction sites and dredging sites shall be managed by the investors/contractors, and the HSE team of NSEZ will supervise the activities.

Monitoring mechanism:

The proposed scope of the noise level monitoring activities during the development phase is as follows:

- Conduct ambient noise level monitoring at the nearest settlement/sensitive sites and compare with Bangladesh's Noise Pollution (Control) Rules 2006 and WHO/WBG standards.

Investors shall ensure monitoring activities during the development phase as per their environmental management plan. The HSE team of NSEZ will check and supervise the monitoring activities.

8.3.2.2 Operational Phase

Key issues: vehicle movements in the access roads for staff mobilization, materials/product transportation in and out of the EZ, and the operation of industries (operation of heavy-duty machinery like boilers, compressors, pumps, hydraulic systems, various industrial operations, etc.) will be the major sources of noise pollution from the EZ. In addition, jetty and terminal operational activities such as vessel loading/unloading, container handling, and access road traffic noise will also be generated. These will impact the community and workers' health and safety, aquatic and terrestrial environment.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the operation phase:

- Develop a noise level management plan aligned with the Noise Pollution (Control) Rules 2006 and National Occupational Health and Safety Policy 2013.
- Designate green belts or landscaped buffers between industrial and residential areas to absorb sound.
- Install silencers, mufflers, and acoustic enclosures on noise equipment.

- Use of personal protective equipment (PPEs) such as earmuffs, earplugs, etc. should be strictly enforced for the workers engaged in high-noise areas. Rotate shifts to limit prolonged exposure to high noise levels.

Noise minimization at the industry sites will be managed by the investors, and the HSE team of NSEZ will supervise the activities.

Monitoring mechanism:

The proposed scope of the noise level monitoring activities during the operation phase is as follows:

- Ambient noise level monitoring should be carried out (at 10 locations) on an annual basis in the EZ and surrounding area, specifically near the sensitive receptors, i.e., schools, settlements, mosques, bazar, etc., considering the parameters leq_{day} , leq_{night} , L_{max} , L_{min} , L_{90} , and L_{10} , etc., and compare with Bangladesh's Noise Pollution (Control) Rules 2006 and WHO/WBG standards.
- Indoor noise level monitoring in factories and ensure compliance with occupational safety limits, e.g., 85 dB(A) over 8 hours.
- Grievances received on impacts related to noise generation will be monitored and evaluated to develop corrective actions, as required throughout the lifecycle of the EZ.

During operation, the NSEZ HSE team shall embed noise level management protocols into EZ's environmental management system and ensure noise level monitoring in the EZ area. The HSE team of NSEZ shall conduct monitoring in the region, and the results to be compared with the Noise Pollution (Control) Rules 2006 as well as the WHO/WBG Standards. NSEZ management may engage DOE or any third-party consultant to carry out monitoring work in the region. The HSE team of NSEZ, in collaboration with BEZA HQ, shall compile all the data/reports and prepare an annual report, and a copy of the annual report may be shared with the DOE.

8.3.3 Managing Surface Water

8.3.3.1 Development Phase

Key issues: Sewage discharge from the construction workforce stationed at the site and runoff may lead to contamination of surface water if not managed properly. Improper handling of lubricants, hazardous substances, and hydrocarbons (fuels, gasoline, etc.) may also cause surface water pollution. Dredging and disposal activities will increase the turbidity in the water column. Waste disposal from marine vessels into the marine environment will impact marine water quality. In addition, pollutants from the upstream area of rivers and khals may carry and discharge into the marine environment may deteriorating the marine water quality.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the development phase:

- Septic tanks should be provided to treat the sewage from temporary toilets at the construction site and workers' accommodation. The septic tanks will need to be adequately designed so that untreated sewage due to leakage or overflows does not have the potential to enter surface water.
- Directly draining raw wastewater and/or used chemicals/oils/lubricants to surface water courses is banned.
- Install temporary sedimentation basins and silt fences to control runoff.
- Incorporate permeable pavement and green roofs to reduce runoff volume and improve infiltration.
- In order to conserve water resources and rainwater, efforts shall be made to utilize the rainwater by constructing appropriate rainwater harvesting structures within each building's premises.

During the development phase, surface water quality at the construction sites and dredging sites shall be managed by the investors and contractors, and the HSE team of NSEZ will supervise the activities.

Monitoring mechanism:

The proposed scope of the surface water quality monitoring activities during the development phase is as follows:

- Water quality monitoring at internal khals (at 5 locations) quarterly basis including the parameters i.e., pH, DO, BOD, COD, TDS, nitrate, ammonia, phosphate, chromium, lead, mercury, chromium, cadmium, total coliform, fecal coliform, oil & grease, etc. and compare with Bangladesh's Environment Conservation Rules 2023.
- Confirmation of appropriate rainwater harvesting structures within each building's design.

The NSEZ HSE team shall collect the surface water samples and test them in the laboratory. Investors will ensure the appropriate rainwater harvesting structures within each building's premises, and NSEZ management shall supervise the implementation activity.

8.3.3.2 Operational Phase

Key issues: The accidental leaks or spills of hydrocarbons (oil, fuel, or other substances) can pollute surface water. During operations, the major threats to surface water quality are likely to be pollution from sewage, effluents from the operation of industries, etc. Discharging brine effluent from the desalination plant may lead to elevated levels of salinity in the direct vicinity of the discharge. Effluents may also contain biocides, chlorine, and lower levels of dissolved oxygen, which will influence water chemistry and quality.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the operation phase:

- Develop a surface water quality management plan aligned with the Environment Conservation Rules 2023, Bangladesh Water Act 2013, Bangladesh Water Rules 2018, and National Water Policy 1999.
- No sewage should be discharged without treatment to any water body.
- Capture and reuse rainwater for non-potable uses like landscaping or cooling systems.
- Adopt recycling and reuse practices for water conservation.
- Ensure primary treatment of liquid waste at an industry level (applicable for highly pollution-generating industries) before sending effluent to the CETPs. Discharged treated wastewater to surface water must meet the effluent standards mentioned in Schedule-3 and Schedule-4 of the ECR 2023.
- Install automatic water quality monitoring stations at key outfalls and upstream/downstream locations.
- Installation of a surveillance system with industrial-grade internet protocol (IP) cameras having Pan Tilt Zoom (PTZ) with leased line real-time connection for data streaming and transmission of the same.

THE NSEZ EHS team shall develop the groundwater quality management plan and embed it in the EZ's environmental management system. During operation, investors shall ensure the sustainable use of water resources, pre-treatment of waste (where needed), and the NSEZ HSE team shall supervise the activities. NSEZ management shall establish CETPs, install automatic water quality monitoring stations at key outfalls and upstream/downstream locations, and a surveillance system.

Monitoring mechanism:

The proposed scope of the surface water quality monitoring activities during the operation phase is as follows:

- Records on water extraction and distribution in the EZ from surface water sources, and ensure a no-objection certificate (NOC) from the Water Resources Planning Organization (WARPO) for surface water extraction.

- Real-time tracking of temperature, pH, BOD, COD, TSS, oil & grease, nitrate, phosphate, total coliform, etc., using sensors.
- Water quality monitoring on a half-yearly basis (before and after the rainy season) (through sampling and analyses to be done by NZES laboratory) at the inside khals and surrounding waterbodies, including Sandwip River and Feni River.

Record of water extraction shall be maintained by the Department of Public Health Engineering (DPHE), and the NOC from the Water Resources Planning Organization (WARPO) under the Ministry of Water Resources (MOWR) will be ensured following the requirements of the Bangladesh Water Act 2013 and Bangladesh Water Rules 2018. In addition, surface water quality monitoring on a half-yearly basis from the inside and surrounding water bodies will be carried out by the NSEZ HSE team, and a copy of the report may be shared with DOE.

8.3.4 Managing Groundwater

8.3.4.1 Development Phase

Key issues: There is a likelihood of having an impact on groundwater quality through sewage disposal from temporary workers' facilities, debris, and solid waste deposits in the landfill site, in case of a lack of proper management. Improper handling of lubricants, hazardous substances, and hydrocarbons (fuels, gasoline, etc.) may also cause groundwater pollution. Dewatering liquid from the deposited dredged material contains leachable contaminants from the dredged material, and if inadequately captured and treated, poses a threat to groundwater quality.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the development phase:

- Establish proper sewage treatment facilities for labor camps and worker settlements (e.g., septic tanks, bio-digesters, or STPs).
- Directly draining raw wastewater and/or used chemicals/oils/lubricants to the ground is forbidden.
- Avoid deep excavation near aquifers to prevent contamination.
- Install recharge wells, percolation ponds, and infiltration trenches to enhance natural replenishment.
- Instruct investors, utility providers, contractors, subcontractors, and workers regarding water saving, considering the groundwater crisis in the EZ surrounding area.
- Construction of the landfill shall include the construction of properly designed leachate treatment ponds, which shall treat the collected leachate on site.

Investors in coordination with the contractors shall ensure the mitigation measures at the construction sites, and the NSEZ HSE team shall supervise the implementation status.

Monitoring mechanism:

The proposed scope of the groundwater quality monitoring activities during the development phase is as follows:

- Groundwater sampling from EZ site and nearest settlements (at 5 locations) and lab analysis on an annual basis following the parameters i.e., pH, TDS, arsenic, boron, cadmium, calcium, chloride, chromium, copper, fecal coliform, total coliform, fluoride, hardness, iron, lead, magnesium, manganese, mercury, nickel, nitrate, nitrite, potassium, salinity, sodium, zinc, etc. and compare with Bangladesh's Environment Conservation Rules 2023.
- Implementation status of the environmental management plan/mitigation measures.
- Track the performance of recharge structures, e.g., percolation ponds, recharge wells.

THE NSEZ HSE team shall collect water quality samples and laboratory analysis. In addition, the implementation of the investors' EMP shall be supervised by the NSEZ HSE team.

8.3.4.2 Operational Phase

Key issues: The economic zone will extract groundwater as well as surface water for industrial operation. Withdrawing groundwater in excess of the rate of recharge may result in the lowering of the water table, land subsidence, and decreased water quality. Accidental spillage or leaks of chemicals, hydrocarbons (oil, fuel, or other substances), and leachate from the landfill site could percolate into the subsurface and potentially contaminate the groundwater.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the operation phase:

- Develop a groundwater quality management plan aligned with the Environment Conservation Rules 2023 and WHO/WBG Standards.
- Conduct baseline studies to map aquifers, recharge zones, and groundwater flow to identify safe yield limits to avoid over-extraction. Enforce withdrawal limits based on aquifer recharge rates.
- Cleaner technology for production processes, especially water-saving machines/ equipment, must be the first alternative for investors.
- Avoid groundwater extraction during EZ operation and more dependent on surface water.
- Promote water recycling and reuse within industrial processes.
- Install observation wells at varying depths across the zone, especially near sensitive receptors and recharge areas.
- Use piezometers to monitor groundwater levels and detect early signs of drawdown or contamination.
- Install water meters and sensors to track groundwater extracted volumes and consumption.

THE NSEZ EHS team shall develop the groundwater quality management plan and embed it in the EZ's environmental management system. NSEZ management through BEZA HQ and in collaboration with DPHE shall carry out a study of aquifer condition and enforce withdrawal limits and install water piezometers to monitor groundwater levels and water meters, and sensors to track groundwater extracted volumes and consumption. Investors shall ensure the sustainable use of groundwater, recycling and reuse, and cleaner technology in their production process.

Monitoring mechanism:

The proposed scope of the groundwater quality monitoring activities during the operation phase is as follows:

- Annual groundwater depletion/replenishment rates in the NSEZ area.
- Groundwater quality monitoring at the landfill site and nearby village on a half-yearly basis (through sampling and analyses to be done by accredited laboratories). Monitoring parameters include pH, dissolved oxygen, temperature, conductivity, cadmium, copper, lead, manganese, nickel, arsenic, selenium, mercury, etc.
- Records on water extraction and distribution from groundwater sources, and ensure a no-objection certificate (NOC) from the Water Resources Planning Organization (WARPO) for water extraction.

NSEZ management through BEZA HQ and in collaboration with DPHE shall monitor the annual groundwater depletion/replenishment rates in the area. In addition, groundwater quality monitoring on a half-yearly basis near the landfill site and the nearest village will be carried out by the NSEZ HSE team, and a copy of the monitoring report may be shared with DOE. A record of water extraction shall be maintained by the DPHE, and a No Objection Certificate from the Water Resources Planning Organization (WARPO) under the Ministry of Water Resources (MOWR) shall be ensured following the requirements of the Bangladesh Water Act 2013 and Bangladesh Water Rules 2018.

8.3.5 Managing Topography and Soil

8.3.5.1 Development Phase

Key issues: the topography of the EZ site will change due to activities such as soil excavation, land development, embankment/super dyke, internal roads, stormwater drainage, construction of access roads, pipelines, etc. These will change to the natural status of the land. The impacts on soil during the construction phase shall be mainly due to loss of topsoil in the construction areas and contamination of the soils of the surrounding area due to solid waste generation from site activities, as well as liquid waste such as lubricants, slurry, and accidental spills, and leaks occurring from storage and work areas. The rainfall and surface runoff can cause soil erosion. Accidental spillage of oil from construction vehicles might cause soil contamination.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the development phase:

- Conduct detailed topographic surveys to identify slopes, drainage, and erosion-prone areas.
- Install silt fences, sediment traps to prevent soil runoff into waterbodies. Construct temporary retention basins to capture sediment-laden runoff.
- Ensure to rehabilitate areas with topsoil and revegetate after completion of activities.
- Good housekeeping and best practices of waste handling should be adopted to eliminate/minimize the risks of soil contamination.
- Store construction materials and chemicals away from drainage paths.
- Implement spill prevention and response plans to avoid accidental contamination.

Investors, in coordination with their appointed contractors, shall be responsible for implementing the mitigation measures at the construction sites. The NSEZ EHS team shall be responsible for the supervision of the implementation of the mitigation measures.

Monitoring mechanism:

The proposed scope of the topography and soil quality monitoring activities during the development phase is as follows:

- Monitor the erosion-prone areas.
- Waste generation volume, segregation, and disposal.
- Availability and implementation of the spill prevention and response plans

Investors, in coordination with their appointed contractors, shall be responsible for monitoring erosion-prone areas, waste generation volume, and management at the construction sites. A monthly report on waste generation volume, segregation, and disposal shall be shared with the HSE team of NSEZ. The NSEZ EHS team shall be responsible for monitoring the availability and implementation of the spill prevention and response plans and waste management at the construction sites.

8.3.5.2 Operational Phase

Key issues: Potential impacts on the soil environment are envisaged due to hazardous and non-hazardous waste generated due to the operation of various industries in the economic zone. Process waste, including sludge and residues, chemical waste, including toxic waste, used/waste oil, oil slurry, spent solvents, CETPs & WTPs sludge, etc., are the sources of hazardous waste. Poor management of such waste from the operations is a potential risk of soil contamination. The waste management facility is another area where potential soil contamination may occur.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the operation phase:

- Develop a soil management plan aligned with the United States Environmental Protection Agency's Soil Quality Standards.

- Establish permanent vegetation cover, e.g., grass, shrubs, etc., on open spaces and embankments.
- Individual manufacturers and factories should have appropriate chemical storage areas with secondary containment on impervious ground and develop a spill and emergency response plan.
- Municipal waste should be disposed of in an integrated solid waste management facility proposed within the EZ.
- Industrial waste to nearby treatment, storage, and disposal facilities and to approved/authorized vendors of DOE and local municipalities. However, waste minimization techniques should be adopted to minimize the generation of waste.
- Implement spill prevention and response plans to avoid accidental contamination.

The NSEZ EHS team shall develop a soil management plan and embed it in the EZ's environmental management system. NSEZ management, through BEZA HQ and in collaboration with the Bangladesh Forest Department, shall develop the greenbelt in the open space and the embankment area. Investors shall establish appropriate chemical storage areas at the industry level, and the NSEZ HSE team shall ensure that. NSEZ management shall establish a waste management facility, and investors shall ensure the proper collection, storage, and disposal of waste from their industry.

Monitoring mechanism:

The proposed scope of the topography and soil quality monitoring activities during the operation phase is as follows:

- Availability of spill kits at each hazardous and chemical storage area.
- Number of spills or incidents.
- Soil quality monitoring at 5 locations on an annual basis to assess nutrient levels, compaction, salinity, and contamination (through sampling and analyses in the laboratory), including waste disposal surrounding area, chemical storage area, etc.

Investors shall ensure the availability of spill kits at each hazardous and chemical storage area, and the number of spills or incidents shall be reported to the HSE team of NSEZ. The NSEZ HSE team shall be responsible for monitoring the soil quality through sampling and analysis in the laboratory.

8.3.6 Managing Sediment

8.3.6.1 Development Phase

Key issues: Construction activities i.e., piling of building, excavation, concreting work, construction of a jetty at the vicinity of the internal khals, Rivers, and Sandwip Channel, accidental spillage of hazardous chemicals like oil and lubricant from the construction vehicles, improper storage and disposal of construction waste, solid and liquid waste from the worker's facilities may mix with rainfall water and it can accumulate on the adjacent khals, Rivers, and Sandwip Channel through runoff. Besides, there are some additional sources, i.e., runoff and erosion of exposed bare soil, slopes, earth, and stockpiles, the release of cement materials with rain, and washing water of dust suppression sprays and vehicle wheels. The extra sediment loads in the khals, rivers, and marine water also lead to an impact on the aquatic environment.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the development phase:

- A Dredging Management Plan should be prepared before starting dredging activities in the Sandwip Channel.
- Sediment quality analysis and analysis of contamination levels in the dredging area before dredging, and compare with USEPA standard (as nationally, sediment quality standards are not available).

- Individual industries should develop an appropriate chemical storage area with secondary containment on impervious ground.
- Municipal waste should be disposed of in an integrated solid waste management facility proposed within the EZ.
- Use silt fences and sediment traps to prevent soil and contaminant-laden runoff from reaching waterbodies.

The dredging contractor shall develop a dredging management plan, carry out sediment quality analysis before starting dredging activities, and establish silt fences and sediment traps. Investors, in coordination with their appointed contractors, shall ensure the development of appropriate chemical storage areas, waste collection and disposal, and other mitigation measures at the construction sites. NSEZ HSE team shall supervise the implementation activities.

Monitoring mechanism:

The proposed scope of the sediment quality monitoring activities during the development phase is as follows:

- Availability of the dredging management plan developed by the dredging contractor.
- Availability of sediment quality test report including the parameters, e.g., pH, electrical conductivity, nitrogen, potassium, calcium, magnesium, chloride, phosphorus, copper, zinc, lead, mercury, cadmium, nickel, chromium, sulfate, organic matter, hydrocarbons, texture, etc.

The appointed dredging contractor shall confirm the quality of dredge sediments before starting dredging, and a copy of the sediment testing report shall be shared with the HSE team of NSEZ. In addition, the NSEZ HSE team shall collect sediment samples and test them in their laboratory or engage other laboratories to perform the activities.

8.3.6.2 Operational Phase

Key issues: the operation of industries in EZ will produce various types of waste. If not properly handled, the waste can contaminate water and sediment quality in the internal khals and Sandwip Channel. Efforts shall be given to recycle about 70% of the wastewater after treatment to meet various industrial usages. The rest of the treated wastewater will then be transferred through the drainage system and discharged into the Sandwip Channel. Waste disposal from ships/vessels may impact sediment quality if proper management is not done.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the operation phase:

- Develop a sediment management plan aligned with the United States Environmental Protection Agency's Soil Quality Standards.
- Ensure proper handling and disposal of solid and liquid waste to prevent leaching into sediments.
- Regularly clean and maintain the drainage infrastructure to prevent sediment buildup.

