

Government of People's Republic of Bangladesh
Ministry of Water Resources



BANGLADESH WATER DEVELOPMENT BOARD

**Bangladesh Sustainable Recovery, Emergency Preparedness
and Response Project (B-STRONG)**



Environmental and Social Impact Assessment (ESIA) Report

November 2025



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ACRONYMS AND ABBREVIATION

BMD	Bangladesh Meteorological Department
BWDB	Bangladesh Water Development Board
CBAECA	Community Based Adaptation to Climate Change through Biodiversity
CCTF	Climate Change Trust Fund
CIIA	Cumulative and Induced Impact Assessment
CMP	Conservation Management Plan
CWBMP	Coastal and Wetland Biodiversity Management Project
DO	Dissolved Oxygen
DoE	Department of Environment
ECA	Ecologically Critical Area
ECC	Environmental Clearance Certificate
ECR	Environment Conservation Rules
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Monitoring Plan
FGD	Focus Group Discussions
IEE	Initial Environmental Examination
IUCN	International Union for Conservation of Nature
KII	Key Informant Interviews
NOC	No Objection Certificate
PRA	Participatory Rapid Appraisal
SCC	Site Clearance Certificate
SEP	Stakeholder Engagement Plan
SIA	Social Impact Assessment
TDS	Total Dissolved Solid
TSS	Total Suspended Solid
UNDP	United Nations Development Program
VESC	Valued Environmental and Social Component
WARPO	Water Resources Planning Organization
WB	World bank

CHAPTER-1: EXECUTIVE SUMMARY

1.1 Project Overview

In August 2024, Bangladesh faced its worst flooding in decades due to heavy monsoon rains and upstream water releases, affecting over 5.8 million people across 11 districts. The disaster resulted in significant loss of life, extensive infrastructure damage, and widespread disruption to daily life and economic activities. In response, the Bangladesh Water Development Board (BWDB), with financing from the World Bank, has proposed an emergency flood response project aimed at rehabilitating flood and erosion protection structures in the five affected districts, namely Noakhali, Brahmanbaria, Cumilla, Feni and Lakshmipur.

The project activities include riverbank protection works, rehabilitation of embankments and water control structures as well as khal/canal excavation in response to the damages due to devastating flood in August 2024 and protect the infrastructure from future floods. The proposed interventions of the project are highlighted in **Table 1-1**.

Table 1-1: Proposed project interventions

Interventions	Unit	Quantity in individual district					Total
		Feni	Noakhali	Cumilla	Laxmipur	Brahmanbaria	
Permanent bank protection works	km	3.14		2.40		0.25	5.79
Precautionary bank protection works	km	10.13	9.85		10.40		30.38
Slope protection works	km			2.555			2.56
Permanent bank and slope protection works	km					1.13	1.13
Regulator repair	No.	20.00			1		21
Repair of Embankment	km	24.55		46.00		2.00	72.55
Khal re-excavation	km			7	12.6		19.60

Project Activities and Phases

Pre-construction Phase

- Geotechnical investigation at the river bank protection and slope protection work sites;
- Carrying out surveys for identifying the correct chainage of rehabilitation embankment, and repair regulator site;
- Site preparation, labor shed construction including toilets and material stockyard;
- Mobilization of equipment and construction material and placing in stockyard;
- Mobilization of labor forces;
- Installation of awareness and information billboards at project sites;

Construction Phase

- Permanent riverbank protection works (5.79 km) in Feni, Cumilla, and Brahmanbaria;
- Precautionary bank protection works (30.38 km) in Feni, Noakhali, and Lakshmipur;
- Slope protection works (2.56 km) in Cumilla and combined bank-slope protection (1.13 km) in Brahmanbaria;
- Repair of 21 existing and damaged regulators, mainly in Feni and Lakshmipur;
- Rehabilitation of 72.55 km of embankments, especially in Cumilla, Feni, and Brahmanbaria;
- Re-excavation of 19.60 km of khals in Cumilla and Lakshmipur for drainage improvement;
- Compliance with environmental, social requirements and occupational health and safety standards during all field operations.

Post-construction Phase

- Routine maintenance of rehabilitated embankments, excavated khals, and slope protection works;
- Operational maintenance of repaired regulators;
- Periodic inspection of protective works (as applicable to project scope);
- Monitoring environmental recovery and hydraulic efficiency of interventions;

Most of the sites are located on BWDB land. However, at some points BWDB land/ original embankment may have been eroded, potentially affecting private land. No land acquisition would be required in Cumilla District as the entire alignment is already acquired. Additionally, no new land acquisition would take place. If any private land falls within the proposed alignment, the alignment will be shifted to utilize previously acquired land. In Brahmanbaria District, no new land will be acquired for this project, and as such there will not be any relocation. Additionally, the existing embankment will only be repaired. As a result, minimal use of private land beyond the existing embankment will be required. Private land will not be needed for bank protection, as the majority of this work will be on the river bank and in the river. For Feni district, there are no resettlement issues for bank protection as the work will take place on river bank. Overall, most of the land falls under existing river side land and previously acquired land. There is no scope for land acquisition for this project.