The NSEZ EHS team shall develop a sediment management plan and embed it with the EZ's environmental management system. Investors shall ensure proper handling and disposal of solid and liquid waste at the industry level, and the NSEZ HSE team shall supervise the activity. NSEZ management shall ensure the maintenance of the drainage infrastructure.

Monitoring mechanism:

The proposed scope of the sediment quality monitoring activities during the operation phase is as follows:

- Annual sediment quality testing at the CETPs discharge point and jetty site.

The NSEZ HSE team shall be responsible for monitoring the sediment quality through sampling and analysis in the laboratory.

8.3.7 Managing Solid Waste

8.3.7.1 Development Phase

Key issues: Solid materials such as domestic/canteen waste, food packet wrappers, paper, plastic drums, paints, oil containers, packaging from construction materials, generation from earthwork generation, debris, excess construction materials, site establishment activities, removal of vegetation/bush/trees, and others will be generated. This may cause environmental degradation at the EZ site as well as its immediate surroundings if adequate measures are not taken. Medical waste will be generated from the first aid facilities in the construction sites, which may pollute the environment if not managed properly.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the development phase:

- Set up a designated waste collection and disposal point at an early date so that onsite disposal can be avoided.
- Segregate waste at source, e.g., concrete, metal, wood, etc., for reuse or recycling.
- Maintain a registry of hazardous waste generators.
- Include waste management clauses in construction contracts.

During the development phase, NSEZ management shall designate a site for solid waste disposal. Investors shall track the record of waste generation, collection, storage, segregation, and disposal of waste that will be generated at the construction sites. The NSEZ HSE team will supervise waste management activities of the investors.

Monitoring mechanism:

The proposed scope of the solid waste monitoring activities during the development phase is as follows:

- Maintain records and daily logs to track waste generation, segregation, and disposal.
- Weekly inspections to ensure proper storage, transport, and disposal practices.
- Monitor contractor performance and enforce penalties for illegal dumping.

Investors' incorporation with their appointed contractors shall maintain daily logs of waste generation, segregation, and disposal to prepare a monthly report. The NSEZ HSE team shall inspect the activities and collect the monthly waste generation and disposal report.

8.3.7.2 Operational Phase

Key issues: Solid waste, including e-waste, will be generated from the EZ operation activities. If the solid waste is not properly managed and disposed of in an unauthorized manner, it will impact the soil and groundwater aquifer contamination through pollutant leaching, air pollution through GHG emission, microbial and terrestrial habitat disruption, an increase in toxicity and potentiality of bioaccumulation, attract pests and rodents, increasing the risk of disease transmission, etc. Wastes originating from ships may include oily sludge, inert materials such as food packaging, and food waste will generate odor and health impacts and ground and surface water contamination, if not managed properly.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the operation phase:

- Develop a solid waste management plan aligned with the national 3R strategy, Solid Waste Management Rules 2021, Hazardous (e-waste) Management Rules 2021, Medical Waste Management Rules 2008, etc.
- Use impermeable surfaces and leachate control systems to prevent soil and water contamination.

- No solid waste generated shall be thrown, burned, or buried on streets, or open public spaces outside the premises, or in the drains or water bodies.
- Institutional strengthening of local government organizations/municipalities for effective solid waste management, including medical and hazardous waste in the region.
- A representative from the Ministry of Agriculture can be incorporated into the implementation of the compost plant as part of solid waste management.
- Design and construction of the landfill shall be in accordance with the Solid Waste Disposal Facility Criteria – Technical Manual published by the US EPA (1993) or other applicable standards.
- The concept of the 3Rs (Reduce, Reuse, Recycle) must be promoted and rewarded.
- Explore waste-to-energy options for non-recyclable waste. And promote composting of organic waste from food courts, landscaping, and canteens.
- In accordance with the requirements of MARPOL 73/78 and its annexes IV and V, appropriate facilities shall be provided for the reception of all wastes (oil mixed water, fuel residues, sludge, garbage from crew and passengers, maintenance of the ship, cargo activities) arising from ships.
- Educate workers on waste generation, segregation, and reduction.

The NSEZ EHS team shall develop a sediment management plan and embed it with the EZ's environmental management system. NSEZ management through BEZA HQ may strengthen the existing capacity of the local municipalities to engage in waste management activities. In addition, representatives from the Ministry of Agriculture may be incorporated into the implementation of the compost plant as part of solid waste management. Investors shall ensure waste management at the industry level, and the NSEZ HSE team shall inspect the waste management activities.

Monitoring mechanism:

The proposed scope of the solid waste monitoring activities during the operation phase is as follows:

- Industry-wise, the monthly waste generation volume and types of waste are analyzed.
- Quantity per classification, treatment, storage, and final disposal of solid waste.
- Groundwater quality monitoring near the landfill site.

During operation, investors shall maintain their monthly waste generation and disposal records and share a copy with the HSE Team of NSEZ. In addition, NSEZ's HSE team will conduct a physical inspection of the waste storage and disposal site to ensure that the waste collection, storage, and disposal are carried out in an acceptable manner and following the applicable national legislations as well as Good International Industry Practices. In addition, groundwater quality monitoring near the landfill site shall be ensured by the HSE team of NSEZ.

8.3.8 Managing Liquid Waste

8.3.8.1 Development Phase

Key issues: the primary wastewater issues relate to stormwater events and sanitary wastewater generated by construction activities on site. Stormwater has the potential to run off into areas containing hazardous materials and either leach into the soil or carry these off the site, potentially contaminating other areas, groundwater, or marine waters. Wastewater generation at construction sites includes surface runoff, which may contain pollutants and traces of solvents, paints, metal compounds, etc., that may impact the nearby surface water resources if not managed properly.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the development phase:

- Before starting construction, identify the potential sources of liquid waste and develop a construction liquid waste management plan aligned with national regulations and international best practices.

- Install temporary containment units, e.g., holding tanks, lined pits, etc., for wastewater and sludge.
- Use bunded areas for fuels and chemicals to prevent leaks at the construction sites.
- Include liquid waste handling protocols in construction contracts.

During the development phase, a waste management plan should be developed by the contractors in their construction environment management plan, and investors shall ensure the implementation of the management measures. NSEZ HSE team shall supervise the overall activities.

Monitoring mechanism:

The proposed scope of the liquid waste monitoring activities during the development phase is as follows:

- Monitor and audit the contractor's practices regularly.
- Requires contractors to maintain daily logs of liquid waste generation and disposal.

Investors' incorporation with their appointed contractor will ensure monitoring activities during the construction phase. The NSEZ HSE team shall conduct monthly inspections to verify containment, treatments, and disposal practices.

8.3.8.2 Operational Phase

Key issues: source of wastewater generation from EZ operational activities is industrial process wastewater/effluent, domestic wastewater/sewage, equipment cleaning, floor washing, etc. Also, sewage will be generated from the sanitary and domestic blocks at the industrial units of the clusters, mixed-use & residential, and common facilities such as amenities and utilities. The untreated wastewater, if discharged into nearby surface waters, may affect the surface water, and/or if disposed of on land without treatment, may pollute the ground and surface water.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the operation phase:

- Develop a liquid waste management plan aligned with the national laws, including Environmental Conservation Rules 2023.
- Design separate drainage systems for stormwater and liquid waste to avoid cross-contamination.
- Directly draining raw wastewater and/or used chemicals/oils/lubricants to surface water courses and the ground is banned.
- Require each industry to install flow meters and sampling ports at the effluent discharge point.
- Require industries to pretreat high-strength or hazardous effluents before sending them to the CETPs and ensure compliance with national effluent discharge standards, e.g., ECR 2023 in Bangladesh.
- Regularly check and maintain CETPs to control the treated wastewater quality, at least as required effluent from the wastewater treatment system, especially BOD, must be less than the mentioned values for minimizing the impact on surface water and sediment qualities.
- Recycling wastewater should be promoted. A digital water flow meter should be installed to measure the discharge volume.
- Continuous monitoring of effluent quality at the outlet of the CETPs by installation of an Online Continuous Emission Monitoring System (CEMS).
- Train staff in emergency response procedures for liquid waste incidents.

NSEZ HSE team shall develop a liquid waste management plan and embed it in the EZ's environmental management plan. Investors shall develop separate drainage systems for their premises, install flow meters, and keep a record of liquid water generation and disposal volume, establishment of ETPs for pretreatment (where required), recycling and reuse, training of the staff, etc. NSEZ management shall ensure the establishment, operation, and maintenance of CETPs. NSEZ management, through BEZA

HQ's and in coordination with the DOE, may install an Online Continuous Emission Monitoring System for continuous monitoring of effluent quality at the outlet of the CETPs.

Monitoring mechanism:

The proposed scope of the liquid waste monitoring activities during the operation phase is as follows:

- Monitoring wastewater quality following parameters such as temperature, pH, BOD, COD, TSS, Oil & Grease, nitrate, phosphate, total coliform, etc., and compare with ECR 2023.
- Volume of waste generation from each industry and its disposal.
- Effectiveness of a separate drainage system to prevent cross-contamination.

NSEZ management, through BEZA HQ's and in coordination with the DOE, shall establish and operate the Online Continuous Emission Monitoring System at the CETPs outlet. Installation of a surveillance system with industrial-grade internet protocol cameras having Pan Tilt Zoom with leased line real-time connection for data streaming and transmission of the same shall be ensured by the NSEZ management. The HSE team of NSEZ will keep records of all data and prepare an annual report. If non-compliance is found as a result of the monitoring, all the work that is required to eliminate the non-compliance will be carried out by the individual investors based on the instructions from NSEZ management. An annual report may be shared with the DOE..

8.3.9 Managing Drainage

8.3.9.1 Development Phase

Key issues: The implementation of the EZ has the potential to change the topography of the land, which may also disrupt the natural drainage of the region. This is because the construction will involve cutting and filling earthworks. The cut-and-fill work will normally change the natural topography of the land, which will result in a disruption of the natural drainage of the land and the surrounding area. EZ site is sloping from north-east to south-west. Storm runoff generated from the entire area of the EZ and its surroundings gets drained to the sea through a number of natural drainage channels passing through the EZ, viz. Ichakhali, Daborkhali, Bamansundar, Hoania, Saherkhali, Domkhali, etc. Altogether, there are 13 drainage channels, all getting discharged to the sea, apart from the Feni River, which passes through EZ before discharging to the sea. Excavation, earthwork, and levelling activities are possible to obstruct the water drainage.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the development phase:

- Conduct a detailed hydrological and morphological study of the NSEZ region before designing an integrated regional drainage management plan and using modelling tools, e.g., EPA's Storm Water Management Model (SWMM), to simulate stormwater flow and size drainage components accordingly. The study should include comprehensive hydrological conditions, including rainfall runoff dynamics, flash flood risk, tidal and non-tidal water levels, global circulation patterns, wave action, cyclones and associated tidal surges, climate change scenario, land use, and future development activities in the region. The study should be carried out immediately. As the partial land area in the NSEZ has already been developed, therefore, it must be carried out before the next phase of land development, Khals modification, and development of other infrastructures in the area. BEZA HQ shall coordinate with BWDB and follow up on the study to ensure the timely completion of the study with adequate technical details, including drainage channels/alignment, catchment, slope, number of sluices, direction of water flow, and the point where water will leave the EZ site.
- A multidisciplinary team of experts, including hydraulic engineers, hydrologists, geologists, urban planners/land use experts, climate change experts, environmental and social experts, etc., should be included in the regional drainage master plan preparation team.
- Avoid blocking or altering natural waterways.

- Install diversion channels, sediment traps, and temporary culverts to manage runoff during construction.
- Excavation of khals/drainage canals in the region to restore the optimal bed level and ensure smooth water flow, and reduce sediment build-up.
- Replacing or repairing deteriorated sluice gates and regulatory structures to allow more effective water level management and prevent backflow.
- Strengthening sidewalls and embankments to prevent erosion, especially in areas with high water pressure, to increase canal durability and stability.
- Use silt fences to prevent sediment-laden water from entering nearby waterbodies.
- Elevate critical infrastructure above flood levels. Design extreme rainfall events using return period analysis, e.g., 50 or 100-year storms.
- Conduct an assessment to explore both structural options (e.g., canal lining, gate improvements) and non-structural measures (e.g., community education and emergency planning) for a holistic drainage management plan.
- Improving drainage in upper catchment areas to enhance downstream capacity and reduce the likelihood of waterlogging in the EZ and surrounding community areas.

Initiative shall be taken by the NSEZ management through BEZA HQ, and collaboration with the Bangladesh Water Development Board (BWDB) for the drainage improvement of the NSEZ development area. Considering the safety of the local community and NSEZ, the improvement and maintenance of the natural canals shall be considered by the NSEZ and BWDB as well.

Monitoring mechanism:

The proposed scope of the drainage monitoring activities during the operation phase is as follows:

- Inspect temporary drainage channels weekly and after heavy rainfall events.
- Inspect that the drainage system and sediment controls are functional during the rainy season.
- Ensure the sluice gates are functional and ensure regular maintenance when required.

NSEZ management, in collaboration with the BWDB, shall perform the monitoring activities.

8.3.9.2 Operational Phase

Key issues: Heavy and continuous rainfall during the monsoon and cyclones may expose the risk of rapid flooding locally, including cumulative flooding in regional areas. The flood control infrastructures, if not well maintained, will be subject to negative impacts such as local flooding due to inadequate maintenance of the drainage system. In addition to that, the natural drainage canals are not properly excavated every year, which is required to maintain sufficient drainage conveyance capacity and reduce the flooding impacts during extreme monsoon and climate change conditions. Different road networks are developing in the EZ surrounding area by the local community without considering proper drainage or water-passing provisions. In such cases, there is a possibility of drainage congestion or flooding in the surrounding area of EZ. Moreover, erratic rainfall will make more worsen conditions in the drainage system in the whole area mainly during the rainy season.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the operation phase:

- Prepare a drainage management plan aligned with the national laws, including the National River Protection Commission Act 2013, the Embankment and Drainage Act 1952, etc.
- Ensure periodic maintenance of stormwater drains, culverts, and retention areas to ensure free flow.
- Check the desilting of drains, especially before the monsoon season.

NSEZ management shall prepare a drainage management plan for the NSEZ and embed it in EZ's environmental management plan. They will also ensure the implementation of the mitigation measures in collaboration with the BWDB.

Monitoring mechanism:

- Presence and functionality of the drainage system, specifically before the monsoon.
- Records, reports, or complaints on flood/waterlogging cases in the region.
- Record of excavation and maintenance activities.

NSEZ management through BEZA HQ and collaboration with the Bangladesh Water Development Board (BWDB) under the Ministry of Water Resources (MOWR) shall inspect the functionality of the drainage system at a regular interval and a special check before the monsoon season, as well as keep and share the record of excavation and maintenance activities in the region. In addition, the excavation of khals, the function of sluice gates, maintenance of the super dike, etc., shall be ensured. Records, reports, or complaints on floods and waterlogging shall be maintained by the HSE team of NSEZ.

8.3.10 Managing Traffic**8.3.10.1 Development Phase**

Key issues: The development of EZ will generate a significant increase in traffic volume on the local road networks. Construction traffic will include vehicles transporting equipment, materials, and personnel. The increased traffic volumes will place an additional burden on the existing roads within the study area. Traffic congestion may occur due to vehicles at the construction site and vehicles entering and exiting the industrial zone. The volume of vehicles involved in transporting raw materials has a lot of potential for traffic accidents and potential injuries to public road users, especially residents living close to the access roads.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the development phase:

- A construction traffic management plan includes separate entry/exit points for construction vehicles and workers.
- Use flaggers, signage, and barriers to manage vehicle-pedestrian interactions.
- Design internal road networks with dedicated lanes for freight, public transport, and non-motorized traffic.
- Identify critical intersections and access points for early interventions.

Investors, in coordination with contractors, shall develop a construction traffic management plan and implement mitigation measures. NSEZ HSE team shall supervise the implementation activities of the investors. In addition, NSEZ management shall ensure the development of road networks in collaboration with the Roads and Highways Department and the Local Government Engineering Department.

Monitoring mechanism:

The proposed scope of the traffic monitoring activities during the development phase is as follows:

- Availability of construction traffic management plan at the construction site and implementation of the plan, including the presence of traffic/warning signage and speed limits for vehicles.
- Vehicle movement log of contractors.
- Inspection to ensure safety measures, e.g., signage, flaggers, etc., are in place.
- Accidents and fatal incidents reporting, including number, type, location, causes, etc.

Investors, in coordination with contractors, shall keep all the records of traffic movement. NSEZ HSE team shall supervise the implementation activities of the investors.

8.3.10.2 Operational Phase

Key issues: Improvement of regional road networks may prompt high-speed driving, which is likely to cause accidents for pedestrians unless adequate road safety measures are adopted. In addition to the risk of accidents, increased traffic will lead to inconvenience to the local public and road users and

increase the potential for nuisance in the region. A huge number of workers will be moved on the access road at a time, therefore, there will be a risk of traffic congestion on access roads as well as the Dhaka-Chattogram Highway. Traffic congestion will not only waste precious time and fuel for commuters but also cause air and noise pollution, along with causing stress and anxiety, leading to impatience and accidents.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the operation phase:

- A Traffic Management Plan should be prepared aligned with national road safety legislation (Road Transport Act 2023, Traffic Rules 2022, etc.) and implemented considering all industries in the region and the demand of local communities.
- Adoption of best transport safety practices across all aspects of project operations to prevent traffic accidents and minimize injuries suffered by project personnel and the public.
- Safety measures should be incorporated in the engineering designs to include, for example, details of signboards to notify the public about the potential dangers, markings, intersection layouts, access restrictions, bus stops, crossings, footpaths, etc.
- Establishment of a traffic police unit to make necessary arrangements to not worsen the existing traffic conditions in the region.
- Speed limitations should be enforced, for instance, on-site 20 km/h, through towns and villages 35 km/h, and on the highway 80 km/h.
- Establish overbridges at the crossing point and educational institutions, and bazar/market areas.
- Provide shuttle buses, bike lanes, and pedestrian walkways to reduce private vehicle use.
- Designate off-site street parking and loading bays to prevent roadside obstruction.
- A 6-lane bypass for Sonagazi from Precinct A may be developed for better access to the northern side of NSEZ.
- A separate access-controlled link from the Dhaka-Chattogram Highway may be developed to connect the jetty and logistics area in NSEZ.
- To establish direct connectivity between the NSEZ site and Chattogram, a new link road (starting near the jetty and following the coastline) can reduce pressure on the existing Dhaka-Chattogram Highway and create a special link for a future mass transit solution.

The NSEZ HSE team shall develop a traffic management plan and embed it in EZ's environmental management system. NSEZ management through BEZA HQ shall ensure the development of road networks, including safety measures, in collaboration with RHD and LGED.

Monitoring mechanism:

The proposed scope of the traffic monitoring activities during the operation phase is as follows:

- Implementation of the traffic management plan, including the presence of traffic signage/warning signage and speed limits for vehicles.
- Accidents and fatal incidents reporting, including number, type, location, causes, etc.

NSEZ management through BEZA HQ, in collaboration with law enforcement agencies, i.e., Bangladesh Police, by establishing traffic units to manage increasing traffic-related issues in the region. In addition, the HSE team of NSEZ shall maintain records of accidents and fatal incidents, including number, type, location, causes, etc., and share the annual report with the NSEZ management.