Table 1-2: Indicative Project Impacts

SL	Impacts/Types of losses	Cumilla	Brahmanbaria	Feni	Total
A.	Number of Affected entities	3492	30	536	4058
1	Affected Residential HHs only	1982	0	384	2366
2	Affected Residential & Business HHs only	46	0	13	59
3	Affected Roadside Shops and Business HHs Only (small scale)	695	0	25	720
4	Number of hhs Losing Secondary Structures Only	79	1	12	92
5	Only Trees Affected HHs	597	29	88	714
6	Affected CPRs	69	0	11	80
7	Affected Gob. Organization	5	0	3	8
8	Number of CPRs Losing Secondary Structures Only	19	0	0	19
B	Number of Affected Households without community public resources (CPRs)	3399	30	522	3951
1	Affected Residential HHs only	1982	0	384	2366
2	Affected Residential & Business HHs only	46	0	13	59
3	Affected Roadside Shops and Business HHs Only (small scale)	695	0	25	720
4	Number of hhs Losing Secondary Structures Only	79	1	12	92
5	Only Trees Affected HHs	597	29	88	714
C	Number of affected units other than B	93	0	14	107
6	Affected CPRs	69	0	11	80
7	Affected Gob. Organization	5	0	3	8
8	Number of CPRs Losing Secondary Structures Only	19	0	0	19
D	Affected Non-title Entities	0	0	145	145
E	Number of Affected Structures	5570	1	1201	6772

SL	Impacts/Types of losses	Cumilla	Brahmanbaria	Feni	Total
1	Number of Primary Structures	4,229	1	803	5033
2	Number of Secondary Structures	1341	0	398	1739

Source: Social Survey, January, 2025

Project Alternatives Considered

At the onset, the study team thoroughly reviewed the project Terms of Reference (ToR), the proposed interventions, and the outputs from the modeling study conducted to appreciate the overall project context and strategy. A detailed review of national policies, legal frameworks, and institutional mandates related to flood management, environmental conservation, and infrastructural rehabilitation was carried out to ensure legal alignment and compliance.

As part of the project planning process, a structured *Alternative/Options Analysis* was undertaken using a prioritized multi-criteria analysis (MCA) framework. Initially, a comprehensive list of flood-damaged locations was pre-screened based on critical red-flag criteria such as requirements for land acquisition, risks of resettlement, presence of illegal sand mining, and interventions involving dredging. Locations failing to meet these criteria were excluded from further consideration to streamline project focus.

For the shortlisted sites, a district-wise mini-MCA was conducted. This included location-specific details—such as Upazila, Union, geographic coordinates, and damage types—and evaluation based on eight criteria: (1) severity of damage, (2) number of potential beneficiaries, (3) urgency of intervention, (4) availability of construction materials, (5) estimated costs, (6) stakeholder preferences including BWDB insights, (7) availability of contractors, and (8) prospects for additional funding.

The MCA enabled scoring and ranking of all interventions, ensuring an objective basis for selection of the most feasible and impactful rehabilitation works. This method supported a transparent and resource-efficient decision-making process aligned with stakeholder priorities and technical constraints.

Associated Facilities and Ancillary Projects

To complement the core structural interventions under the Emergency Flood Response Project in the five flood-affected districts (Feni, Noakhali, Cumilla, Lakshmipur, and Brahmanbaria), several associated facilities and ancillary components have been integrated into the overall project framework. These supportive elements are critical to ensure the effectiveness, sustainability, and operational longevity of the main works.

Regulator Repair and Water Control Structures

- A total of **21 regulators** is scheduled for repairs (20 in Feni and 1 in Lakshmipur), which will restore flood regulation capacity and ensure better water flow and drainage control during monsoon events.
- These works include gate, hoist, and slab repairs, along with site-specific erosion protection.

Support Facilities for Construction and Supervision

- Establishment of temporary labor sheds, material stockyards, and machinery yards near embankment and regulator repair sites.
- Installation of billboards, construction signage, and information boards to ensure public awareness and contractor accountability.

Access and Operational Infrastructure

- Construction of access road (Feni District, access road of 40-vent regulator) and embankment maintenance roads are integrated within the 72.55 km embankment repair scope (notably 46 km in Cumilla and 24.55 km in Feni).
- These facilitate movement of materials and ensure future inspection and maintenance access.

Drainage and Canal Support Works

- 19.60 km of Khal re-excavation (in Cumilla and Lakshmipur) will be supported by small-scale drainage culverts, desilting structures, and service crossings where applicable.
- Associated desilting and canal-side embankment strengthening will ensure continuous drainage flow.

Riverbank Stabilization Measures

- In addition to the **30.38 km precautionary** and **5.79 km permanent bank protection**, the project will integrate minor ancillary works such as:
 - Toe protection and transition slabs,
 - Turfing and bioengineering where applicable,
 - CC block storage and staging yards.

Environmental and Social Compliance

- Designated zones for waste management, sediment disposal, and noise/dust mitigation during construction.
- Temporary relocation support for any informal dwellers during regulator or embankment work phases (if applicable).

1.2 Baseline Environmental and Social Conditions

The baseline assessment presents a comprehensive overview of the physical, biological, and socio-economic conditions across the project areas in Brahmanbaria, Cumilla, Feni, Lakshmipur, and Noakhali. The study used a mix of primary surveys, stakeholder consultations, and secondary data to evaluate existing environmental quality and community dynamics for anticipating potential project impacts and guiding sustainable development interventions.

The baseline assessment reveals a biologically diverse and socially complex project area. It underscores the need for integrated environmental and social that prioritize ecological health, support community livelihoods, and protect vulnerable groups. This baseline provides a foundation for effective environmental and social management planning throughout the project lifecycle.

1.2.1 Physical Environment

Data on various physical environmental parameters have been collected from both primary and secondary sources. Secondary data have been collected from various sources such as Bangladesh Meteorological Department (BMD), Soil Resource Development Institute (SRDI) and so on. Air and noise qualities have been measured at five representative locations near the proposed interventions in the five study districts. The measurements have been done by EnviroCare and their report is in Appendix-C.

Surface and ground water samples have been collected from study rivers and canals/khals at or near proposed intervention sites and then tested at IWM Water Quality Laboratory. Soil samples have been collected from the proposed dredging locations of Ruhita Khal in Cumilla district and C-khal in Lakshmipur district. These samples are tested at Institute of National Analytical Research and Service (INARS) laboratory of Bangladesh Council of Scientific and

Industrial Research (BCSIR). Moreover, the benthic species present in the soil samples are identified at the laboratory of the Department of Zoology, University of Dhaka. The sampling locations are presented in the following map.

Air Quality: Ambient air quality was monitored at five locations. Except for PM₁₀ levels in Fulgazi, Feni (which slightly exceeded the national standard), all other parameters (PM_{2.5}, SO₂, NO_x, CO) were within permissible limits, indicating relatively clean air.

Water Quality: Surface water samples from major rivers and khals indicated varied conditions. While pH levels were mostly neutral to slightly alkaline, high salinity, EC, and TDS were observed in areas like Musapur Regulator and Noler Char. Dissolved oxygen (DO) levels were generally adequate for aquatic life but varied by location. Groundwater analysis revealed that most samples met national drinking water standards, though occasional exceedances were found in chloride, iron, and turbidity.

Soil Quality: The study area contains silty loam to clayey soils, with generally acidic to slightly acidic pH levels. Fertility is medium to high, supporting intensive agriculture. Coastal areas like Lakshmipur are affected by salinity intrusion.

Noise Levels: Noise monitoring in residential zones showed levels mostly within standards, except in Fulgazi during the daytime, likely due to traffic and local activities.

Climate: The region experiences a tropical monsoon climate with hot summers, mild winters, and heavy rainfall during June–September. Average annual temperatures range between 20–28°C, with humidity peaking in the monsoon.

1.2.2 Biological Environment

The Biological environment are the living organisms, such as animals, plants, microorganisms etc., are often referred as biotic factors and affect human life as in particular period or place. Initially, secondary data sources such as IUCN Report, other ESIA studies in the area were analyzed in order to compile a potential presence/absence list of significant fauna and flora species. Then, field surveys (details in Appendix-D) were carried out for validation checks against the earlier-compiled species lists in order to establish a comprehensive baseline. The study team comprising Team Leader, Ecological and Fisheries Experts, Environmentalist and field researchers visited the project intervention sites, noted species by direct observation, interviews with local residents, and inspection of fishermen's catches and fish market survey.

Flora

The region supports diverse terrestrial and aquatic vegetation. Homesteads are rich in fruit-bearing trees like mango, guava, jackfruit, and coconut, along with bamboo, supari and medicinal plants. Grasslands, floodplains, and seasonal char lands support a mosaic of natural and human-modified ecosystems. A variety of creepers, herbs, shrubs, and aquatic plants (e.g., water hyacinth, lotus, duckweed) contribute to biodiversity and ecosystem services.