8.3.11 Managing Terrestrial and Mangrove Flora

8.3.11.1 Development Phase

Key issues: vegetation cover of an approximate 8,920.46-acre area will be cleared, resulting in the loss of terrestrial and planted mangrove plant species such as Akashmoni, Jhao, Keora, Gewa, and Karoi, thereby reducing vegetation cover.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the development phase:

- Avoid mangrove/forest/vegetation area/land as much as possible during land acquisition and development for industry setup.
- Minimize mangrove/forest/vegetation clearance by applying site-specific and selective clearing techniques during site preparation.
- Keep records of vegetation clearance data, including the number of terrestrial flora species and individual mangrove plants removed.

NSEZ management, through their engaged contractors, shall ensure the implementation of the mitigation measures.

Monitoring mechanism:

The proposed scope of monitoring activities during the development phase is as follows:

- Area and number of mangroves/forest/vegetation clearance.
- Photographic documentation and GIS mapping of changes in flora.

NSEZ management shall be responsible for carrying out the monitoring activities. In addition, NSEZ management through BEZA HQ shall inform Bangladesh Forest regarding the vegetation clearance activities.

8.3.11.2 Operational Phase

Key issues: BEZA allocated a total of 40.37% (13,646.28 acres) of land as mangroves, green areas, vegetation, and open spaces which is a significant increase compared to the existing coverage. Roadside vegetation may also be impacted by vehicular emissions and deposition of airborne pollutants (e.g., dust, heavy metals). These factors can reduce plant health, photosynthetic activity, and regeneration capacity. Mangroves, being sensitive to changes in salinity, sedimentation, and water quality, may decline in ecological function if not carefully protected through operational management practices.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the operation phase:

- Plant trees in designated open spaces, roadside, embankments, etc. Tree selection for plantation should include mangroves, native timber, and fruit-bearing species.
- Maintain and protect the designated forests inside the EZ master plan area.
- Restrict unauthorized access to sensitive green space and forested areas.

NSEZ management through BEZA HQ can collaborate with the Bangladesh Forest Department to ensure the implementation of the mitigation measures.

Monitoring mechanism:

The proposed scope of monitoring activities during the operation phase is as follows:

- Annual monitoring of vegetation health.
- Routine audits of greenbelt and buffer zone maintenance activities.

The NSEZ HSE team, in collaboration with the Bangladesh Forest Department, should perform the monitoring activities. If needed, a third-party organization could be engaged in annual monitoring activities.

8.3.12 Managing Terrestrial Fauna

8.3.12.1 Development Phase

Key issues: Development activities such as vegetation clearance and facility construction within the EZ will lead to habitat loss and destruction for terrestrial wildlife. These activities will reduce vegetation cover, diminishing food sources as well as roosting, foraging, and nesting areas for various faunal species. The movement of construction vehicles may result in roadkill, particularly of nocturnal animals. Some animals may be forced to relocate to nearby habitats. The occupation of space by infrastructure may also lead to human-wildlife conflicts, as displaced animals seek shelter in nearby settlements.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the development phase:

- Minimize habitat disruption by restricting vegetation clearance to designated areas and preserving key patches of natural habitat for wildlife refuge.
- Translocation of existing wildlife that is available in the EZ boundary to the nearest forest area, as well as the Wildlife Sanctuary, i.e., Hazarikhil Wildlife Sanctuary.
- Install wildlife-friendly fencing and crossing structures near construction zones to reduce animal-vehicle collisions.
- Install wildlife safety signs in and around the project site, indicating dos and don'ts for workers and visitors.
- Wildlife crossings, such as underpasses and overpasses, should be incorporated into road and railway infrastructure to facilitate safe wildlife movement in the area.
- Coordinate with the Forest Department for any required approvals or support in managing impacts on protected or threatened species.

NSEZ management, in coordination with investors, will implement the mitigation measures at the construction sites.

Monitoring mechanism:

The proposed scope of monitoring during the development phase includes the following:

- Maintain records of wildlife sightings, incidents, and relocation reports, including roadkill and human-wildlife conflict events.
- Pre-and post-clearing assessments to track species displacement.

NSEZ management, in coordination with investors, shall keep records of wildlife sightings, incidents, and relocation reports, including roadkill and human-wildlife conflict events.

8.3.12.2 Operational Phase

Key issues: During the operation of EZ, terrestrial wildlife may face ongoing and long-term ecological pressures due to permanent infrastructure, increased human activity, and industrial operations. Habitat disturbance caused by roads, railways, and built structures can disrupt movement corridors, breeding grounds, and foraging areas. The risk of human-wildlife conflict may increase as displaced mammals enter nearby settlements in search of food or shelter.

Measures to be considered:

- Preserve ecological corridors between green open spaces and nearby forests to allow for safe movement and dispersal of mammals.
- Install wildlife crossings and signage near roads and transport routes to reduce the risk of roadkill and improve safety for animals and drivers.
- Establish a wildlife incident response protocol to document, manage, and mitigate human-wildlife conflict cases.

- Provide environmental awareness and training for zone employees, residents, and security staff on wildlife protection and reporting procedures.

The NSEZ HSE team will be responsible for implementing the mitigation measures.

Monitoring mechanism:

- Records of wildlife sightings, incidents, and relocation reports, including roadkill and human-wildlife conflict events.

The NSEZ HSE team, in collaboration with the Bangladesh Forest Department, should perform the monitoring activities. If needed, a third-party organization could be engaged in annual monitoring activities.

8.3.13 Managing Birds/Avifauna

8.3.13.1 Development Phase

Key Issues: During the development, disturbances to bird populations, including migratory and conservation-priority species, may occur. The construction of roads, site clearance, increased human presence, land development, and jetty construction will impact the habitats of migratory winter and resident birds. These factors can drive sensitive bird species away, reducing local species diversity, particularly in and around the identified IBAs, i.e., the Ganges-Brahmaputra-Meghna Delta and Muhuri Dam. Habitat loss from vegetation clearance will particularly affect ground-nesting birds and those dependent on mudflats and coastal vegetation.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the development phase:

- Avoid or minimize vegetation clearance in ecologically sensitive areas, especially within proximity to IBAs and known bird habitats.
- Bird diverters shall be installed on power lines and other structures to prevent collisions and electrocutions.
- Educate construction workers and contractors about bird-sensitive zones and the importance of minimizing disturbances.
- Install signage and barriers to prevent unauthorized access to critical bird habitats during development.

Investors and engaged contractors shall ensure the mitigation measures, and the NSEZ HSE team shall supervise the implementation activities.

Monitoring mechanism:

The proposed scope of monitoring activities during the development phase is as follows:

- Monitor the occurrence of birds at the EZ site and adjacent IBA zones to assess species presence and diversity.
- Reporting of any bird mortality or injury events, with root cause analysis and mitigation follow-up.

Investors and engaged contractors shall keep records of bird mortality or injury events at the construction sites, and the NSEZ HSE team shall supervise the monitoring activities.

8.3.13.2 Operational Phase

Key Issues: During the operation of the EZ, the preserved forested areas and green open spaces will provide valuable habitats for both resident and migratory birds. However, ongoing industrial operations, increased traffic, artificial lighting, and infrastructure use can disturb bird behavior and ecology. Accidental spills and contaminated runoff may degrade the nearby Sandwip Channel and mudflats, threatening the foraging grounds of waterbirds, particularly migratory species.

Measures to be considered:

- Preserve and manage green open spaces and buffer zones to serve as functional habitats for birds, particularly during breeding and migratory periods.
- Install bird-friendly lighting (e.g., downward-facing, low-glare LEDs) to reduce light pollution impacts, especially near jetties, wetlands, and known bird habitats.
- Train staff and residents on bird conservation practices, conflict prevention, and proper waste disposal.

The NSEZ HSE team will be responsible for implementing the mitigation measures.

Monitoring mechanism:

The proposed scope of monitoring activities during the operation phase is as follows:

- Monitor bird occurrence in green spaces, buffer zones, and mudflats to track species diversity and abundance.
- Record of bird capture, mortality, or injury events.

The NSEZ HSE team, in collaboration with the Bangladesh Forest Department, should perform the monitoring activities. If needed, a third-party organization could be engaged in annual monitoring activities.

8.3.14 Managing Aquatic Mammals

8.3.14.1 Development Phase

Key issues: During the development, marine construction activities, particularly jetty construction, pile driving, dredging, and marine blasting pose several threats to aquatic mammals, especially the Irrawaddy Dolphin and Indo-Pacific Humpback Dolphin.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the development phase:

- Limit underwater construction activities, e.g., pile driving, dredging, etc., to daylight hours to minimize disruption to dolphin behavior and improve visual detection.
- Avoid dredging activities during dolphin breeding seasons.
- Deploy acoustic deterrent devices and marine mammal observers before initiating pile driving or blasting to detect and safely displace nearby dolphins.
- Ensure that all construction vessels and marine crews receive dolphin-safety training, including visual ID, safe operating procedures, and emergency response.
- Implement spill-prevention protocols and secondary containment systems for fuels, oils, and chemicals to prevent marine contamination.
- Use silt curtains, sediment traps, and real-time turbidity monitoring to reduce suspended sediments near sensitive marine mammal habitats.

Investors, in collaboration with appointed contractors, shall be responsible for implementing the mitigation measures at the construction sites. NSEZ HSE team shall supervise the implementation activities.

Monitoring mechanism:

The proposed scope of monitoring activities during the development phase is as follows:

- Monitor dolphin activity before starting any piling and dredging work.
- Incident reporting system for marine mammal sightings, vessel strikes, or strandings, including response protocols and data archiving.

NSEZ management, in coordination with Investors and appointed contractors, shall be responsible for carrying out monitoring activities related to aquatic mammals. Bangladesh Forest Department, as a regulatory authority, shall supervise the monitoring activities.

8.3.14.2 Operational Phase

Key issues: During the operation of the EZ, continuous marine activity, including increased vessel traffic, jetty operations, and maintenance dredging, presents persistent threats to aquatic mammals like Irrawaddy and Indo-Pacific Humpback Dolphins.

Measures to be considered:

- Conduct regular acoustic monitoring and assess ambient noise levels near operational hotspots to ensure thresholds remain within dolphin-safe levels.
- Ensure all industrial effluents meet national discharge standards, particularly for heavy metals, hydrocarbons, chlorine, and salinity.
- Implement a marine wildlife awareness program for jetty operators, cargo ships, and tourist boat crews, including dolphin identification, safe operating procedures, and emergency response protocols.
- Install clear signage on docks and terminals regarding dolphin conservation, no-wake zones, and waste management rules for visiting vessels and tourists.
- Control tourist boat numbers, routes, and speeds through a permit-based system with trained ecotourism guides to reduce harassment of dolphin groups.

The NSEZ management will be responsible for implementing mitigation measures.

Monitoring mechanism:

- Annual dolphin population surveys using visual tracking to assess distribution and abundance shifts.
- Incident reporting for vessel strikes, dolphin strandings, or behavioral anomalies, supported by trained response teams.

The NSEZ HSE team will be responsible for conducting monitoring activities. If needed, a third-party organization could be engaged in annual monitoring activities. Bangladesh Forest Department, as a regulatory authority, will supervise the dolphin-related monitoring activities.

8.3.15 Managing Aquatic Fauna

8.3.15.1 Development Phase

Key Issues: Construction activities such as land reclamation, jetty construction, pile driving, dredging, and shoreline modification are expected to significantly impact ichthyofauna, plankton, and benthos.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the development phase:

- Avoid construction in critical spawning and nursery areas during peak breeding seasons.
- Use prefabricated structures to reduce in-water construction time and seabed disturbance.
- Install silt curtains, sediment booms, and cofferdams around dredging and pile-driving zones to minimize sediment spread.
- Prohibit direct discharge of wastewater or cement washout into water bodies.
- Limit pile driving, dredging, and other high-noise activities to daylight hours.
- Implement soft-start procedures before initiating pile driving to reduce fish shock and displacement.
- Prohibit the disposal of solid construction waste into aquatic environments.

Investors in collaboration with appointed contractors shall be responsible for implementing the mitigation measures at the construction sites. NSEZ HSE team shall supervise the implementation activities.

Monitoring mechanism:

The proposed scope of monitoring activities during the development phase is as follows:

- Check fish and other aquatic fauna mortality incidents in aquatic ecosystems where construction work is ongoing.

Investors and appointed contractors shall be responsible for carrying out monitoring activities related to aquatic fauna. THE NSEZ HSE team will supervise the implementation of the mitigation measures.

8.3.15.2 Operational Phase

Key issues: operation of the EZ poses persistent threats to ichthyofauna, plankton, and benthos due to ongoing discharges, habitat alteration, oil spills, increased vessel activity, and pollution.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the operation phase:

- All discharges must comply with DOE-prescribed limits for heavy metals, organic load, pH, temperature, and other pollutants.
- Implement spill prevention measures for fuel and chemicals at the jetty and industrial zones.
- Train staff in spill response protocols and emergency reporting.
- Rehabilitate degraded aquatic habitats and promote native vegetation in riparian zones.
- Prohibit direct disposal of food waste, plastics, packaging, and industrial residues into water bodies.
- Coordinate with local fisheries authorities to establish seasonal fishing bans in spawning areas.

The NSEZ HSE team will be responsible for implementing the mitigation measures.

Monitoring mechanism:

The proposed scope of monitoring activities during the operation phase is as follows:

- Monitor aquatic fauna mortality at discharge and downstream points.
- Conduct boat-to-boat surveys to assess fish catch by fishermen.

The NSEZ HSE team, in collaboration with the Bangladesh Fisheries Department, should perform the monitoring activities. If needed, a third-party organization could be engaged in annual monitoring activities.

8.3.16 Managing Hilsa Fisheries

8.3.16.1 Development Phase

Key issues: During the development of the EZ, impacts on the Hilsa (*Tenualosa ilisha*) fishery are anticipated, particularly near Mayani Point in Mirsharai, a known spawning and breeding ground within the Sandwip Channel. Construction activities such as dredging, pile driving, and aquatic infrastructure development may temporarily alter or degrade hilsa habitats. Increased sedimentation can smother eggs, larvae and may disrupt breeding behaviors.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the development phase:

- Restrict jetty construction activities and dredging in known hilsa spawning areas, e.g., near Mayani Point during the eleven-day peak spawning periods (three days before and seven days

after the full moon, including the day of the full moon, totaling eleven days of the moon, which first appears in the Bengali month of *Ashwin* each year).

- Deploy silt curtains, booms, and sediment traps in dredging and reclamation areas to control turbidity and protect sensitive aquatic zones.
- Avoid nighttime construction during hilsa breeding seasons to reduce light and acoustic interference.
- Raise awareness among construction workers and vessel operators regarding hilsa sensitivity and legal responsibilities.

Investors in collaboration with appointed contractors shall be responsible for the implementation of the mitigation measures. NSEZ HSE team shall supervise the implementation activities.

Monitoring mechanism:

The proposed scope of monitoring activities during the development phase is as follows:

- Hilsa fish mortality incidents occur in aquatic ecosystems where construction work is ongoing.

Investors in collaboration with appointed contractors shall be responsible for the implementation of the mitigation measures. NSEZ HSE team shall supervise the implementation activities.

8.3.16.2 Operational Phase

Key issues: During the operation of the EZ, persistent environmental stressors may continue to affect the Hilsa (*Tenualosa ilisha*) population, particularly in and around the Sandwip Channel and Mayani Point spawning grounds. Continuous discharges of industrial effluents, even when partially treated, can introduce heavy metals, organic toxins, and other contaminants into hilsa habitats. The physical presence of jetties and other coastal infrastructure may obstruct migratory routes or create hydrological changes that deter spawning.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the operation phase:

- Ensure that the effluents discharging from CETPs into the Sandwip Channel meet the national standards, i.e., ECR 2023.
- Develop and enforce bycatch reduction strategies for multi-species fishing vessels operating in the Sandwip Channel.
- Engage local fishing communities in co-management practices, including enforcement of seasonal bans and habitat stewardship.

The NSEZ HSE team will be responsible for implementing the mitigation measures.

Monitoring mechanism:

The proposed scope of monitoring activities during the operation phase is as follows:

- Monitor hilsa mortality at discharge and downstream points of NSEZ.
- Conduct boat-to-boat surveys to assess hilsa catch by fishermen.

The NSEZ HSE team will be responsible for monitoring activities. If needed, a third-party organization could be engaged in annual monitoring activities. In addition, the Department of Fisheries (respective Upazila Fisheries Office) under the Ministry of Fisheries and Livestock will be responsible for supervision of the monitoring activities.

8.3.17 Managing Land Acquisition, Resettlement, Rehabilitation & Speculation

8.3.17.1 Development Phase

Key Issues: The NSEZ development phase involves extensive land acquisition in Mirsharai, Sitakunda, and Sonagazi Upazilas, causing physical and economic displacement of affected populations. This includes loss of multi-crop agricultural lands (critical for food security), grazing lands, and traditional livelihoods such as fishing (affecting 2,557 registered fishermen in Mirsharai, 800 in Sonagazi, 6,000 in Sitakunda) and livestock rearing (300 buffalo/sheep owners, 150 grazing boys). Land speculation and hoarding by investors anticipating compensation distort land valuation and create community tensions. Vulnerable groups (e.g., women, elderly, people with disabilities, and unregistered workers) face disproportionate impacts due to a lack of an entitlement matrix, budget, or gender-sensitive design.

Measures to be Considered:

- Develop a comprehensive Land Acquisition and Resettlement Plan (LARP) aligned with World Bank ESS5, national laws, and the Resettlement Policy Framework (RPF), including an entitlement matrix and budget for compensation and rehabilitation.
- Engage in early, meaningful, and inclusive consultations with affected persons, ensuring informed participation and consent, with sex-disaggregated data collection to address gender-differentiated impacts.
- Prioritize avoidance of triple-crop land acquisition to safeguard food security, using spatial planning to identify alternative sites with lower agricultural value.
- Provide fair and timely compensation for all affected households, including undocumented workers, based on a Gender Impact Assessment and market-based valuation to counter speculative price hikes.
- Implement the Livelihood Restoration Plan (LRP) accordingly.
- Offer targeted support for vulnerable groups (women, elderly, people with disabilities) through reserved training seats, childcare, accessible transport, and priority compensation.
- Implement policy controls (e.g., transaction monitoring, price caps) to curb land speculation and hoarding, coordinated with the Land Department and local authorities.
- Establish a confidential Grievance Mechanism (GM) with anonymous reporting channels (e.g., hotlines, online platforms) to address acquisition and speculation grievances, ensuring accessibility for illiterate and vulnerable groups.

During the development phase, BEZA HQ, and the Land Department will implement these measures in coordination with the respective Deputy Commissioner (DC) offices and appointed third-party consultants

Monitoring Mechanism:

- Track the number of physically and economically displaced households, disaggregated by gender and vulnerability status.
- Monitor the percentage of affected individuals receiving timely and adequate compensation, using sex-disaggregated data.
- Assess the number of vulnerable persons supported through RAP and LRP, including training participation and income restoration outcomes.
- Monitor land price trends and speculative transactions through market surveys and Land Department data.
- Track GRM usage and resolution rates for acquisition and speculation grievances.
- Conduct quarterly audits of income restoration outcomes.
- Share quarterly progress reports with BEZA HQ, Deputy Commissioner (DC) offices, local authorities, and World Bank, using a traceable risk scoring methodology (aligned with ESS1).

Monitoring will be conducted by the NSEZ authority of BEZA, in coordination with DC offices, the Land Department, and third-party consultants, with enhanced institutional capacity through budgeted HSE team recruitment and training.