Fauna

Fish: Fish market surveys and consultations identified a rich assemblage of indigenous (e.g., mola, shing, tengra, puti) and exotic aquaculture species (e.g., Thai pangas, tilapia). Seasonal floods allow exchanges between wild and cultured fish stocks.

Reptiles: Species such as Bengal monitors, vine snakes, soft-shell turtles, and skinks are present. Wetlands support freshwater turtles, indicating healthy aquatic ecosystems.

Birds: The area hosts numerous species, including the national bird (doel), waterbirds (herons, kingfishers), raptors (black kite), and migratory birds.

Mammals: Small mammals like jungle cats, mongooses, bats, and shrews are common. Larger predators like foxes and jackals indicate a stable food chain.

1.2.3 Social Environment

The socio-economic environment refers to the social and economic conditions that influence the lives and livelihoods of people in the study area. It includes factors such as income levels, employment patterns, education, health services, housing conditions, and access to basic infrastructure. Most of the socio-economic information are collected for the proposed interventions and influence area from the population census of 2022 and field investigations.

Understanding the socio-economic environment is crucial for assessing community needs, identifying vulnerable groups, and designing effective development interventions. A well-informed analysis ensures that projects are responsive to local realities and contribute to sustainable improvements in quality of life.

Demographics: The study area house a population of about 2.1 million (BBS, 2022). Literacy rates average 84.73%, and average household size is 4.27. Population density is about 1,974 per square kilometer ranging from about 279.6 per square kilometer at Karerhat on bank of Feni River to 7300 per square kilometer at Uttar Durgapur in Cumilla on bank of Gomati. Ethnic minorities, female-headed households, and people with disabilities are identified as vulnerable groups.

Livelihoods: Out of the total population aged 5 years and above in the study area, approximately 28.44% are employed, 27.71% are engaged in household work, 1.35% are actively seeking employment, and the remaining 42.51% are not working (including students, elderly, etc.). From the compiled employment data across various unions, the total employed population stands at 544,016. Among them, the largest share (56.05%) is engaged in the service sector, followed by 27.89%% in agriculture and 16.06% in industry. However, discussions with local communities revealed that the people engaged in service sector often provides service in agriculture and many individuals categorized under agriculture are also involved in fishing, petty trading, and other small-scale economic activities, indicating diverse income sources that blur strict sectoral classifications.

Land Use: Land is used for agriculture, aquaculture, and homesteads, with riverbanks and floodplains playing key roles. Intervention zones include major rivers like the Feni, Gomti, Selonia, Muhuri, and associated khals.

Gender and Vulnerability: Women face significant socio-cultural constraints, including limited economic participation and decision-making power. Child marriage, dowry, and domestic violence are common. Targeted social compliance are necessary to address these disparities.

Cultural Heritage: The project area includes significant cultural and historical sites such as Mainamati-Lalmai, Shalban Bihar, and war cemeteries. Interventions are planned with attention to preserving these heritage zones. No construction activities or interventions will occur within close proximity to these areas that may directly affect these culturally and historically important locations. Though these historically important locations are within 2 km radius of the construction site, but the works will not directly/indirectly affect these historical sites.

1.3 Key Environmental and Social Impacts

As part of the environmental impact assessment, the project's potential effects during pre-construction, construction, and post-construction phases have been evaluated, focusing on their interactions with environmental components. Valued Environmental and Social Components (VESC) are defined as fundamental elements of the physical, biological or socio-economic environment that are likely to be impacted by a proposed project. VESC may vary by project, industry, and geographic region, to reflect the nature of the potential project effects and the environmental, economic, social, heritage, and health context within which the project is implemented. In this project, the following VESC are likely to be affected by the project activities:

- Water Quality
- Air and Noise Quality
- Lives and livelihood of people
- Fisheries resources: fish habitats and fish migration
- Terrestrial Biodiversity
- Flood protection and drainage facilities
- Crop production

Key risks and impacts of the project interventions on the VESC and sensitive receptors are presented in the following table.

Table 1-2: Key Environmental risks and impacts of the project interventions on the identified VESCs

Major Project Activities	Location	VESC/ Issue	Sensitive Receptors	Potential Impacts
Pre-Construction Phase				
• Site clearing • Fencing the project area • Building labor sheds • Construction material stockpiling • Mobilization of construction equipment, vehicles, excavators etc. • Fire fighting arrangements • Water supply • Drainage system	Along banks of: • Feni, Little Feni, Muhuri, Kahua, Selonia rivers and Matubhuiyan Khal in Feni • Little Feni and Meghna River in Noakhali • WAPDA, Rahmatkhali and C khals in Lakshmipur • Gomati River and Ruhita Khal in Cumilla • Hawra River in Brahmanbaria	Terrestrial vegetation	Terrestrial vegetation	Herbs and shrubs are likely to be temporarily damaged in the footprint area of labor shed construction material stockyard. Some amphibian and reptile Species may be temporarily affected.
		Lives and livelihood of people	Local community/ day labourers	The pre-construction activities will create employment opportunities and have positive impact on livelihood improvement & poverty reduction.
		Water Quality	Fish habitat, quality and fish production	Oil and grease release for transportation of construction equipment and materials may cause degradation of river water. Besides, increasing the water turbidity and decreasing the DO may cause death of sensitive fishes.
		Land dispute	Local inhabitants/ land owners	Dispute may arise between BWDB and private landowners during land demarcation for construction/ rehabilitation of embankment since both khals and private land, and some settlements, shops, etc. fall within the embankment alignment.
Construction Phase				
Operation of construction equipment	Along banks of: • Feni, Little Feni,	Noise quality	Inhabitants near the proposed bank protection,	Noise level may increase due to operation of construction and excavation equipment, i.e.

Major Project Activities	Location	VESC/ Issue	Sensitive Receptors	Potential Impacts
	Muhuri, Kahua, Selonia rivers and Matubhuiyan Khal in Feni • Little Feni and Meghna River in Noakhali • WAPDA, Rahmatkhali khals in Lakshmipur • Gomati River in Cumilla • Hawra River in Brahmanbaria		construction and repair sites Terrestrial fauna	from a mixture machine, vibrator, excavator etc.
Operation of excavation equipment	• C khal in Lakshmipur; • Ruhita Khal in Cumilla;		Aquatic and terrestrial fauna	
Construction activities such as production of CC blocks, sand filling of geo-bags, construction of embankment	Along banks of: • Feni, Little Feni, Muhuri, Kahua, Selonia rivers and Matubhuiyan Khal in Feni • Little Feni and Meghna River in Noakhali • WAPDA, Rahmatkhali khals in Lakshmipur • Gomati River in Cumilla	Air Quality	Terrestrial flora and fauna Nearby communities	Deterioration of air quality due to operation of construction and excavation equipment (i.e. exhaust emissions from construction equipment); dust generation from the vehicle movement, making concrete for construction of regulator and production of CC blocks, sand filling of geo-bags, construction of embankment.

Major Project Activities	Location	VESC/ Issue	Sensitive Receptors	Potential Impacts
	Hawra River in Brahmanbaria			
- Canal/Khal excavation - Spoil management	- C khal in Lakshmipur - Ruhita Khal in Cumilla			
Construction/ repair activities and river bank protection works, if construction waste is thrown into the river or stacked on riverbanks during monsoon/rainfall events	- Feni, Little Feni, Muhuri, Kahua, Selonia rivers and Matubhuiyan Khal in Feni - Little Feni and Meghna River in Noakhali - WAPDA, Rahmatkhali khals in Lakshmipur - Gomati River in Cumilla - Hawra River in Brahmanbaria	Surface Water Quality	Aquatic flora and fauna Fisheries resources Domestic/drinking water for local people	Deterioration of water quality is likely due to throwing construction waste into the river, river bank protection works.
Excavation activities	- C khal in Lakshmipur - Ruhita Khal in Cumilla			Excavated/dredged materials may disperse into water
Construction/ repair of embankments and regulators	Along banks of: Feni, Little Feni, Muhuri, Kahua, Selonia rivers and Matubhuiyan Khal in Feni	Soil Erosion	Communities on riverbanks Terrestrial flora and fauna	Soil erosion might occur from base and surface of embankment and regulator approach and backfilled area.

Major Project Activities	Location	VESC/ Issue	Sensitive Receptors	Potential Impacts
	• Little Feni and Meghna River in Noakhali • WAPDA, Rahmatkhali khals in Lakshmipur • Gomati River in Cumilla • Hawra River in Brahmanbaria		Aquatic flora and fauna	
Construction/ repair activities if construction wastes are disposed in the surrounding lands or CC blocks are constructed and stockpiled on agriculture land	Along banks of: • Feni, Little Feni, Muhuri, Kahua, Selonia rivers and Matubhuiyan Khal in Feni • Little Feni and Meghna River in Noakhali • WAPDA, Rahmatkhali khals in Lakshmipur • Gomati River in Cumilla • Hawra River in Brahmanbaria	Changes in Land Quality and Environmental Pollution	Flora and fauna Local community	Changes in land quality and environmental pollution due to disposal of construction wastes in the surrounding lands or CC blocks are constructed and stockpiled on agriculture land.
Excavation activities, if excavated materials are dumped on the agriculture land	• C khal in Lakshmipur • Ruhita Khal in Cumilla	Crop Production loss	Local community	Loss of crop production will occur if excavated materials are dumped on the agriculture land