8.3.17.2 Operational Phase

Key Issues: The operational phase sustains displacement impacts due to exclusion zones and infrastructure (e.g., jetties, breakwaters), limiting access to fishing grounds and grazing lands. Ongoing land valuation distortions from speculation may affect new acquisitions for industrial expansion. Vulnerable groups face barriers to alternative livelihoods, risking long-term poverty and social exclusion.

Measures to be Considered:

- Update the LARP with long-term strategies, integrating Gender Impact Assessment findings and a revised entitlement matrix for ongoing compensation and rehabilitation.
- Sustain the LRP with targeted programs for fishermen, livestock owners, and farmers, including job placement in NSEZ industries and ongoing vocational training.
- Continue policy controls to monitor and prevent land speculation, with regular market assessments and coordination with local authorities.
- Strengthen the GRM for ongoing acquisition and livelihood grievances, ensuring accessibility and sex-disaggregated reporting.
- Support cultural preservation through community centers and events to maintain social identity for displaced populations.

Monitoring Mechanism:

- Monitor ongoing displacement and compensation delivery, disaggregated by gender and vulnerability.
- Track LRP participation, job placement rates, and income restoration outcomes.
- Assess land price stability and speculative activity through annual market surveys.
- Track GRM usage and resolution rates, ensuring inclusivity for vulnerable groups.
- Share annual reports with BEZA HQ, DC offices, using a harmonized risk framework (aligned with ESS1).

Monitoring will be conducted by the NSEZ HSE team, with strengthened institutional capacity, in coordination with local authorities and NGOs.

8.3.18 Managing Community Health, Safety, and Security

8.3.18.1 Development Phase

Key Issues: The influx of 1.4 million workers increases health, safety, and security risks in Mirsharai, Sitakunda, and Sonagazi Upazilas. Local health systems (e.g., 112 hospital beds) face pressure from increased demand, while construction activities elevate risks of traffic accidents, noise, dust emissions, and communicable diseases (e.g., HIV/AIDS). Interactions between workers and host communities may lead to crime and gender-based violence (GBV), exacerbated by inadequate risk mapping and weak grievance mechanisms.

Measures to be Considered:

- Implement the Community Health, Safety, and Security Plan aligned with World Bank ESS4, incorporating a Gender Impact Assessment.
- Strengthen healthcare infrastructure by upgrading significant numbers of community clinics and Upazila Health Complexes and establishing a temporary medical facility in the project township with STI prevention and emergency services.
- Implement a Traffic Management Plan and enforcing safety protocols to reduce accidents and congestion.

- Conduct awareness campaigns on communicable diseases (e.g., HIV/AIDS), targeting workers and communities, using local languages and accessible formats (e.g., radio, posters).
- Establish a confidential GRM with anonymous reporting channels (e.g., hotlines, online platforms) and trained staff to address health, safety, and security grievances, ensuring accessibility for women and vulnerable groups.
- Enhance policing and emergency response facilities near worker camps and high-density areas, with trained personnel using minimal force protocols.
- Coordinate with public health, transport, and law enforcement agencies to deliver services.

Monitoring Mechanism:

- Track the number and capacity of health and education facilities upgraded or established.
- Monitor community accident rates, health incidents (e.g., STI cases), and traffic-related complaints, disaggregated by gender.
- Assess the reach and effectiveness of disease awareness campaigns through participant feedback.
- Track GRM usage and resolution rates for health, safety, and security grievances.
- Share quarterly reports with BEZA HQ, local authorities, using a traceable risk scoring methodology (aligned with ESS1).

Monitoring will be conducted by the NSEZ HSE team, with enhanced capacity through budgeted recruitment and training, in coordination with public health, transport, and law enforcement agencies.

8.3.18.2 Operational Phase

Key Issues: The operational phase introduces long-term health and safety risks from industrial accidents, chemical releases, effluent discharges, and increased road traffic. Social challenges, including inequality and insecurity, may persist due to weak community engagement and resource competition.

Measures to be Considered:

- Update the Community Health, Safety, and Security Plan, integrating Gender Impact Assessment findings.
- Maintain permanent healthcare facilities (e.g., Medical College Hospitals) with emergency and maternal health services and conduct periodic public health assessments.
- Ensure industrial compliance with effluent treatment and air pollution control, aligned with environmental standards.
- Sustain the Traffic Management Plan with upgraded road networks and public transport systems.
- Continue awareness programs on industrial risks and disease prevention, collaborating with community-based health and safety forums.
- Strengthen policing and emergency response systems, with regular training for security personnel.
- Maintain the GRM for health, safety, and security grievances, with sex-disaggregated reporting.

Monitoring Mechanism:

- Conduct annual audits of emergency preparedness, industrial compliance, and health service capacity.
- Monitor health indicators (e.g., STI rates, respiratory issues) and air/water quality in communities.
- Track traffic accidents, congestion, and community feedback on safety, disaggregated by gender.
- Assess GRM usage and resolution rates.

- Share annual reports with BEZA HQ, local authorities, using a harmonized risk framework (aligned with ESS1).

Monitoring will be conducted by the NSEZ HSE team, with strengthened capacity, in coordination with public health, transport, and law enforcement agencies.

8.3.19 Managing Occupational Health, Safety, and Security

8.3.19.1 Development Phase

Key Issues: Construction workers face risks from machinery accidents, dust and chemical exposure, heat stress, fire hazards, and mental stress due to long hours and poor accommodation. Limited training, inadequate personal protective equipment (PPE), and weak oversight increase injury and illness risks, particularly for female and migrant workers.

Measures to be Considered:

- Establish a comprehensive Occupational Health and Safety (OHS) Management System aligned with World Bank ESS2, including risk mapping.
- Conduct mandatory safety training and emergency preparedness drills for all workers, with modules for women and migrant workers.
- Ensure availability and mandatory use of PPE across all job sites, with regular inspections.
- Provide safe, hygienic, and gender-segregated accommodation with WASH facilities and mental health support.
- Perform regular safety inspections and audits at construction sites, using a traceable risk scoring methodology.
- Establish a confidential GRM for OHS complaints, with anonymous reporting channels and timely resolution protocols.
- Coordinate with vocational training institutes to deliver OHS training programs.

Monitoring Mechanism:

- Track the number of training sessions conducted, PPE distribution, and worker participation, disaggregated by gender.
- Monitor accident frequency, severity rates, and incident response actions.
- Assess compliance with OHS standards through monthly site inspections.
- Track GRM usage and resolution rates for OHS complaints.
- Maintain an accident incident register for systematic logging and analysis.
- Share quarterly reports with BEZA HQ, local authorities, using a harmonized risk framework (aligned with ESS1).

Monitoring will be conducted by the NSEZ HSE team, with enhanced capacity through budgeted recruitment and training, under BEZA HQ oversight and in coordination with NSEZ Management.

8.3.19.2 Operational Phase

Key Issues: Ongoing exposure to chemicals, heavy machinery, noise, and industrial waste poses risks of occupational diseases and chronic health conditions. Long shifts and unsafe work cultures may undermine worker morale and productivity.

Measures to be Considered:

- Maintain and update the OHS Management System, integrating lessons from the development phase.
- Implement health surveillance programs for early detection of occupational illnesses.
- Train industrial workers on safe handling of chemicals and hazardous substances, with regular refresher courses.
- Ensure emergency exits, fire control systems, and adequate ventilation in industrial units.

- Maintain 24/7 security with trained personnel using minimal force protocols.
- Continue the GRM for OHS complaints, with expanded reporting channels and sex-disaggregated data.
- Coordinate with public health agencies and NGOs to provide mental health and occupational health services.

Monitoring Mechanism:

- Conduct annual health screenings and exposure monitoring, disaggregated by gender.
- Audit safety records and analyze accident trends, using a traceable risk scoring methodology.
- Track training participation, drill effectiveness, and security incident resolution.
- Monitor GRM usage and resolution rates for OHS complaints.
- Maintain an accident incident register.
- Share annual reports with BEZA HQ, local authorities, using a harmonized risk framework (aligned with ESS1).

Monitoring will be conducted by the NSEZ HSE team, with strengthened capacity, in coordination with public health agencies and NSEZ Management.

8.3.20 Managing Labor Influx & Infrastructure Readiness

8.3.20.1 Development Phase

Key Issues: The influx of 1.4 million male-dominated, semi-skilled workers strains local resources including housing, water, sanitation, healthcare, education, and transportation in Mirsharai, Sitakunda, and Sonagazi Upazilas, increasing risks of GBV, child labor, and forced labor. Weak infrastructure planning exacerbates vulnerabilities, particularly for women and vulnerable groups.

Measures to be Considered:

- A comprehensive Labor Influx and Infrastructure Readiness Plan will be implemented, incorporating timelines, spatial planning, and service projections, aligned with World Bank ESS2, ESS4, and the Labor Influx Guidance Note.
- Phase 1 (up to 2025): Approximately 0.7 million of workers are expected to reside in and around NSEZ. Housing will be facilitated primarily through personal arrangements, supplemented by WASH-compliant and gender-segregated worker accommodations. Existing healthcare and educational facilities will be enhanced through coordination with NHA, LGED, and the Ministry of Health, including central hospital, clinics, and primary and secondary schools. Transport and utility networks will be upgraded to meet initial demand. These measures aim to mitigate overcrowding, prevent informal settlements, and reduce associated social risks.
- Phase 2 (2026–2030): Cumulative workforce will reach approximately 1.05 million. Housing will be expanded by significant number of additional units, hospital capacity increased to beds, and vocational and secondary education facilities scaled up. Transport networks, including BRTC services and rail links, will be enhanced, along with utilities such as energy, water supply, and waste treatment. Continued coordination with local and national authorities will ensure service readiness, reduce slumification risks, and support sustainable urban growth.
- Phase 3 (2031–2040): Cumulative workforce is projected to reach 1.4 million. Fully functional NSEZ townships will provide adequate housing, a regional medical center, higher education and university-level training, multi-modal transport systems, and smart utility infrastructure. These measures aim to ensure long-term sustainability of worker settlements, equitable access to services, and integrated urban planning.
- Implement the inclusive infrastructure scheme with universal access design features to accommodate diverse populations, including persons with disabilities and the elderly following the provision of BNBC as referred by Bangladesh Economic Zones (Construction of Building) Rules 2017.

- Conduct spatial planning for worker accommodations with WASH facilities, gender-segregated spaces, and security.
- Prohibit child and forced labor through mandatory contractor audits and a worker verification system with age documentation checks.
- Implement awareness campaigns on local culture, GBV prevention, and the Code of Conduct, targeting workers and communities in local languages.
- Coordinate with local government, LGED, and NHA for service delivery and urban planning to prevent slumification.
- Establish a confidential GRM with anonymous reporting channels to address labor influx grievances, ensuring accessibility for women and migrant workers.

Monitoring Mechanism:

- Track the number of worker accommodations constructed and their compliance with WASH and gender-segregated standards.
- Monitor service delivery (e.g., healthcare, education, transport) through usage data and community feedback, disaggregated by gender.
- Assess the reach and effectiveness of awareness campaigns and Code of Conduct compliance.
- Track GRM usage and resolution rates for labor influx grievances.
- Share quarterly reports with BEZA HQ, local authorities, using a traceable risk scoring methodology.

Monitoring will be conducted by the NSEZ HSE team, with enhanced capacity through budgeted recruitment and training, in coordination with local government, LGED, and NHA.

8.3.20.2 Operational Phase

Key Issues: Long-term workers and their followers residency and informal settlements overburden local services, risking slumification. Job competition between local and migrant populations may persist, with gender-differentiated access to services remaining a gap.

Measures to be Considered:

- Update the Labor Influx and Infrastructure Readiness Plan, coordinating with LGED and NHA to support urban growth and prevent slumification.
- Encourage local hiring and skill development programs to reduce job competition, prioritizing women and vulnerable groups.
- Continue enforcing the Code of Conduct for all workers, with regular audits and training.
- Ensure long-term housing with adequate utilities and gender-segregated facilities.
- Strengthen coordination with local authorities for service delivery and urban planning.
- Sustain the GRM for labor influx grievances, with sex-disaggregated reporting.

Monitoring Mechanism:

- Monitor labor profiles, turnover trends, and local hiring rates, disaggregated by gender.
- Conduct annual community consultations to assess perceptions and concerns.
- Track informal settlement growth and service delivery through usage data and environmental audits.
- Assess GRM usage and resolution rates.
- Share annual reports with BEZA HQ, local authorities, using a harmonized risk framework (aligned with ESS1).

Monitoring will be conducted by the NSEZ HSE team, with strengthened capacity, in coordination with local authorities, LGED, and NHA.

8.3.21 Managing Child Labor and Forced Labor

8.3.21.1 Development Phase

Key Issues: The influx of 1.4 million workers increases risks of child labor and forced labor in construction and supply chains, particularly affecting vulnerable populations (children, migrant workers) due to economic desperation and weak oversight. Non-compliance with international labor standards threatens the project's reputation.

Measures to be Considered:

- Develop a Child Labor and Forced Labor Policy aligned with ILO conventions, World Bank ESS2, and national laws, including risk mapping of supply chains and subcontractors.
- Conduct mandatory due diligence and audits of contractors and subcontractors to ensure no employment of individuals under 18 or forced labor practices.
- Implement awareness campaigns on child labor and forced labor risks, legal consequences, and reporting mechanisms, targeting workers, contractors, and communities in local languages.
- Establish a worker verification system with regular site inspections and age documentation checks.
- Provide accessible reporting mechanisms (e.g., anonymous hotlines, online platforms) for workers and communities to report violations, integrated into the GRM.
- Coordinate with local authorities and NGOs to monitor and prevent exploitation in high-risk areas (e.g., worker camps).

Monitoring Mechanism:

- Track the number of contractor and subcontractor audits conducted.
- Monitor the number of reported child or forced labor incidents and their resolution status through GRM.
- Assess the reach and effectiveness of awareness campaigns through participant feedback and school attendance data.
- Conduct monthly site inspections and maintain a worker age verification register.
- Share quarterly compliance reports with BEZA HQ, local authorities, using a traceable risk scoring methodology (aligned with ESS1).

Monitoring will be conducted by the NSEZ HSE team, with enhanced capacity through budgeted recruitment of labor inspectors, in coordination with DC offices and third-party auditors.

8.3.21.2 Operational Phase

Key Issues: The operational phase sustains risks of child and forced labor in industrial supply chains and informal sectors due to high labor turnover and weak enforcement, threatening compliance with labor standards.

Measures to be Considered:

- Maintain and update the Child Labor and Forced Labor Policy, aligning with evolving standards.
- Conduct periodic supply chain audits across industrial units to ensure compliance with labor standards.
- Provide ongoing training for industrial management on identifying and preventing child and forced labor.
- Strengthen partnerships with local labor authorities and NGOs to monitor informal labor markets.
- Maintain the GRM with expanded, multilingual reporting channels for workers to report violations anonymously.

Monitoring Mechanism:

- Conduct annual supply chain audits and report compliance rates.
- Monitor GRM usage and resolution rates for child and forced labor complaints.
- Track training participation and school enrollment trends through community surveys.
- Share annual compliance reports with BEZA HQ, local authorities, using a harmonized risk framework (aligned with ESS1).

Monitoring will be conducted by the NSEZ HSE team, with strengthened capacity, in coordination with local authorities and NGOs.

8.3.22 Managing Gender-Based Violence (GBV) and Sexual Exploitation and Abuse/Sexual Harassment (SEA/SH)

8.3.22.1 Development Phase

Key Issues: The development phase, spanning until 2040, involves a predominantly male workforce of 1.4 million workers, increasing risks of Gender-Based Violence (GBV), Sexual Exploitation and Abuse (SEA), and Sexual Harassment (SH). Women, adolescent girls, and vulnerable groups (e.g., poor or female-headed households) face risks of rape, sexual assault, harassment, exploitation, forced marriage, and psychological abuse due to demographic imbalances, economic desperation, and weak grievance mechanisms. Risks of STIs, unwanted pregnancies, and trafficking are heightened, with inadequate gender-sensitive design.

Measures to be Considered:

- Ensure the continuous implementation of SEA/SH Action Plan and GBV Prevention and Response Plan aligned with World Bank ESS2, ESS4, and SEA/SH Good Practice Note, incorporating a Gender Impact Assessment with sex-disaggregated data.
- Enforce a mandatory Code of Conduct for all workers, contractors, and subcontractors, prohibiting all nine GBV types (rape, sexual assault, harassment, exploitation, sexual favors, physical assault, forced marriage, denial of resources, psychological abuse), with zero-tolerance policies and disciplinary actions.
- Implement a community awareness strategy, including:
 - Culturally sensitive campaigns in local languages on GBV/SEA/SH risks, prevention, legal consequences, and reporting, using posters, radio, and street plays.
 - Engagement of women's groups, youth organizations, and NGOs to co-design programs.
 - Workshops in high-risk areas (e.g., worker camps, markets) on gender sensitivity and STI prevention.
- Establish a confidential GRM with multiple reporting channels (e.g., anonymous hotlines, online platforms, community-based focal points with trained female staff) and survivor-centered protocols (acknowledgment within 48 hours, resolution within 14 days where feasible).
- Conduct mandatory GBV/SEA/SH training for workers, supervisors, and camp management, covering gender sensitivity, cultural norms, and STI risks.
- Provide gender-segregated facilities (restrooms, accommodations, safe transport) at construction sites and camps.
- Partner with NGOs and health authorities for survivor support services, including STI treatment, counseling, and legal aid.
- Implement economic empowerment programs (e.g., vocational training, microfinance) for women and girls to reduce vulnerability to exploitation.

Monitoring Mechanism:

- Track the reach and effectiveness of awareness campaigns using sex-disaggregated participant data and feedback.
- Monitor GRM usage for GBV/SEA/SH complaints, resolution rates, and survivor satisfaction.
- Assess the accessibility and usage of gender-segregated facilities through regular audits.

- Conduct quarterly community consultations to evaluate GBV/SEA/SH risks and GRM trust.
- Monitor health service data for STIs, unwanted pregnancies, and trafficking cases.
- Audit compliance with the Code of Conduct and training participation.
- Share quarterly reports with BEZA HQ, local authorities, NGOs, using a traceable risk scoring methodology (aligned with ESS1).

Monitoring will be conducted by the NSEZ HSE team, with enhanced capacity through budgeted recruitment and training, in coordination with NGOs and health authorities.

8.3.22.2 Operational Phase

Key Issues: The operational phase sustains GBV, SEA/SH risks due to ongoing worker-community interactions and informal settlements. Women and adolescent girls remain vulnerable to exploitation, trafficking, and harassment due to economic disparities and weak enforcement.

Measures to be Considered:

- Update the SEA/SH and GBV Prevention and Response Plan, integrating Gender Impact Assessment findings.
- Continue enforcing the Code of Conduct across industrial units, with regular audits and disciplinary measures.
- Sustain the community awareness strategy, embedding GBV/SEA/SH education in schools, community centers, and digital platforms.
- Strengthen the GRM with expanded, multilingual reporting channels and continuous staff training on survivor-centered approaches.
- Provide ongoing GBV/SEA/SH training for workers, management, and security personnel.
- Ensure industrial units maintain gender-segregated facilities and safe transport.
- Continue survivor support services through NGO partnerships, ensuring access to medical, psychological, and legal aid.
- Implement economic empowerment programs for women and girls, with incentives for industries employing women.

Monitoring Mechanism:

- Monitor awareness campaign effectiveness and GRM usage, using sex-disaggregated data.
- Track compliance with the Code of Conduct and training participation.
- Assess gender-segregated facility usage and accessibility through annual audits.
- Conduct annual community surveys to evaluate GBV/SEA/SH risks and GRM trust.
- Monitor health and law enforcement data for STIs, pregnancies, and trafficking cases.
- Share annual reports with BEZA HQ, local authorities, using a harmonized risk framework (aligned with ESS1).

Monitoring will be conducted by the NSEZ HSE team, with strengthened capacity, in coordination with NGOs and health authorities.

8.3.23 Managing Social Cohesion and Conflict

8.3.23.1 Development Phase

Key Issues: The influx of 1.4 million workers disrupts social cohesion in Mirsharai, Sitakunda, and Sonagazi Upazilas, creating potential tensions between host communities and migrant workers over resources (e.g., housing, water, jobs, healthcare, education). Competition for limited services, cultural differences, and economic disparities may lead to social stratification, discrimination, or conflicts, particularly in informal settlements. The absence of a Social Cohesion Risk Assessment exacerbates these risks, threatening community stability and project success, rated High Risk due to labor influx.

Measures to be Considered:

- Conduct a comprehensive Social Cohesion Risk Assessment to map potential host-migrant tensions, identifying high-risk areas (e.g., informal settlements, markets) and vulnerable groups (e.g., women, youth, unregistered workers).
- Implement community-building initiatives, including:
 - Host-migrant forums to foster dialogue, cultural exchange, and mutual understanding, involving community leaders, women, and youth.
 - Community events (e.g., cultural festivals, sports, vocational workshops) to promote integration and reduce prejudice.
 - Awareness campaigns on diversity, inclusion, and conflict prevention, using local languages and accessible formats (e.g., radio, community meetings, posters).
- Establish a confidential GRM to address conflict-related grievances, with anonymous reporting channels (e.g., hotlines, online platforms, community-based focal points) and trained mediators to resolve disputes.
- Coordinate with local authorities and NGOs to provide equitable access to services (e.g., healthcare, education, water) for host and migrant communities, reducing resource competition.
- Engage community leaders, women's groups, and youth organizations to mediate tensions and promote social cohesion.
- Support cultural preservation through community centers and events to maintain social identity and reduce tensions.
- Integrate Gender Impact Assessment findings to address gender-differentiated risks in community interactions, ensuring equitable participation.

Monitoring Mechanism:

- Conduct quarterly Social Cohesion Risk Assessments, tracking tension indicators (e.g., resource competition, discrimination incidents) and community perceptions, disaggregated by gender and host/migrant status.
- Monitor the number and effectiveness of host-migrant forums and community events through participation data and feedback.
- Track GRM usage for conflict-related complaints and resolution rates, ensuring accessibility for vulnerable groups.
- Assess equitable service access through community surveys, disaggregated by host and migrant populations.
- Share quarterly reports with BEZA HQ, local authorities, using a traceable risk scoring methodology (aligned with ESS1 and ESS10).

Monitoring will be conducted by the NSEZ HSE team, with enhanced capacity through budgeted recruitment and training, in coordination with local authorities and NGOs.

8.3.23.2 Operational Phase

Key Issues: The operational phase's population influx sustains risks of social conflict due to ongoing competition over jobs, housing, healthcare, and education. Informal settlements and exclusion zones may deepen social divisions, while cultural differences and weak governance could escalate tensions, particularly for vulnerable groups like women, youth, and unregistered workers. Inadequate risk assessments and community engagement exacerbate these challenges, rated Medium Low but requiring sustained mitigation.

Measures to be Considered:

- Update the Social Cohesion Risk Assessment to address operational phase dynamics, focusing on informal settlements and industrial areas.
- Sustain community-building initiatives, including regular host-migrant forums, cultural events, and inclusion campaigns to foster integration.

- Strengthen the GRM with expanded, multilingual reporting channels and trained mediators for conflict resolution.
- Promote equitable hiring in NSEZ industries, prioritizing local and vulnerable groups to reduce job competition, based on Gender Impact Assessment findings.
- Coordinate with local authorities and the Urban Development Directorate to regulate informal settlements and ensure equitable service access.
- Engage community-based organizations, including women and youth representatives, to monitor and mediate tensions.
- Support cultural preservation through community centers and events to maintain social cohesion.

Monitoring Mechanism:

- Conduct annual Social Cohesion Risk Assessments, tracking conflict indicators and community feedback, disaggregated by gender and host/migrant status.
- Monitor participation in community-building initiatives and their impact on social cohesion through surveys.
- Track GRM usage and resolution rates for conflict-related complaints, ensuring inclusivity.
- Assess service access and job distribution through annual surveys, focusing on vulnerable groups.
- Share annual reports with BEZA HQ, local authorities, using a harmonized risk framework (aligned with ESS1 and ESS10).

Monitoring will be conducted by the NSEZ HSE team, with strengthened capacity through recruitment and training, in coordination with local authorities and NGOs.

8.3.24 Managing Living and Livelihoods

8.3.24.1 Development Phase

Key Issues: The development of the NSEZ significantly impacts traditional livelihoods, particularly for fishermen and livestock-dependent communities in Mirsharai, Sitakunda, and Sonagazi Upazilas. Approximately 2,557 registered fishermen in Mirsharai, 800 in Sonagazi, and 6,000 in Sitakunda, along with unregistered/seasonal fishermen, face disruptions due to dredging activities in the Sandwip Channel and restricted access to khals (e.g., Ichakhali, Bamon Sundar, Saherkhali) caused by super-dyke and sluice gate construction. Fish catches have declined from 40-100 kg to 5-40 kg per visit since 2018, and fishing nets are damaged by increased marine traffic. Relocated fish landing stations (e.g., Saherkhali, Domkhali) lack adequate facilities for resting, sanitation, drinking water, and safe boat parking, increasing economic and safety burdens, particularly for women involved in post-harvest activities. Livestock-dependent communities, including 300 buffalo/sheep owners and 150 grazing boys, have lost access to grazing lands within EZ, reducing livestock numbers from 20,000 to 8,000 and impacting the dairy value chain. These disruptions threaten food security, cultural identity, and socio-economic stability, with vulnerable groups (e.g., women, elderly, and unregistered fisherfolk) facing disproportionate impacts.

Measures to be Considered:

- Implement Livelihood Restoration Plan (LRP) aligned with the World Bank's Resettlement Policy Framework (RPF) to address the needs of fishermen, livestock owners, and allied workers.
- Provide financial compensation for affected fishermen and livestock owners, prioritizing those with documented and undocumented losses, to mitigate economic impacts.
- Develop alternative livelihood programs, including:
 - Vocational training in mechanized boat repairing, fish handling, drying, value-added processing, eco-tourism guiding, automobile repair, plumbing, home appliance repair,

- masonry, driving, office management/computer literacy, welding, security services, and handicraft making/marketing.
 - Agribusiness training in climate-resilient agriculture, integrated farming, fish hatcheries, feed production, and fish health services for fishermen.
 - Support for small-scale enterprises (e.g., fish stalls, food kiosks, mobile vending, community-run canteens) targeting NSEZ workers, with a focus on women and youth.
- Establish green and blue job opportunities, such as environmental monitoring, waterway maintenance, mangrove restoration, and eco-tourism, leveraging fishermen's knowledge of coastal environments.
- Construct resting facilities, sanitation stations, drinking water points, and cyclone-resistant boat parking areas at relocated fish landing stations (e.g., Saherkhali, Domkhali, Muhuri, Bamonsundar, Ichakhali Ghat).
- Provide targeted support for women in fishing communities, including childcare, transportation, and safe access to relocated landing sites, to support post-harvest activities.
- Support livestock-dependent communities through:
 - Allocation of designated grazing areas within or near the EZ to sustain livestock rearing.
 - Training in stall-feeding techniques and dairy value chain businesses (e.g., milk processing, marketing).
 - Microfinance and cooperative programs to support alternative income sources for buffalo/sheep owners and grazing boys.
- Conduct early and inclusive consultations with fishermen, livestock owners, and vulnerable groups (e.g., women, elderly, and unregistered workers) to ensure informed participation and consent.
- Implement BEZA's Skill and Social Development Program and Enterprise and Skill Agency (Skills Voucher Programme) in collaboration with NGOs and firms to deliver training and support services.
- Establish a Grievance Redress Mechanism (GRM) to address livelihood-related concerns, ensuring accessibility for undocumented fisherfolk and livestock owners.
- Enhance the capacity of BEZA's Social and Livelihood Restoration Unit (SLRU).

Monitoring Mechanism:

- Track the number of households participating in the LRP and Skills Voucher Programme, disaggregated by fishermen, livestock owners, and gender.
- Monitor the percentage of affected individuals achieving income restoration through alternative livelihoods or compensation.
- Record the number of training sessions conducted and participants trained, particularly in green/blue jobs and agribusiness.
- Assess the functionality and usage of new facilities at fish landing stations (e.g., sanitation, boat parking).
- Monitor the allocation and usage of designated grazing areas for livestock.
- Conduct quarterly community feedback surveys to evaluate the effectiveness of livelihood programs and address cultural and social impacts.
- Track grievances related to livelihood disruptions and their resolution rates.
- Share quarterly progress reports with BEZA HQ, local authorities.

Monitoring will be conducted by the NSEZ authority of BEZA, in coordination with the respective DC offices and third-party consultants.

8.3.24.2 Operational Phase

Key Issues: During the operational phase, increased shipping activities, exclusion zones, and infrastructure developments (e.g., jetties, breakwaters) will further restrict fishermen's access to fishing grounds in the Sandwip Channel, reducing catches and damaging equipment. Large vessels' bow waves and washes pose safety hazards, and anchored vessels may expand the project footprint,

impacting fisheries. Livestock grazing lands will be fully restricted due to boundary fencing, leading to permanent loss of traditional feeding grounds and economic losses for buffalo/sheep owners. These changes threaten the socio-economic stability and cultural identity of fishing and livestock-dependent communities, with women, youth, and elderly facing challenges adapting to new livelihoods. The impact is rated Medium Low for fishermen and livestock communities, but ongoing support is critical to prevent long-term poverty and social exclusion.

Measures to be Considered:

- Sustain and expand the Livelihood Restoration Plan (LRP) to support long-term income restoration for fishermen and livestock-dependent communities.
- Promote local hiring in NSEZ industries, prioritizing fishermen and livestock owners for jobs in environmental monitoring, waterway maintenance, and industrial roles, with training to bridge skill gaps.
- Provide ongoing vocational training through BEZA's Skill and Social Development Program, focusing on:
 - Green and blue jobs (e.g., eco-tourism, mangrove restoration, fish hatcheries).
 - Agribusiness and enterprise development (e.g., fish stalls, canteens, dairy processing).
 - Technical skills (e.g., boat repair, welding, driving, handicraft production).
- Establish permanent facilities at fish landing stations, including cyclone-resistant boat parking, sanitation, resting areas, and cold storage for fish, ensuring accessibility for women.
- Develop alternative grazing lands or fodder supply programs outside the EZ boundary to support livestock rearing, with microfinance for stall-feeding and dairy businesses.
- Support women's participation through reserved seats in training programs, scholarships, and incentives for industries employing women, addressing cultural barriers.
- Strengthen community support programs through NGOs and firms to provide microfinance, cooperatives, and market access for small-scale businesses.
- Maintain and update a Stakeholder Engagement Plan (SEP) to involve fishing and livestock communities in decision-making processes.
- Ensure the GRM remains accessible, confidential, and responsive to address ongoing livelihood concerns.
- Promote cultural preservation initiatives to maintain the social fabric of fishing and livestock communities, such as community centers and events.

Monitoring Mechanism:

- Monitor the number of local hires from fishing and livestock communities in NSEZ industries and their retention rates.
- Track participation in training programs and the establishment of small-scale businesses.
- Assess the economic impact of livelihood programs through income surveys and market access data.
- Monitor the usage and condition of fish landing station facilities and alternative grazing areas.
- Conduct annual community consultations to evaluate livelihood restoration outcomes and cultural impacts.
- Track grievances and resolution rates, ensuring inclusion of undocumented workers.
- Share annual livelihood restoration reports with BEZA HQ, local authorities.

Monitoring will be conducted by the NSEZ HSE team in coordination with local authorities, NGOs, and relevant ministries.

8.3.25 Managing Disasters

8.3.25.1 Development Phase

Key issues: natural hazards anticipated in the NSEZ region are cyclones, earthquakes, tsunamis, and floods/flash floods. The area is located in the high-risk zone for cyclones and its associated disasters like storm surges. As per the seismic zone map, the NSEZ site and study region fall in both severe

seismic intensity zone (zone 3) with coefficients of 0.28 and moderate seismic intensity zone (zone 2) with coefficients of 0.20. If an earthquake occurs during the construction phase, the damage would be extended to some extent, such as the collapse of buildings and injury from falling objects. According to this classification, the EZ site falls within zone-I, which is reportedly the most vulnerable belt. According to the Upazila Disaster Management Plan of Mirsharai and Sitakunda, both upazilas are flood-prone areas, specifically vulnerable to flash floods. These disasters can impact the development activities and damage the infrastructure in the EZ area.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the development phase:

- Ensure that the regional disaster issues have been considered and the disaster risk reduction strategy has been embedded into the environmental assessment reports.
- Conduct disaster mapping for floods, cyclones, earthquakes, and integrate findings into infrastructure design.
- Bangladesh National Building Code 2020 should be applied to ensure structures are designed and constructed following sound architectural and engineering practices, including aspects of fire prevention.
- Elevate roads, utilities, and critical facilities above flood levels.
- All structures should be designed above the high flood level of the coastal flood for 100 years, the river flood for 25 years, and the historical maximum of the pluvial flood return period.
- Regular supervision and maintenance for adequacy and intactness of the flood control measures provided at the site.
- Preserve natural buffers like mangroves and wetlands to reduce storm surges and erosion.

During the development phase, individual industries will ensure the measures that are suggested above, and NSEZ management will assist them by coordinating with relevant government authorities.

Monitoring mechanism:

The proposed scope of the natural disaster monitoring activities during the development phase is as follows:

- Monitor cyclone paths, flood warnings, and erosion-prone areas.
- Connect with the national early warning system, e.g., Cyclone Preparedness Program (CPP), Bangladesh Meteorological Department (BMD), and Flood Forecasting and Warning Center (FFWC) alerts.
- Designate evacuation routes and shelters.
- Record of casualties, loss, and damage.

During the development phase, individual industries will monitor disasters and take necessary action to protect their industries and workers against emergencies. NSEZ management will assist them by coordinating with relevant government authorities.

8.3.25.2 Operational Phase

Key issues: earthquakes can damage buildings of individual industries and infrastructures. Cyclones and associated storm surges, tsunami-generated waves, and floods can inundate the area.

Measures to be considered:

The following measures could mitigate the anticipated negative impacts during the operation phase:

- Establish an on-site emergency control center in the NSEZ with trained personnel to take care of and handle the expected emergency.
- Maintain communication systems for real-time alerts and coordination with different government authorities, including the Bangladesh Meteorological Department (BMD), the Flood Forecasting and Warning Center (FFWC), etc.

- Display of emergency contact numbers should be made in the emergency control center and all other site locations. The emergency control center should be comprised of personnel well-trained in health and safety management at the NSEZ site.
- Develop contingency plans for supply chain disruptions, power outages, and workforce displacement.
- Regularly inspect and reinforce embankments, drainage systems, and shelters.
- Conduct periodic mock drills for evacuation, fire, and chemical spills and audits to test preparedness.
- Maintain coordination with Bangladesh Fire Service & Civil Defense (BDSCD), Cyclone Preparedness Programme (CPP), etc., for evacuation and rescue support.
- Ensure the availability of first aid and ambulance facilities at the NSEZ site.
- Tie-ups with the local hospitals in the area to handle various emergencies.
- Develop green buffer zones along the coastline by planting mangroves, which will act as natural shields.
- Update disaster preparedness plan based on lessons learned.

During the operation phase, NSEZ management will establish an on-site emergency control center and assist the individual industries in the EZ to manage disasters/emergencies.

Monitoring mechanism:

The proposed scope of the natural disaster monitoring activities during the operation phase is as follows:

- Availability of emergency preparedness and response/evacuation plan in the individual industry.
- Records of training, including mock drills, first aid, etc., in the individual industry.
- Inspect embankments, drainage, and vulnerable slopes.
- Trends of natural disasters, time of occurrence, etc.
- Record of casualties, loss, and damage.

During the operation phase, individual industries will prepare their own emergency response/evacuation plan, including the natural disaster issues in the project region. They will also keep all the training records related to natural disaster/emergency issues and preserve the loss and damage. A copy of the report will be shared with the NSEZ management.

NSEZ management will set up a disaster management committee, which will be responsible for monitoring and declaring an emergency in the EZ. They will inspect the embankments, drainage, and vulnerable slopes. During the emergency they will communicate with the Upazila and District administration, Bangladesh Meteorological Department (BMD), Flood Forecasting and Warning Center (FFWC), Bangladesh Fire Service and Civil Defense (BFSCD), Volunteers of Cyclone Preparedness Programme (CPP), District Disaster Management Committee (DDMC), Upazila Disaster Management Committee (UZDMC), Union Disaster Management Committee (UDMC), Local Police Station, Health Complex, and others to get assistance.

8.4 Recommendations to Strengthen Social Inclusion Aspects for Future Investments

To strengthen social inclusion within the NSEZ, it is essential to implement socially responsive strategies across all project phases. Starting with planning, conducting culturally adapted needs assessments for local and marginalized communities, and ensuring the inclusion of women, households living below the poverty line, persons with disabilities, and Indigenous groups. Communication materials should be designed in local languages and accessible formats to promote broad-based participation in consultations. When engaging with indigenous or minority communities, apply Free, Prior, and Informed Consent (FPIC) protocols to respect their preferences in project design. To enhance local capacity,

targeted skills training linked to project jobs and set employment targets for local and underrepresented groups, including women and youth, with support measures like childcare and transportation subsidies should be provided. For service accessibility, structure pricing models that offer affordable access to essential resources, such as water, sanitation, healthcare, and education, facilities are accessible to low-income households should be ensured. Gender-sensitive facilities, such as separate restrooms, breastfeeding rooms, and well-lit public spaces, should be incorporated during the construction of labor accommodations. Additionally, all infrastructure is accessible to individuals with disabilities and should be ensured.

Resettlement Action Plan (RAP) and Livelihood Restoration Plans (LRP) should be developed considering fair compensation with full replacement cost for those affected by physical and/or economic displacement. Targeted assistance programs can further support vulnerable groups, providing income support or transition grants where necessary. To ensure safe working conditions, establish robust health and safety protocols, equipment provision, and emergency response measures that meet national and international standards. Regular monitoring and evaluation are crucial; track inclusion metrics like local employment rates, access to services, and safety outcomes, with assessments to understand impacts on marginalized groups. The grievance mechanism should be accessible through multiple channels, such as in-person offices, online forms, and hotlines, with trained staff to handle sensitive issues. Publicize grievance resolutions to foster trust and adapt project activities based on feedback to continuously improve inclusion. These strategies will embed social inclusion and accountability across NSEZ operations, promoting equitable development and maximizing benefits for local communities, especially those that are vulnerable or marginalized.