Major Project Activities	Location	VEESC/ Issue	Sensitive Receptors	Potential Impacts
Construction activities such as production of CC blocks, sand filling of geo-bags, construction of embankment	- Feni, Little Feni, Muhuri, Kahua, Selonia rivers and Matubhuiyan Khal in Feni - Little Feni and Meghna River in Noakhali - WAPDA, Rahmatkhali khals in Lakshmipur - Gomati River in Cumilla - Hawra River in Brahmanbaria	Fish habitat, quality and fish Production	- Fisheries resources - Local communities and their livelihoods	- Decline of water quality due to construction debris and excavation of River and lubricant, oil from the machineries. Moreover, increased turbidity in the water due to excavation and slope preparation would decline the DO and pH in the water for construction and excavation period. - Movement of the excavator and other equipment would also enhance the water turbidity.
Khal excavation Spoil management,	- C khal in Lakshmipur - Ruhita Khal in Cumilla			
Khal excavation Spoil management	- C khal in Lakshmipur - Ruhita Khal in Cumilla	Fish migration and movement	Fisheries resources	Fish migration and movement may be disturbed temporarily during re-excavation and construction period.
		Fish Diversity and species richness	- Fisheries resources - Livelihoods	Fish diversity and composition may decrease partially during re-excavation period.
		Benthic environment	Benthos Aquatic fauna Fisheries resources	The benthic environment will be lost temporarily which acts as source of food for fishes and other aquatic species.
Construction activities	Feni, Little Feni,	Fish mortality	Fisheries	The release of toxic substances from CC

Major Project Activities	Location	VESEC/ Issue	Sensitive Receptors	Potential Impacts
such as production of CC blocks, sand filling of geo-bags, construction of embankment • Khal excavation and • Spoil management,	Muhuri, Kahua, Selonia rivers and Matubhuiyan Khal in Feni • Little Feni and Meghna River in Noakhali • WAPDA, Rahmatkhali khals in Lakshmipur • Gomati River in Cumilla • Hawra River in Brahmanbaria • C khal in Lakshmipur • Ruhita Khal in Cumilla		resources • Local communities and their livelihoods	block preparation, along with oil and lubricants from machinery, can lead to the mortality of juvenile fish and a reduction in phytoplankton and zooplankton populations in construction and excavation area
		Terrestrial biodiversity	Terrestrial flora and fauna	Terrestrial flora and fauna may be adversely affected due to vegetation loss in areas designated for CC block production, stockpiling, and embankment construction
		Aquatic biodiversity	Aquatic flora and fauna	Aquatic resources may be adversely impacted during bank protection work, and re-excavation works
		Social Forestation	Terrestrial flora and fauna	Damage of social forestation on the slope of the embankment and river side may be cut at construction points
Construction activities such as production of CC blocks, sand filling of geo-bags, construction of embankment	Along banks of Little Feni River in Noakhali;	Mangrove vegetation	Mangrove vegetation	Mangrove vegetation is likely to be damaged in a few interventions area such as Little Feni River.
All project activities	Along banks of: • Feni, Little Feni, Muhuri, Kahua, Selonia rivers and Matubhuiyan Khal in Feni • Little Feni and	Employment opportunities, Livelihood improvement and Poverty reduction	Local community	Employment opportunities for the local semi-skilled and unskilled labours will be created in the construction related activities.

Major Project Activities	Location	VESC/ Issue	Sensitive Receptors	Potential Impacts
	Meghna River in Noakhali - WAPDA, Rahmatkhali khals in Lakshmipur - Gomati River in Cumilla - Hawra River in Brahmanbaria - C khal in Lakshmipur - Ruhita Khal in Cumilla			
All project activities	Project locations	Occupational Health and Safety	Project workers	The workers may be injured during riverbank protection work, repair of water control structures and embankment, excavation of khals. Some of these injuries may turn into casualty, if not properly treated.
Post-Construction Phase				
Riverbank protection and embankment construction/repair	Along banks of: - Feni, Little Feni, Muhuri, Kahua, Selonia rivers and Matubhuiyan Khal in Feni - Little Feni and Meghna River in Noakhali - WAPDA, Rahmatkhali khals in Lakshmipur - Gomati River in	Riverbank Stability	Local community Terrestrial and aquatic flora and fauna	Riverbank protection works will save land, settlements and infrastructures at different vulnerable locations
		Flood protection	Local community Terrestrial flora and fauna	Flood control embankment will save crops and infrastructures from flood and storm surge