8.5 Recommendation for the Integration of ES Policy/Principles in the Development Appraisal and Strategic Actions

Integrating environmental and social policies and principles into development appraisal and strategic actions is essential for ensuring sustainable and equitable outcomes. To integrate environmental and social policy principles effectively into the appraisal and strategic actions for NSEZ, the recommendations are as follows, but not limited to:

- Define clear environmental and social objectives that emphasize sustainable growth, resilience, and social inclusion in alignment with national and international standards.
- Incorporate Comprehensive Environmental and Social Impact Assessments (ESIA), including cumulative impacts, and develop Environmental and Social Management Plans (ESMPs) with mitigation measures and monitoring indicators.
- A risk classification system to guide due diligence and prioritize climate resilience to address environmental vulnerabilities should be implemented by NSEZ during the development and operation of NSEZ.
- Build internal expertise on environmental and social standards, provide training on ESF principles to NSEZ staff and stakeholders, and clarify roles in implementing safeguards.
- Establish monitoring and reporting protocols with quantitative and qualitative indicators, facilitate public access to E&S performance data, and adopt adaptive management practices based on feedback and new data.
- Incorporate Environmental, Social, and Governance (ESG) criteria into strategic planning and investment decisions to enhance sustainable development and accountability.
- Engage with all relevant stakeholders, including local communities, government agencies, and non-governmental organizations, to gather diverse perspectives and ensure inclusive decision-making.
- Foster partnerships between public, private, and civil society sectors to leverage resources, expertise, and networks for achieving ES goals.

8.6 Recommendations for Preferred Alternatives Considering E&S Aspects to Reach Ultimate Development Goal with the Public-Private Partnership Projects

Public-private partnerships can play a crucial role in achieving sustainable development goals by balancing environmental, social, and economic aspects. Some of the recommendations for preferred alternatives to consider include:

- A feasibility study of the PPP Project should be carried out, considering the issues, including environmental, social, technical, commercial, and financial considerations.
- Screening should be undertaken for the PPP projects and categorized following the procedure developed for the NSEZ, and the E&S instrument shall address the potential environmental difficulties associated with PPP development.
- All applicable national legislation, standards, and E&S guidelines of BEZA and the World Bank should be followed in all PPP Projects.
- Prioritize private sector expertise in sustainable technologies and green infrastructure for minimal environmental impact in the development and operation of NSEZ.
- Establish governance frameworks with joint oversight, regular impact assessments, and third-party audits for accountability.
- Involve local communities in decision-making processes to align the development of NSEZ with local needs, fostering support and minimizing resistance.
- Build capacity within both public and private sectors for managing environmental and social risks, in alignment with international best practices and the World Bank's standards.
- Investment in solar and wind power projects to reduce carbon footprints and promote clean energy.
- Implement recycling programs, waste-to-energy projects, and sustainable waste disposal methods to minimize environmental impact.

8.7 Measures for Monitoring the Implementation of PPPs

Monitoring the implementation of PPP is crucial to ensure that projects meet their objectives and deliver value for money. Identified measures for effective monitoring are as follows, but not limited to:

- Establish clear and measurable KPIs to track the progress and performance of the project under the provisions of PPP for NSEZ.
- Set up regular reporting and periodic performance reviews to track environmental, social, and financial milestones, allowing for adjustments or corrective actions as needed.
- Engage independent auditors to assess compliance with environmental, social, and governance standards and ensure transparency.
- A stakeholder engagement plan developed for NSEZ should be adopted by creating ongoing channels for stakeholder feedback, enabling communities, NGOs, and authorities to report concerns and ensuring prompt responses.
- Engage stakeholders, including local communities and civil society organizations, in the monitoring process to ensure transparency and accountability.
- Establishment of real-time monitoring digital tools, enabling quick identification of issues and corrective actions, should be ensured by NSEZ.
- Regularly check compliance with national regulations and international guidelines, ensuring adherence to environmental and social safeguards.
- Conduct periodic audits to assess long-term impacts and ensure the effectiveness of mitigation measures.
- Track and assess the effectiveness of environmental, social, and financial risk mitigation strategies, applying corrective measures as needed for NSEZ.

- Conduct periodic cost-benefit analyses to evaluate the financial viability and impact of the project.

8.8 Auditing Procedures/Monitoring Framework for Compliance with the Regional Environmental Management Plan

The effective implementation of a Regional Environmental Management Plan requires a robust auditing and monitoring framework to ensure compliance with environmental standards and regulations. This framework not only facilitates the assessment of ongoing environmental impacts but also ensures that mitigation measures are in place and functioning as intended. The auditing procedures are as follows, but not limited to.

- Develop clear and comprehensive auditing procedures to ensure compliance with environmental standards and regulations throughout the lifecycle of NSEZ.
- Establish key performance indicators to monitor and evaluate environmental performance, focusing on critical areas such as air quality, water management, and biodiversity conservation.
- Conduct routine audits that assess both immediate and long-term environmental impacts, including on-site inspections to ensure ongoing compliance and effectiveness of mitigation strategies.
- Engage independent third-party auditors to ensure objectivity, transparency, and adherence to international environmental standards.
- Continuously track the implementation and effectiveness of mitigation measures and take prompt corrective actions when necessary to address any compliance gaps or environmental risks.
- Implement real-time environmental monitoring systems to quickly detect and resolve any compliance issues, ensuring swift responses to potential environmental concerns.
- Actively involve local communities and stakeholders in the auditing process to ensure the environmental management approach is aligned with local priorities and concerns.
- Ensure strict compliance with regional and national environmental laws and regulations throughout all stages of the NSEZ.
- Regularly publish audit results and environmental performance reports to ensure transparency, build public trust, and maintain accountability to stakeholders.
- Use audit findings to continuously improve the environmental management plan, adapting strategies as necessary to address emerging environmental challenges and ensure long-term sustainability.

9 EXISTING LEGAL AND REGULATORY FRAMEWORK

This chapter describes the legal and regulatory framework relevant to the NSEZ development and operation, covering national environmental, social, land, labor and working conditions, health and safety legislation, ecology and biodiversity, disasters, climate change, power and energy, tourism, etc.

9.1 Gap and Recommended Changes in Existing Legal and Regulatory Framework

A gap assessment of the existing legal and regulatory framework applicable to the management of environmental and social issues during the development and operation of the EZ and necessary recommended changes in the regulations is provided in Table 9-1.

Table 9-1: Gap and recommended changes in existing legal and regulatory framework

Aspects	Act/rules/law/ordinance/policy	Recommended Changes ²⁷
Environment	Bangladesh Environment Conservation Act, 1995, and its amendments in 2000, 2002, and 2010	-
	Environment Conservation Rules, 2023	-
	Environment Court Act, 2010	-
	National Environment Policy, 2018	-
Air Quality and Pollution Control	Air Pollution (Control) Rules, 2022	Provision of Continuous Air Quality Monitoring Stations, specifically in the EZ and its adjoining areas. Incorporation of a representative from BEZA in the national committee related to air pollution control.
Noise and Vibration	Noise Pollution (Control) Rules, 2006	A national standard for vibration has not been formulated yet. Therefore, a vibration standard can be adopted following ISO 2631-1:1997, BS 6472: 1992, or any international standards/good practices.
Water Quality and Pollution Control	Environment Conservation Rules, 2023	-
	Bangladesh Water Act, 2013	-
	Bangladesh Water Rules, 2018	-
	National River Protection Commission Act, 2013	-
	Natural Water Reservoir Conservation Act, 2000	-
	National Water Policy, 1999	-
Soil and Sediment	-	A national standard for soil and sediment quality has not been formulated yet. Therefore, a soil

²⁷ Blank cells indicating no specific recommendations

Aspects	Act/rules/law/ordinance/policy	Recommended Changes ²⁷
Quality and Pollution Control		and sediment quality standard can be adopted following USEPA or any international standards/ good practices.
Ecology and Biodiversity	Biodiversity Act, 2017	-
	Wildlife (Conservation and Security) Act, 2012	Authorize all forest officers and designated personnel to enforce the Act. Include authority to arrest individuals suspected of wildlife crimes. Grant authority to the Coast Guard, BGB, Navy, and Fisheries officers to combat wildlife crimes.
	Protected Area Management Rules, 2017	-
	Ecologically Critical Areas Management Rules, 2016	-
	Marine Fisheries Act, 2020	-
	Protection and Conservation of Fish Act, 1950 and its amendment in 1982 and Rules, 1985	Clear definitions need to be developed for Maximum Sustainable Yield (MSY), fishing effort-MSY per type of 'Fishing Net'. Clear definitions need to be developed for Illegal Unreported and Unregulated (IUU) fishing.
	Forests Act, 1927, and its amendments in 1982, 1989, 2000, and 2018	Prioritize biodiversity and ecosystem conservation and promote the involvement of local communities. Introduce penalties for activities that threaten biodiversity, conservation of natural heritage, and ecosystems, such as noise pollution from tourism in the Sandwip Channel. Similarly, enforce strict punishments for illegal activities like unauthorized fishing in the Sandwip Channel and other harmful practices.
	Bangladesh Wildlife Conservation Master Plan 2015-2035	
Land Acquisition, Resettlement, and Compensation	Acquisition and Requisition of Immovable Property Act, 2017	The provision of compensation for the non-titled holders should be adopted.
Occupational Health and Safety	National Occupational Health and Safety Policy, 2013	-
	Bangladesh Labor Act, 2006 and amendments in 2013, Labor Rules, 2015	-
	Fatal Accidents Act, 1855	-

Aspects	Act/rules/law/ordinance/policy	Recommended Changes ²⁷
	Factory Act, 1965 and Factory Rule, 1979	-
	Boiler Act, 1923	-
	Explosive Act 1884	-
	Explosive Substance Act 1998	-
	Public Procurement Rule (PPR), 2008	-
	National Child Labor Elimination Policy, 2010	-
	Bangladesh Industry Policy, 2016	-
Community Health, Safety, and Security	National Health Policy, 2011	-
	National Policy for Safe Water Supply and Sanitation, 1998	-
	Bangladesh Penal Code	-
Waste Management	Solid Waste Management Rules, 2021	Incorporation of a representative from BEZA in the national committee related to solid waste management. Provision of an environmental assessment before the selection and development of a solid waste management facility, including a landfill site. Site selection criteria, operation, and standards for establishing a landfill site in coastal areas.
	Medical Waste (Management and Handling) Rules, 2008	-
	Hazardous Wastes and Ship Breaking Waste Management Rules, 2011 & amendment in 2012	-
	Hazardous Waste (E-waste) Management Rules, 2021	-
	National 3R Strategy for Waste Management, 2010	-
Disaster Management	Disaster Management Act, 2012	-
	Fire Prevention and Extinction Act, 2003, and Fire Prevention and Extinction Rules, 2014	-
	Bangladesh National Building Code, 2020	-
	Standing Orders on Disaster, 2019	-

Aspects	Act/rules/law/ordinance/policy	Recommended Changes ²⁷
	National Disaster Management Policy, 2015	-
Climate Change and GHGs	Bangladesh Climate Change Trust Act, 2010	-
	Ozone Depleting Substance (Control) Rules 2004 and amendments in 2014	-
	National Adaptation Plan of Action, 2009	-
	Bangladesh Climate Change Strategy and Action Plan, 2009	Adopt restrictions on the introduction of exotic species (particularly invasive alien species) in plantation programs undertaken as a climate change/GHG mitigation measure (i.e., to store carbon).
	Bangladesh Delta Plan, 2100	Plan implementation should ensure the adoption of environmental measures to minimize air, water, and land pollution arising from infrastructural development.
Power and Energy	Renewable Energy Policy, 2008	Promote non-grid and small-scale facilities with substantial incentives and capacity building. Promote waste-to-energy production technologies, especially solid waste management in the EZ area, in an environmentally friendly manner. Focus on solar power plants in the EZ area.
Tourism	National Tourism Policy, 2010	Address the extent of growth of mass tourism in the EZ surrounding area and restrictions that might be required to address environmental degradation and pollution control. Tourism-related infrastructure development in ecologically protected areas, protected areas, wildlife sanctuaries, water-stressed areas, etc., should be prohibited.

10 INSTITUTIONAL ARRANGEMENTS, ASSESSMENT, AND STRENGTHENING CAPACITY

10.1 BEZA's Institutional Arrangement

Bangladesh Economic Zone Authority (BEZA) was officially instituted by the government on 9 November 2010. BEZA aims to establish economic zones in all potential areas in Bangladesh to encourage rapid economic development through the increase and diversification of industry, employment, production, and export. BEZA is governed by a two-level management structure, i.e., Governing Board and Executive Board. The governing board is the highest body that undertakes overall policy decisions. The executive board is responsible for overseeing day to day operation of BEZA. BEZA has an approved staff strength of 130 officers and staff²⁸.

10.1.1 One Stop Service

Under the BEZA, the One Stop Service (OSS) Center was officially launched on 21 October 2019, as a single window for investors in the BEZA. By establishing OSS at BEZA HQ, investors have been relieved of visiting different ministries and departments to obtain required licenses and approvals. The officers from BEZA and concerned ministries/departments provide detailed consultation and information services to the investors from BEZA OSS and can organize required inspections for the investors before starting their business operation.

In partnership with 14 different ministries and departments, BEZA OSS offers a total number of 125 government services²⁹ including import permits, export permits, local sale and purchase permits, project clearance, NOC for bank loans, VISA recommendations, work permits, sale permits, manufacturing permits, building plan approval, utility connection, name clearance, certificate of incorporation/registration, TIN certificate, VAT registration, environment clearance, license for service providers, fire safety clearance, factory registration with DIFE, boiler registration, captive power plant (permission from DOE), customs clearance, sub-contract permit, NOC for an offshore banking license, permission for installation of WTP & ETP, permission for installation of generator, remittance clearance, request for utility connection, renewal of boiler registration, etc. Representatives from different ministries/departments/agencies are working in the OSS.

10.2 National Special Economic Zone

In the Project Implementation Unit of the NSEZ, there are nine officers including the Project Director, Deputy Project Directors, Assistant Project Directors, Executive Engineers, and Accounts Officer. In addition, twenty-eight project consultants including legal, investment promotion, procurement, IT, monitoring & evaluation, social specialist, financial management specialists, environment specialist, administrative support, occupational health & safety, procurement, social counselors, environment counselors, audit officer, engineers, estimator, draftsman, etc. are working³⁰. Allotted manpower for NSEZ (particularly for Mirsharai 2A and 2B Economic Zone) is shown in Table 10-1.

Table 10-1: Allotted Manpower for NSEZ (Mirsharai Economic Zone 2A & 2B)

S/N	Designation	Number of Manpower	
		Mirsharai 2A EZ	Mirsharai 2B EZ
1.	General Manager	1	1
2.	Manager	1	1

²⁸ <https://beza.gov.bd/about-beza/beza-management/>

²⁹ <https://beza.gov.bd/news/bangladesh-economic-zones-authority-beza-is-announce-the-official-inauguration-of-beza-one-stop-service-centre-oss/>

³⁰ https://NSEZ.gov.bd/?page_id=49

S/N	Designation	Number of Manpower	
		Mirsharai 2A EZ	Mirsharai 2B EZ
3.	Deputy Manager	2	2
4.	Assistant Engineer	1	1
5.	Accountant	1	1
6.	Assistant Manager	3	3
7.	Sub-Assistant Engineer	3	3
8.	Auditor	1	1
9.	Computer Operator	1	1
10.	Senior Assistant	1	1
11.	Assistant Accountant	1	1
12.	Office Assistant cum Computer Typist	2	2
13.	Task Assistant	2	2
14.	Office Assistant	3	3
Total		23	23

Source: BEZA, April 2024

10.3 Assessment of the Capacity of BEZA

10.3.1 Environmental and Social Management System

An environmental and social management system is a set of processes and practices that enable an organization to manage the impacts of its organizational activities on the environment and social issues, and also to increase its operating efficiency. It helps the organization to achieve its environmental and social goals through consistent control of its operations. The existing environmental and social management system of BEZA has been discussed below:

Environmental and Social Policy

Currently, BEZA's environmental and social compliances and obligations are guided by Chapter 10 (section 43) of Bangladesh Private Economic Zone Policy 2015 as well as Sections 33 and 34 of BEZA Act 2010. BEZA has also prepared a draft Green Zone Development Policy 2019 of BEZA. Based on the overarching policy and legal framework, EIA/ESIA studies are conducted as per national (Department of Environment) and development partners' requirements. Furthermore, staff/investors/contractors are made aware of their E&S due diligence through training.

Identification of Risks and Impacts

Identification of risks and impacts is done formally and informally by BEZA officials during project development as well as during execution. The formal process involves conducting EIA/ESIA studies as per GOB and development partner requirements.

Management Programs

BEZA currently has response procedures for E&S problems, action plans, and monitoring and review processes based on project-specific Environmental Management Plans (EMPs) to address E&S issues, for example, land acquisition and resettlement, occupational health and safety, resource efficiency, etc.

Organizational Capacity and Competency

BEZA has numerous staff and consultants who have day-to-day involvement in managing E&S risks and impacts. The main responsibility lies with the Project Directors, and they are supported by the Environment and Development Unit. Recently an Environment and Development Unit has been established by BEZA based on its HQ at Dhaka. The unit is under the planning and development wing and is responsible for environmental, social, health, and safety management. Presently, the unit consists of three officers i.e., Director, Deputy Director, and Assistant Director. To support the unit, seven environmental and social councilors are working in different economic zones in Bangladesh, and they are supporting the HQ team for environmental management, grievance, consultation with the community, implementation of CSR activities, etc.

Emergency Preparedness and Response

BEZA is in the process of developing a business continuity plan for economic zone operation during disasters under the national resilience program of the Ministry of Planning. Similar programs are also planned under the NSEZ of the World Bank. For individual economic zone development projects, there are also emergency response plans as part of the project environmental and social management plan.

Stakeholder Engagement

BEZA has prepared a stakeholder engagement plan under the Private Investment and Digital Entrepreneurship Project (PRIDE) project and identified the stakeholders in terms of project-affected people, other interested parties, and vulnerable groups. BEZA also conducts stakeholder consultation meetings in different economic zones. A grievance mechanism has already been established to address complaints and grievances throughout the lifecycle of the project. The grievance mechanism is intended to address issues and complaints in an efficient, timely, and cost-effective manner.

Monitoring and Review

The E&S team of BEZA reviews the E&S monitoring/reporting activities of Contractors and Consultants of each development project. The E&S team also provides feedback and takes follow-up measures when required. BEZA appointed environment and social counselors in different economic zones. These counselors are currently performing monitoring and review functions at the site level to ensure the smooth operation of the economic zone. BEZA conducts monthly coordination meetings where monitoring and review issues are raised.

10.4 Assessment of the Capacity of NSEZ

According to the review of the existing organogram of BEZA and NSEZ and discussion with the officials from the BEZA, it was realized that currently, NSEZ does not have permanent and dedicated staff responsible for environmental, social, health, and safety, etc. One environment specialist, one social specialist, and one occupational health & safety specialist/consultant are working under the Project Implementation Unit (PIU) of NSEZ at the head office on a contractual basis. In addition, three environmental and social councilors are working in NSEZ on a project-based contract under the Private Investment and Digital Entrepreneurship (PRIDE) Project of BEZA.

10.5 Current Environmental and Social Practices in NSEZ

A review of the current environmental and social practices of the existing and under-construction industries, such as collection, treatment, and discharge of wastewater, solid waste management, occupational health and safety, community health and safety, etc., has been carried out under the RESA. The review outcome is as follows:

Wastewater Management:

Currently, wastewater is managed by individual industries in their premises inside of the NSEZ. Industries already setup their Effluent Treatment Plants (ETPs) that are applicable based on the types/nature of industries such as Asian Paints and Modern Modern Syntex Ltd. to treat generated liquid waste. These industries are collecting and treating wastewater following the effluent treatment

water quality standards as mentioned in the Environment Conservation Rules, 2023. The regulatory agency, i.e., the Department of Environment (DOE) is ensuring the water quality by their quarterly monitoring activities. Day-to-day records of wastewater management are maintained by individual industries and the environment councilors of NSEZ/BEZA supervise the activity and collect monthly data for reporting purposes.

Solid Waste Management:

Currently, there are no centralized solid waste management facilities in NSEZ. A feasibility study is ongoing for the development of an effective waste management system including capacity development of the local municipal authority. Primarily individual industries are collecting and storing solid waste inside of their premises, then transferring to a designed site determined by NSEZ/BEZA authority for temporary solid waste disposal. Day-to-day records of solid waste management are maintained by individual industries and the environmental councilors of NSEZ/BEZA supervise the activity and collect monthly data for reporting purposes.

Occupational Health & Safety:

NSEZ adopted several proactive measures to ensure occupational health and safety (OHS) issues for workers and industrial staff across the zone. Medical services are readily available within the NSEZ through the deployment of a nurse and a doctor who provide immediate healthcare support in case of any health emergencies. Each industry within NSEZ employs its own Health and Safety Officer responsible for implementing and supervising workplace safety measures. In addition, the zone authority has engaged a dedicated OHS consultant to support industries in aligning with national OHS standards and improving overall safety performance. To strengthen emergency medical response, a memorandum of understanding has been signed with Chattogram Medical College, ensuring quick referral and treatment for workers requiring advanced medical care. Furthermore, the OHS aspects are periodically monitored by the NSEZ Counselor, who visits industrial units, checks compliance, and ensures that identified issues are addressed in a timely manner. These integrated efforts demonstrate NSEZ's commitment to maintaining a safe, healthy, and compliant industrial environment.

Community Health & Safety:

The current practices of NSEZ reflect a comprehensive approach aligned with the WB's ESS4 to safeguard community health, safety, and security throughout both the development and operational phases. To ensure the safety of infrastructure and equipment, all construction and industrial facilities within the zone adhere to the Bangladesh National Building Code. A robust three-tier grievance redress mechanism is in place, allowing affected individuals to raise concerns at the project level, zone level, and BEZA headquarters. All grievances are systematically recorded in a grievance register, and a functional Grievance Redress Committee, including female representatives, ensures inclusive and gender-sensitive resolution. To minimize community exposure to hazardous materials, industries within the zone operate functional Effluent Treatment Plants in compliance with national environmental regulations. Emergency preparedness and response systems have been established through coordinated planning with fire services, health authorities, and relevant security agencies. In terms of security, each industry maintains its own security arrangements, while Industrial Police are permanently deployed to manage labor issues, ensure order, and assist in emergencies. A Joint Task Force-comprising the Army, Coast Guard, and other relevant agencies stands ready to respond to serious incidents and maintain overall zone security. Moreover, NSEZ gives special consideration to ecosystem services and vulnerable groups, with tailored provisions to safeguard the livelihoods and resource access of fisherfolk and grazing communities.

10.6 Action Plan to Strengthen Staffing, Capacity, Systems, and Implementation

10.6.1 Establishment of an Environmental Laboratory

Considering the extent and diversity of the NSEZ, a full-fledged environmental laboratory equipped with ambient air, ambient noise, drinking/groundwater, wastewater, soil quality, and sediment quality monitoring systems should be established to ensure the proper environmental management in the NSEZ and the surrounding region. The monitoring and testing service shall focus on the parameters that are mentioned in the Environment Conservation Rules 2023 as well as international standards, i.e., WHO, IFC EHS Guidelines, USEPA, etc. To ensure smooth operation, staffing, and maintenance of the proposed laboratory, as well as to generate monitoring reports, at least two (2) lab technicians should be recruited in NSEZ for the first phase of development and operation. In addition, environmental safeguard specialists having a relevant educational background should be recruited in the NSEZ HSE team to ensure environmental monitoring and assist the laboratory team.

Basically, the NSEZ HSE team will supervise the monitoring of environmental pollution levels, viz. ambient air quality, surface water quality, groundwater quality, wastewater quality, noise level, solid waste management, biodiversity, health safety, emergency/disasters, grievance, etc., either departmentally or by appointing external agencies wherever necessary. Monitoring will also be done by individual industries, contractors, and subcontractors in line with regulatory compliance, so as to ensure that the pollution is limited to allowable values and to take corrective action by either providing new equipment or improving the performance of the pollution control equipment.

In case the monitored results of environmental pollution are found to exceed the allowable values, the HSE team will suggest remedial action and get these suggestions implemented through the concerned industrial authority. The actual operation and maintenance of pollution control equipment of each industry is under the respective industry head. The HSE team will also coordinate all the related activities, such as the collection of statistics on the health of workers and population of the region, afforestation, green belt development, etc.

10.6.2 Introduction of ESG Digital Tools in the Monitoring System

Environment, Social, and Governance (ESG) digital transformation is one of the most impactful concepts helping to shape modern business worldwide. Digital transformation refers to the integration of digital technology into all areas of business, resulting in profound changes to operations, culture, and customer value. It's not just about adopting new technologies but about fundamentally changing how businesses operate and deliver value. Adopting an ESG framework can have numerous benefits for businesses, including improved reputation, lower risk, lower cost, etc. Investors, consumers, and regulators are increasingly advocating accountability and transparency on these aspects nowadays. Meeting these rising expectations necessitates robust ESG reporting, and digital transformation is emerging as a powerful ally in this endeavor.

An ESG data management software is a tool that can be developed by BEZA, which will enable them to accurately, efficiently, and transparently track and report on their environmental, social, and governance performance in different economic zones as well as NSEZ. Digitalization can significantly improve operational efficiency, leading to a reduced environmental footprint. This digital tool will allow to the generation of reports based on specific parameters. These tools will make it easy to visualize and share data with their employees, customers, other stakeholders, and the general public. Graphs, charts, and dashboards can be easily generated using data visualization tools, which can then be shared with stakeholders. Analysis of ESG data over time, trends that point to areas for improvement, and use this information to make continuous improvements in ESG performance. These activities ultimately will have a positive impact on both society and the environment and lead to better changes for future generations.

10.6.3 Formulation of a Disaster Management Committee

The NSEZ site is located in a disaster-prone area in Bangladesh. Therefore, NSEZ shall constitute a Disaster Management Committee (DMC). The DMC will be the apex planning body and will play a major role in the preparedness and mitigation of any disaster in the NSEZ. The committee will have the following key functions:

- Preparation of a comprehensive disaster management plan for NSEZ and update the plan as and when required.
- Setting up the Emergency Control Centre (ECC) during emergencies.
- Coordination with the different Disaster Management Committees, including District, Upazila, and Union-level disaster management committees.
- Supervise emergency response measures in case of any emergency.
- Track of predictable natural hazard events such as floods, cyclones, earthquakes, tsunamis, tidal surges, etc.
- Organize training and capacity-building programmes on disaster management for individual establishments in the NSEZ.
- Periodic monitoring of emergency response plans and the corresponding procedures of individual establishments in the NSEZ.
- Prepare reports and documents on disaster events in NSEZ and preserve a copy of the report. The report should include, but not be limited to a) date and time of occurrence, b) source and cause of the disaster, c) description of the response efforts, d) recommendation for preventive & mitigation measures, and e) plan for upgrading emergency preparedness and response plan.

The DMC of the NSEZ shall have units/teams including a) a disaster monitoring unit to keep track of foreseeable hazards, b) a disaster/emergency response team shall advise the DMC to declare an emergency in the NSEZ, and c) training center for dissemination of information, organize capacity building training programs such as mock drills, and emergency evacuation procedures in industrial areas and residential areas.

An Emergency Control Centre shall be formulated in case of emergencies declared by the DMC. The ECC shall be chaired by the head of NSEZ and/or authorized representative and will have representatives from the Bangladesh Police, Fire Service and Civil Defense, Health Complex, Factory Inspectorate, local authorities/Upazila/District administration, utility providers, and investor association.

10.6.4 Capacity Building/Strengthen Staffing

NSEZ will ultimately be responsible for the management and supervision of all activities during the development of the EZ and will have principal responsibility for implementing environmental and social management plans and mitigation measures. However, investors/plot owners will be responsible for each specific development and operation inside of the EZ.

Environmental and social management of the NSEZ requires a multidisciplinary approach with consolidated and coordinated efforts from a number of agencies/departments/authorities. Various institutions/departments will be involved during the development and operation of the EZ. The investors and appointed contractors will also be responsible for the monitoring and implementation of the environmental and social management plan of individual projects/investments in the NSEZ during development activities in the EZ, and also reporting the progress to the NSEZ through individual project owners/investors.

During operation, NSEZ will be responsible for ensuring all companies abide by operational-level environmental and social management and monitoring plans for NSEZ. However, the investors/plot owners must comply with the environmental and social management plan developed as part of the unit-specific environmental assessment and the guidelines set by NSEZ.

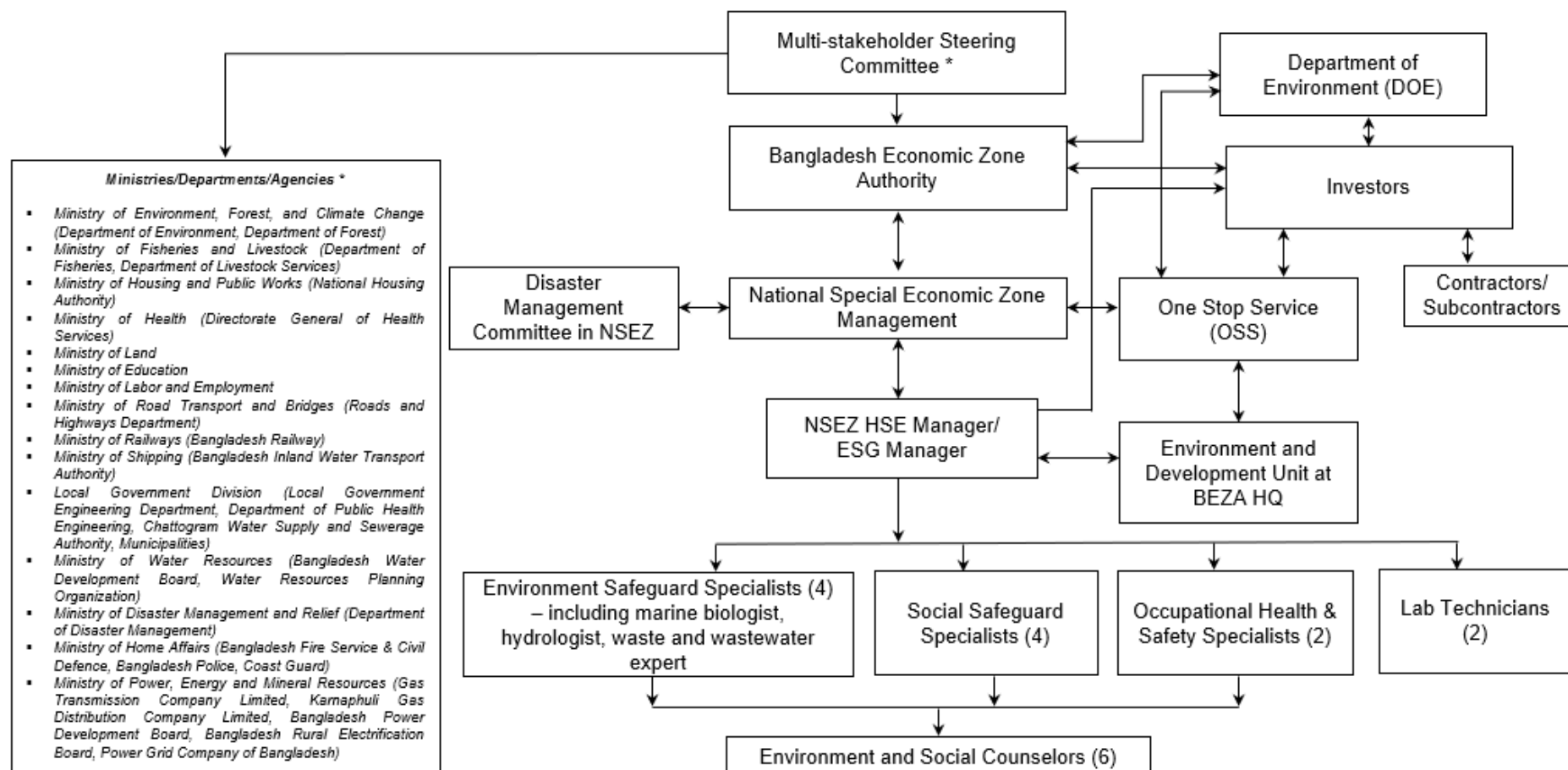
NSEZ is committed to providing resources and establishing the systems and components essential to the implementation and control of the environmental and social management and monitoring plan. These include appropriate human resources and specialized skills, training programmes, communication procedures, documentation control, and a procedure for the management of change. NSEZ will support the process and have an HSE team with competent staff on the basis of appropriate education, training, and experience. For the first phase, one HSE Manager/ESG Manager, two environment safeguard specialists, four social safeguard specialists, two occupational health and safety specialists, two lab technicians, and six environment and social counselors are to be recruited for NSEZ.

to ensure the overall environmental, social, and health and safety risk management. They will be responsible for implementing environmental, social, gender, land acquisition, compensation, resettlement, grievance management, stakeholder engagement plans, etc. They will need to raise their capacity to perform their safeguards responsibility, and for quality assurance, supervision, and monitoring.

10.6.4.1 Propose Organogram for EHS Management

An organogram of the proposed HSE team for managing regional environmental and social issues has been given in Figure 10-1.

Figure 10-1: Proposed HSE Team



10.6.4.2 Roles and Responsibilities

The effective implementation of the regional environmental and social management and monitoring will be dependent on established and clear roles, responsibilities, and reporting lines within the NSEZ organizational structure, as well as other departments/agencies working in the region. The organizational structure for regional environmental and social management is defined below. The structure will be maintained throughout the development and operation phases, whilst being reviewed on a regular basis to adapt the structure as necessary. The key roles and responsibilities of different stakeholders are provided in Table 10-2.

Table 10-2: Roles and Responsibilities

Role	Overall Responsibilities
BEZA HQ	- Multi-stakeholder steering committee shall be established under the leadership of BEZA. - Organize quarterly or half-yearly meetings with other stakeholders (ministries/departments/agencies) working in the region to get the progress of the activities performed by other stakeholders. - Ensure environmental and social safeguard compliance in NSEZ. - Review and clear all E&S safeguard documents prepared by investors. - Guide NSEZ for the successful implementation of ES management plans. - Review the progress of the development and operation of NSEZ. - Coordinate with other ministries/departments/agencies as and when required.
OSS at BEZA HQ	- Assist investors in completing the screening procedures with the help of the environment and development unit of BEZA HQ and the NSEZ HSE team. - Submit environmental and social safeguard documents/reports that will be prepared by the investors, considering the category of the project. - Communication with DOE and assisting investors in getting environmental permits from DOE.
Other Ministries/ Departments/ Agencies in the region	- Participate in multistakeholder steering committee meetings that will be organized by BEZA. - Preparation of regional monitoring plans and ensuring their implementation. For example, the fisheries department shall prepare a regional fish monitoring plan to monitor the species diversity, production, extinction, impacts, etc., and implement the monitoring plan accordingly. BWDB shall prepare a regional drainage management plan considering the NSEZ and other development activities in the region and ensure the implementation and monitoring as will be suggested in the regional plan. - Relevant Ministries/Departments/Agencies shall provide the necessary permits/approvals/licenses and advisory services to the NSEZ. - Coordination meetings with the NSEZ management as well as the HSE team regarding their activities. - Monitoring and periodic inspection of their implementation activities and plans/programs.
NSEZ Management	- Attend the multi-stakeholders' steering committee meeting and share the progress of the development and operation of the NSEZ. - Allocate necessary resources, time, and budget for the achievement of environmental and social management requirements.

Role	Overall Responsibilities
	• Designate specific personnel on-site or at the administrative level, and clearly define their roles and responsibilities within the environmental and social management system. • Review of regular internal environment and social performance reports. • Timely completion of mandatory training related to HSE issues. • Encourage and respond positively to observations related to environment and social management, and suggestions for improvements from personnel. • Always engage with the local communities and relevant government authorities/departments/institutions professionally and positively. • Participate in internal and external audits. • Recognize and reward good behaviors by personnel at all levels.
Department of Environment (DOE)	• Attend the multi-stakeholder steering committee meeting to get the overall implementation progress of different activities/projects in the region. • Share any concerns, issues/problems in the meeting to inform other stakeholders by providing advice or taking direct action to prevent degradation of the environment. • Review and provide approval or issuance of improvement comments on the project environmental assessment report. • Issue the environmental clearance certificate and the associated conditions. • Monitor all environmental issues to assess any possible changes in the environment and their possible impacts on the region. • Monitor the EZ operational activity to determine its immediate and long-term effects on the environment. • Routinely monitor the environmental and social management plan, certificate/license conditions compliance, and issuance of compliance notes or stoppage, or improvement orders to the project. • Carry out site inspection to ensure compliance with the environmental clearance certificate conditions of approval, and monitor the effects on the environment of any activities carried out on the premises. • Renewal of environmental clearance certificate for individual industries. • Preparation and implementation of regional environmental and social management plans regarding air, noise, and water quality.
NSEZ HSE Manager/ESG Manager and Other Specialists, Counselors	• Assist the OSS team at BEZA HQ regarding the screening and safeguard report review that will be prepared by the investors to get permits from DOE. • Ensuring that the environmental and social management plans prepared are up to date. • Ensure compliance with all relevant legislation as well as adherence to all environmental and socio-economic mitigation measures specified in the individual industries' ES management plans. • Undertake scheduled site supervision/audit to determine the state of environmental and social compliance in the NSEZ region. • Review the project activities, methodologies, and plans in relation to the requirements of the mitigation and management measures of environmental and social management plans. • Collect, organize, and review monitoring data and performance monitoring reports provided by the contractor(s), investors, and provide summary

Role	Overall Responsibilities
	results of such reports to NSEZ management, BEZA HQ, and other stakeholders. • Monitor the environmental and social aspects, especially during the development phase, to ensure that the environmental and social requirements of the contract and the mitigation measures proposed in the ES management plans are implemented. • Monitoring of operational activities of the industries/investors in the NSEZ.
Investors/Plot Owners	• Prepare and submit the screening form to the OSS at BEZA HQ for categorization of the project. • Prepare and submit an environmental assessment report to DOE through OSS at BEZA HQ based on the category of the project, which includes the plan for environmental management, mitigation measures, and monitoring to be conducted, for its business operation. • Obtain approval of the environmental clearance certificate from DOE before commencing the construction works at the project site. • Implement environmental mitigation measures and submit of monitoring report to the NSEZ management/HSE team in accordance with the submitted management plans.
Contractor(s) and subcontractor(s)	• Preparation and implementation of the Construction Environmental and Social Management Plan. • Responsible for ensuring compliance with all relevant legislation as well as adherence to all environmental and socio-economic mitigation measures specified in the environmental and social management plan. • Ensuring that all environmental monitoring data is made available at regular intervals and that any divergences from performance standards will be fully explained, together with any necessary preventative measures. • Recruit qualified environmental, social, and health and safety specialists to develop and enforce environmental, social, safety, and health precautionary measures for both the workers and the community at large. • Appoint a Community Liaison Officer to bridge the gap between the contractor and the community and coordinate grievance redress to ensure community concerns are addressed. • Day-to-day monitoring of environmental matters - this will include wider environmental and social aspects, including matters not directly concerned with the actual construction. • Preparation of weekly and monthly environmental inspection and monitoring reports in a format acceptable to investors and NSEZ. • Undertake mainstreaming of gender issues into the entire project, including but not limited to work placements, tools and fixtures, sanitary utilities, creating awareness on sexual harassment, and any other forms of discrimination based on gender, ethnic background, and race. • Ensure that all workers are provided with appropriate PPEs and further always enforce their use.
Disaster Management Committee	• Preparation of a comprehensive disaster management plan for NSEZ and update the plan as and when required. • Setting up the Emergency Control Centre (ECC) during emergencies. The ECC shall be chaired by the head of NSEZ and/or authorized representative and will have representatives from the Bangladesh Police,

Role	Overall Responsibilities
	Fire Service and Civil Defense, Health Complex, Factory Inspectorate, local authorities/Upazila/District administration, utility providers, and investor association. • Coordination with the different Disaster Management Committees, including District, Upazila, and Union-level disaster management committees. • Supervise emergency response measures in case of any emergency. • Track of predictable natural hazard events such as floods, cyclones, earthquakes, tsunamis, tidal surges, etc. • Organize training and capacity-building programs on disaster management for individual establishments in the NSEZ. • Periodic monitoring of emergency response plans and the corresponding procedures of individual establishments in the NSEZ. • Prepare reports and documents on disaster events in NSEZ and preserve a copy of the report. The report shall include, but not be limited to a) date and time of occurrence, b) source and cause of the disaster, c) description of the response efforts, d) recommendation for preventive & mitigation measures, and e) plan for upgrading emergency preparedness and response plan.