Major Project Activities	Location	VESC/ Issue	Sensitive Receptors	Potential Impacts
	Cumilla Hawra River in Brahmanbaria			
Khal excavation Construction/ repair of regulators	Along banks of: - C khal in Lakshmipur - Ruhita Khal in Cumilla	Drainage Improvement	Local community Terrestrial flora and fauna	Drainage conditions will improve after completion of the project/ khals excavation.
		Changes in Land Use & Drainage Patterns		Land use and drainage patterns may be changed due to commercial and industrial growth, development of settlements etc. consequent to protection of land from erosion and flooding.
		Crop Production	Terrestrial flora and fauna	Crop cultivation is likely to increase due to erosion and flood protection and drainage improvement.
		Fish habitat, quality and fish Production		Habitat quality and fish production may increase concurrently.
		Fish migration and movement		Fish movement may be increased and smooth due to sufficient water round the year because of incremental depth of khals.
Riverbank protection and embankment construction/repair	Along banks of: - Feni, Little Feni, Muhuri, Kahua, Selonia rivers and Matubhuiyan Khal in Feni - Little Feni and Meghna River in Noakhali - WAPDA, Rahmatkhali	Terrestrial biodiversity		Terrestrial flora and fauna is likely to be enriched due to protection of riverbank and stabilization of land and flood protection works, and maintenance excavation.
		Employment opportunities, Livelihood improvement and Poverty reduction	Local community	Agricultural and commercial activities may increase in the area consequent to land stability after erosion and flood protection, which may create new opportunities for income generation and livelihood improvement.

Major Project Activities	Location	VESC/ Issue	Sensitive Receptors	Potential Impacts
	khals in Lakshmipur - Gomati River in Cumilla - Hawra River in Brahmanbaria	Communication facility	Local community	The embankment-cum road might be paved resulting improved network in the study area.
Khal excavation Construction/ repair of regulators	Along banks of: - C khal in Lakshmipur - Ruhita Khal in Cumilla	Domestic water facilities	Local community	The khals will retain fresh water after re-excavation and construction/rehabilitation of water control structures. The local people may use this water for domestic purposes
All project activities	Project locations	Occupational Health and Safety	Project workers	Labors may encounter accidents during O&M of construction activities and excavation.

Table 1-3: Key Social risks and impacts of the project interventions on the identified VESCs

Major Project Activities	Location	Social Issue / VESC	Sensitive Receptors	Potential Impacts
Pre-Construction Phase				
Site clearance, fencing, mobilization of equipment	Along project banks and khal excavation sites in Feni, Noakhali, Lakshmipur, Cumilla, Brahmanbaria	Resettlement	Squatters, non-titled affected people, shop owners, structure owners, ethnic communities	Temporary displacement or permanent loss of shelter/business; possible conflicts over compensation and relocation.
Demarcation of embankment land	All project sites	Land ownership dispute	Local inhabitants, landowners, BWDB	Disputes may arise between BWDB and private landowners regarding land acquisition, boundary alignment, or compensation.
Establishment of labor sheds and material stockyards	Within project sites and adjacent community areas	Community safety and social interaction	Nearby community, women and children	Risks of community disturbance, women's safety concerns, and social tension due to presence of non-local laborers.
Construction Phase				
Riverbank protection, excavation, construction of CC blocks and regulators	All project sites	Livelihood disruption	Local traders, boatmen, fishermen, day laborers	Temporary disruption of income due to restricted access to rivers, khals, or roads; loss of workdays for fishermen during excavation.
Transportation of construction materials	Access roads and project vicinity	Traffic congestion and communication disruption	Local commuters, school children, road users	Increased traffic, road damage, and restricted movement causing delay to school and work; increased accident risk.
Construction activities (noise, dust, vibration)	Near residential areas, schools, markets	Noise and air pollution	Students, teachers, local residents	Noise and dust pollution from heavy machinery and mixing plants may disturb academic activities and daily life.
Labor influx during	Worker camps, nearby markets	Labor influx and	Local community, women	Potential social conflicts, gender-based

Major Project Activities	Location	Social Issue / VESC	Sensitive Receptors	Potential Impacts
construction period	and settlements	social conflict	and vulnerable groups	violence risks, disease transmission, and increased demand on local resources.
Construction activities and restricted access during works	Riverbanks, khal excavation sites	Education and communication disruption	School-going children, teachers, local transport operators	Access to schools and markets may be temporarily disrupted due to machinery movement or blocked roads.
Movement of heavy equipment and vehicles	Project approach roads	Risk of accidents	Pedestrians, children, community members	Accidental injuries due to poor traffic management and high-speed movement of heavy vehicles.
All construction activities	All sites	Occupational health and safety	Construction workers	Workers exposed to accidents, machinery injuries, heat stress, unsafe working conditions without PPE.
Post-Construction Phase				
Completion of riverbank protection and embankment	All project sites	Improved communication and accessibility	Local community	Embankment-road improves connectivity; travel and trade become easier.
Drainage and flood control improvement	Re-excavated khals and regulators	Improved livelihood and living conditions	Farmers, traders, households	Reduced flood risks enhance crop productivity, housing security, and income opportunities.
Project completion and handover	All project locations	Employment and livelihood enhancement	Local community, women, youth	Operation and maintenance activities create new employment; improved local economy.
Improved land stability and flood protection	Project influence areas	Resettlement rehabilitation outcomes	Resettled households	Livelihood restoration and improved security for displaced households due to protected land and increased access to resources.