10.6.5 Capacity Building Training

To help build the institutional capabilities of NSEZ and different agencies or bodies that will be involved in the implementation of different environmental and social management plans, different areas of capacity enhancement have been recommended as part of the training program. A list of proposed capacity-building training programs that can be organized for different stakeholders based on their requirements:

- National legislation related to the environment, social, waste management, labor, occupational health and safety, land acquisition and resettlement, biodiversity management, cultural heritage, Indigenous community, and others.
- Introduction to WB ESS1-10 under WB ESF
- Labor and working conditions
- Occupational health and safety
- Community health and safety
- Stakeholder engagement plan and implementation
- Preparation of IEE, EMP, ESIA, RPF, LRP, RAP, etc.
- ESMP compliance monitoring and audit, and reporting
- Efficient use of resources and prevention of pollution
- Emergency procedure and response
- Solid and liquid waste management
- Industrial waste management
- Wastewater treatment technology and reuse
- Terms and conditions of employment according to national working laws and regulations, Contractor and sub-contractor Codes of Conduct
- Worker's organizations
- Workplace risk management
- Prevention of accidents at work sites
- Incident causation, investigation, and reporting
- HSE induction/orientation course (site safety rules, PPE requirements, Emergency Preparedness and Response)
- Daily toolboxes talk for workers at the start of each day's job
- Refresher HSE courses as required
- First aid training (for site first aiders)
- Safe driving techniques (for drivers)
- Grievance redress mechanism
- Raising awareness and measures to prevent and mitigate GBV risks

- Sensitization and awareness raising on HIV/AIDs, STIs, harassment, sexual behavior, GBV, etc.
- Labor influx management
- Child labor and minimum age employment rules
- Effective communication
- Conflict management
- Accident/incident reporting
- Community skill development training
- Other issues to be determined.

To ensure effective implementation of ESHS management in NSEZ, a phased approach will be adopted for recruiting an HSE team, establishing systems, and providing capacity-building training (Table 10-3). The HSE team will supervise environmental monitoring, social safeguards, occupational health and safety, and disaster management. Capacity building will be continuous, ensuring that all team members, contractors, and investors comply with regulatory requirements, WB ESS, and international best practices.

Table 10-3: Phased Capacity Building, HSE Team Recruitment, and Training Plan

Intervention/ Component	Description	Phase / Year	Responsible Party
HSE Team Recruitment	Recruit core HSE staff: HSE Manager/ESG Manager, environmental specialists, social specialists, OHS specialists, lab technicians	Phase 1 (Year 1–2)	NSEZ Management/ BEZA
Expansion of HSE Staff	Recruit additional specialists as NSEZ expands; include disaster management, lab technicians, and monitoring staff	Phase 2–3 (Year 3–10, Year 11–20)	NSEZ Management/ BEZA
Environmental Laboratory Setup	Establish full-scale lab for air, water, soil, noise, and sediment monitoring; recruit lab technicians	Phase 1 (Year 1–2)	NSEZ HSE Team
ESG Digital Tool Implementation	Develop and integrate ESG monitoring software for data collection, visualization, and reporting	Phase 1–2 (Year 1–5)	NSEZ HSE Team & IT Department
Disaster Management Committee (DMC)	Form DMC, develop disaster plans, establish Emergency Control Centre, conduct mock drills	Phase 1 (Year 1–2)	NSEZ Management, Local Authorities
Capacity Building – Core HSE Team	Training on WB ESS1-10, environmental and social safeguards, OHS, labor influx management, community engagement, waste management, emergency response	Phase 1–3 (Continuous)	NSEZ Social Safeguard & HSE Team
Capacity Building – Investors / Contractors	Induction and refresher training on EHS standards, grievance management, GBV/SEA/SH awareness, labor and workplace regulations, accident/incident reporting	Phase 1–3 (Continuous)	NSEZ HSE Team, Contractors
Community and Stakeholder Training	Workshops on health, safety, disaster preparedness, GBV awareness, and environmental protection	Phase 1–3 (Continuous)	NSEZ Social Safeguard Team, NGOs
Monitoring and Reporting System	Establish documentation, incident reporting, and adaptive management procedures; maintain hard and soft copies, cloud backup	Phase 1–3 (Continuous)	HSE Manager/ESG Manager

Intervention/ Component	Description	Phase / Year	Responsible Party
Auditing and Review	Internal and external audits of environmental and social management performance; periodic review and adaptive updates	Phase 2–3 (Year 3–10, Year 11–20)	NSEZ HSE Team, External Audit Firms

10.7 Communication

NSEZ will maintain a formal procedure for communications with the regulatory authorities, i.e., DOE and communities. The HSE Manager/ESG Manager will be responsible for the communication of EHS issues to and from regulatory authorities whenever required.

The following communication level can be distinguished regarding the NSEZ.

- Internal communication among various levels and functions of the NSEZ/BEZA.
- Internal communication among the various parties/investors is involved in NSEZ.
- Relevant communication from external interested parties related to ES issues.

Meetings should be held, as required, between NSEZ and the appropriate regulatory authorities and community representatives to review EHS performance, areas of concern, and emerging issues. Dealing will be transparent, and stakeholders should have access to personal information to address concerns raised.

10.8 Monitoring and Reporting Procedures

During the implementation of the NSEZ, management shall designate an HSE team that will visually assess the contractor's practices. If high pollutant levels are observed, then they will instruct the individual industry/contractors/subcontractors to make necessary corrections immediately. Photographic records will be established to provide useful environmental monitoring tools. A full record shall be kept as part of normal contract monitoring and shared with the NSEZ HSE team. All the records shall be kept in the NSEZ office and shall be backed up at several locations, including secure cloud storage facilities. Records will be kept in both hardcopy and softcopy formats. The HSE manager/ESG manager of the NSEZ shall be responsible for maintaining a master list of applicable EHS documents and making sure that this list is communicated to the appropriate parties. The HSE manager/ESG manager shall be responsible for providing notice to the affected parties of changes or revisions to documents, issuing revised copies, and checking that the information is communicated within that party's organization appropriately.

All applicable regulations will be enforced by the NSEZ management and designated staff of the HSE team. Under environmental law, water quality discharge standards, air pollution emission standards, and noise standards have been established. It is a legal obligation of the individual industry/contractors/subcontractors that any discharges from the work sites meet these standards. The contractors/subcontractors will be required to develop a system for maintaining and controlling their own EHS documentation and describe these systems in their respective EHS plans.

10.9 Incident Reporting System

The purpose of the procedure will be to ensure all incidents and accidents involving contractor(s)/subcontractor(s), workers, visitors, local community, property, and activities are reported, investigated, and recorded.

The NSEZ HSE team will look after the overall incidents and accident records on the NSEZ site. The individual industry shall deploy one Health and Safety Officer to facilitate and coordinate the reporting, recording, and investigation of all occupational health and safety incidents by:

- Receive all notifications of incidents/accidents and ensure proper response is being followed, including reporting, investigations, and review.

- Once aware of an emergency, the actions should be taken, i.e., contact or communicate with the emergency control centre of the NSEZ and site manager, coordinate activities of all personnel in the ECC and monitor its effectiveness, coordinate the activities of all personnel in the ECC and make further directions as required by the situation, etc.
- Maintain the NSEZ emergency response plans and associated processes.
- Display names and contacts of personnel to be reached out to in case of emergencies.
- Keep a record of incident reports and actions being taken to prevent recurrence.
- Coordinate training requirements for the emergency response team and all other site personnel.
- Ensure that adequate emergency response information and instructions are provided in training and inductions.
- Undertake planned inspections to ensure emergency response equipment and facilities are complete.

10.10 Auditing of Regional Environmental and Social Management Plan

Regular internal audits as well as environmental and social monitoring shall be carried out by individual industries, contractors, and subcontractors in order to evaluate the performance of the environmental and social management plan. A copy of the audit report shall be shared with the NSEZ HSE team.

NSEZ HSE team will prepare environmental and social monitoring reports twice a year regarding the management of environmental and social issues. In addition, they may conduct an annual audit on the regional environmental and social components. An external firm/third party also may be engaged to perform the annual audit.

10.11 Managing Changes to the NSEZ Activities

Changes in the NSEZ may occur due to unanticipated situations. Adaptive changes may also occur during the course of the NSEZ life cycle. NSEZ will implement a formal procedure to manage changes in the EZ that will apply to all activities. The objective of the procedure will be to ensure that the impact of changes on the worker's labor and working conditions, the environment, and the communities' socio-economic conditions are identified and assessed prior to changes being implemented.

The management of the change procedure will ensure that:

- Proposed changes have sound technical, safety, environmental, and commercial justification.
- Changes are reviewed by competent personnel, and the impact of changes is reflected in documentation, including operating procedures and drawings.
- Hazards resulting from changes that alter the conditions assessed in the RESA will be identified and assessed, and the impact(s) of changes that do not adversely affect the management of health, safety, or the environment.
- Changes are communicated to personnel who are provided with the necessary skills, via training, to effectively implement changes.
- The appropriate person accepts the responsibility for the change.

As information regarding the uncertainties becomes available, the NSEZ environmental and social management plan/procedure will be updated to include that information in subsequent revisions. Environmental and social assessment, as well as engineering feasibility and cost considerations, will be taken into account when choosing between possible alternatives.

11 CONCLUSIONS AND RECOMMENDATIONS

11.1 Conclusions

The EZ proposed by the BEZA has strategic value on many fronts. As Bangladesh believes that the establishment of industrial zones throughout the country will contribute to the development of the national economy, it could also be said that the Project is strategic in the economic sense. The Project will contribute to the economic development of the Chattogram region as well as the economic development of the country. The EZ will seek to develop the socio-economic conditions of the people living in the region. There is no denying that, once the Project is implemented, it will substantially enhance international trade. It also has the huge potential of attracting investors from inside and outside the country by establishing a favorable investment environment. At the micro-economic level, the EZ will promote entrepreneurship and create job opportunities.

In terms of the physical environment, most of the impacts could be controlled and limited in and around the project area. Major negative impacts, such as but not limited to air pollution, surface water, groundwater contamination, solid and liquid waste generation and disposal, dredging and disposal activities, and traffic flow, are expected for EZ master plan implementation. However, the implementation of appropriate mitigation and management plans will minimize these impacts. In terms of the biological environment, the major negative impact is the clearance of existing vegetation, impacts on marine mammals and fish due to dredging activities, though no protected areas are involved. However, the implementation of appropriate mitigation measures, such as creating green areas inside and outside of the EZ and keeping the existing environmental conditions as much as possible, will minimize the impact on the ecosystem. In terms of the social environment, the existing social infrastructures and services, living and livelihoods of the fisherman and livestock-dependent community, risks for infectious diseases, traffic, occupational health and safety, and community health and safety are expected. However, the implementation of appropriate mitigation and management plans, such as managing working conditions during the construction work, providing security, and maintaining safety prevention measures during EZ master plan implementation, will minimize these impacts.

On the other hand, some positive impacts of the EZ, such as an increase in job opportunities and improvement of social infrastructure, are also expected. There are no land issues for the project and the community living in nearby villages are pleased to see the project implementation as early as possible. They would like to get employment in the EZ. Cumulative impacts could be expected on land use changes, topography and drainage, air quality, water quality, mangroves, aquatic and marine fauna, livelihoods, community health and safety, and social wellbeing due to the different activities of EZ in the surrounding area. The cumulative impacts typically result from the actions of multiple stakeholders; it is necessary to engage with these stakeholders for effective collaboration and coordination.

Individual industries/investors in the EZ will carry out environmental assessments and or environmental management plans, including adequate mitigation measures and monitoring plans to reduce the negative impacts and consider necessary budget allocation for the industry. It should be confirmed that the environmental and social impacts of the industry are adequately assessed in the report, and the ES risk management strategy are formulated properly. In the process of environmental assessment, an opportunity for public involvement should be ensured, and comments from the public and DOE will be reflected in the report. Thus, the environmental assessment will be completed in accordance with the requirements of the environmental assessment procedure properly for the project proponent to follow the EMP accordingly.

Individual investors will be required to obtain a No Objection Certificate/approval/license/permission from relevant departments/authorities as per their nature of work. BEZA, through their One Stop Service (OSS), may guide/support in obtaining NOC/approval/license/permission. It may be concluded that if proper mitigation measures are implemented, the EZ would cause the least effect on the area's existing environmental and social setting. On the other hand, it is expected that the EZ will generate a large

number of employment opportunities for the residents of the region, as well as other regions of the country and abroad.

11.2 Recommendations

The following is a highlight of some of the key recommendations of this RESA report:

- To mitigate air pollution, a regional air quality monitoring program needs to be established. NSEZ management through BEZA HQ in collaboration with DOE may establish a continuous air quality monitoring station in the region. Based on the review of regional monitoring data, DOE shall need to consider appropriate steps to regulate industries by linking it with the issue of Environmental Clearance or decisions about new industries in the region.
- To mitigate water pollution, regional water quality monitoring needs to be prepared and implemented. NSEZ management through BEZA HQ in collaboration with DOE shall establish an integrated continuous and online base monitoring system at the CSTPs and CETPs outlet for water quality monitoring.
- Regular monitoring of groundwater tables in the region should be ensured, and permission should be taken from WARPO for the abstraction of groundwater. In addition, a groundwater quality monitoring program should be established particularly for landfill sites.
- Segregation of solid waste at sources is strongly recommended and all waste management should comply with the requirements of the Solid Waste Management Rules 2021. The solid waste incinerator should be designed and operated following the operating standards mentioned in the Solid Waste Management Rules 2021. Medical and solid waste management systems should be established in coordination with municipalities and medical institutions or licensed vendors. An integrated solid waste management system shall be developed and established for the EZ.
- Fully functional and cost-effective central wastewater treatment plants are recommended. The treated water must meet the standards as mentioned in the ECR 2023 and ensure reuse to a maximum extent to reduce the volume of water consumption and wastewater. Installation of a surveillance system with industrial-grade internet protocol cameras having pan tilt zoom with leased line real-time connection for data streaming and transmission of same is recommended.
- Develop a land use plan for the region, considering future industry development and induced development, and ensure phase-wise development, after the completion of one phase, and develop the next phase of land.
- Construction of green structures, use of climate-friendly construction materials, renewable energy, electric vehicles, adoption of carbon trading for high-emission industries, and emission monitoring for the industries.
- To protect terrestrial and mangrove flora, BEZA allocated 13,646.28 acres (40.37%) of land as mangrove, green areas, vegetation, and open spaces to maintain native habitats and ecological balance within the EZ.
- To protect wildlife, preserve forest habitat, reforest open spaces, limit night-time construction, control noise and light pollution, and develop wildlife corridors. Protect Important Bird Areas and migratory routes. Relocate vulnerable species proactively and manage waste to deter opportunistic species.
- To protect dolphins and hilsa fish, restrict dredging and construction during peak spawning and migration periods, enforce noise reduction measures, manage runoff and pollution, and protect hilsa spawning grounds in the Sandwip Channel.
- EZ area is vulnerable to various natural disasters, including cyclones, tidal surges, earthquakes, floods, etc. Therefore, it is recommended to establish an emergency control center under a disaster management committee to monitor and manage natural disasters in EZ and maintain coordination with other emergency response teams. A green belt development is strongly recommended outside of the existing super dike to protect the super dike as well as EZ from severe cyclones and associated tidal surges.

- NSEZ management through BEZA HQ, in collaboration/technical input from BWDB, shall prepare a regional drainage management plan and monitor the function of drainage in the region specifically before the monsoon, and take precautionary measures to reduce floods and waterlogging.
- Compensation for the land, loss of income, and other investment losses as per the national legislation and WB ESSs.
- A livelihood restoration plan should be developed and adopted for the fishermen and livestock-dependent communities.
- A township development for the workers in collaboration with NHA, considering the distance between the living and working sites.
- Currently, the available social infrastructure of the region is not enough to meet the needs of existing communities. Therefore, it is recommended to develop infrastructures including educational institutes, medical facilities, roads, drainage and culverts, waste management facilities, graveyards, playgrounds, community centers, recreational facilities, police stations, fire services, etc., phase by phase in coordination with relevant government agencies and ministries, and local government institutions.
- Considering the environmental and social risks and impacts assessment, the following improvement of the NSEZ Master Plan is required:
 - Utility demands, including water, gas, power, etc., should be revised considering the detailed assessment, and phase-wise development should be preferred.
 - One tourist spot, namely Guliakhali Sea Beach, falls within the master plan boundary; therefore, the master plan boundary should be revised by excluding the tourist spot.
 - According to the Master plan, measures for earthquakes have been proposed considering Bangladesh National Building Code (BNBC) 2015. However, this has been updated therefore the updated BNBC 2020 needs to be adopted for the infrastructure development in EZ.
 - Provision for fishermen shall be considered, including a shelter house for the fisherman to park their boats outside of the Super Dyke and protect boats from Cyclones and associated tidal surges.
 - Provision for the livestock-dependent community regarding the alternative grazing land and access to the Sandwip Channel.
- Based on the assessment, ES risk management measures have been provided to mitigate the environmental and social impacts in the region. Considering the ES risk management mitigation measures and monitoring requirements, BEZA should develop environmental and social management plans including but are not limited to air quality management plan, noise level management plan, waste management plan, drainage management plan, traffic management plan, biodiversity management plan, livelihoods restoration plan, grievance management plan, etc., and clauses incorporating necessary terms and conditions in the land lease agreement with investors as well as developers.

Investors, contractors, and subcontractors should take care of the local community and its sensitivity toward local customs and traditions. Environmental and social management measures proposed should be implemented in the true spirit. To address these issues formulation of laws and changes in future plans of the relevant district and upazila administrations will be required. Therefore, it is suggested that BEZA, as well as NSEZ management, should coordinate with the relevant district and upazila administration of Feni and Chattogram Districts, along with the departments/agencies/institutes/authorities related to all stages of the EZ master plan implementation. This will provide awareness of issues to be dealt with by relevant government departments and administration. This coordination will help relevant authorities develop their future strategies proactively to address the anticipated issues likely to arise in the EZ region.

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