1.4 Summary of Mitigation Measures

A detailed summary of the mitigation measures is illustrated in the Table 1-4, and Table 1-5 which the contractor needs to follow. Complying the measures presented in this table, the contractor is required to prepare excavation and construction plans and obtain approval from the Project Director (PD) of BWDB to ensure that no critical habitats are impacted. Construction and excavation methods should be chosen to minimize harm to aquatic, benthic, and terrestrial habitats, reduce air and noise pollution, and enhance operational precision. Regular inspection and monitoring will be carried out to assess the effectiveness of impact mitigation measures and re-adjusted where necessary.

The project's Environmental Management and Mitigation Plan requires a multidisciplinary approach, involving coordinated efforts from multiple agencies. Several institutions are likely to participate in the project's implementation. The contractor is responsible for carrying out the ESMP during construction, while BWDB is mainly tasked with overseeing and monitoring its implementation. In this regard, BWDB will appoint a National Environment Specialist for overseeing and monitoring implementation of the EMP.

Table 1-4: Environmental Mitigation and enhancement measures

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
Pre-Construction Phase: Bank and slope protection works and embankment repair/re-sectioning					
Engagement of Environmental and other technical staff	Without adequate technical staff, it would be difficult to implement EMP as prescribed.	Contractors and BWDB shall hire all technical staff as described in institutional arrangement Section for effective implementation of the EMP. Contractor's staff: Occupational Health and Safety Specialists, Community Liaison Officers, BWDB staff: Environment Specialist, DSC, Resettlement specialist, GRM officer	–	Included in Contractor's Budget	Contractors supervised by PIU/ BWDB
Inclusion of environmental Clauses in Construction Contracts	Compliance by the Contractor to requirements defined in the ESIA, EMP and BMP.	Specific environmental and biodiversity conservation clauses are added to contract specifications and a separate environmental bill-of-quantities section is to be prepared.	–	Included in Contractor's Budget	BWDB / PIU Contractors
Site Clearance & Restoration	There may be some loss of land cover/trees/habitats	Loss will be replenished after construction/repair activities	Negligible	Included in Contractor's Budget	Contractors supervised by PIU and Environmental Specialist, Social Specialist and Gender and GVB Specialist of PIU and E&S specialist of M&E firm
	There is no scope for land acquisition or dislocation of physical assets	(Avoidance) Planning and design team of project interventions tried their best not to create any resettlement or ES issues. However, if any ES issue arises the RPF shall be fully implemented prior to initiation of project activities.			
	Clearing the sites and dismantling the damaged infrastructure is likely to generate some debris, spoils, scraps etc. and create	The debris/ spoils/ scrapes etc. shall be disposed of timely and properly without creating hindrance and encumbrance for the local communities.			

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
	hindrance and encumbrance for the local communities				
Loss of livelihood	Temporary unemployment of people due to the rehabilitation of infrastructure	Preferably employment with the contractor for the affected unskilled workers	Negligible	-	The contractor, supervised by BWDB officials.
Fish habitat, quality and fish production	Clearing the sites and dismantling the damaged infrastructure may generate some debris, spoils, scraps etc. and create hindrance and encumbrance for the local communities.	The driver/crew of construction machinery shall be aware of the driver and crew, and the excavator and related equipment shall be driven properly and avoid accidents. So that oil or lubricant does not spill into the river water.	Negligible	Included in Contractor's Budget	The contractor, supervised by BWDB officials
Pre-Construction Phase: Regulator Repair					
Engagement of Environmental and other technical staff	Without adequate technical staff, it would be difficult to implement EMP as prescribed.	Contractors and BWDB shall hire all technical staff as described in institutional arrangement Section for effective implementation of the ESMP. Contractor's staff: Occupational Health and Safety Specialists, Community Liaison Officers, BWDB staff: Environment Specialist, DSC, Resettlement specialist, GRM officer	–	Included in Contractor's Budget	Contractors PIU/ BWDB
Inclusion of environmental Clauses in Construction Contracts	Compliance by the Contractor to requirements defined in the ESIA, EMP and BMP.	Specific environmental and biodiversity conservation clauses will be added to contract specifications and a separate environmental bill-of-quantities section will be prepared.	–	Included in Contractor's Budget	BWDB / PIU

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
Site Clearance & Restoration	There may be some loss of land cover/trees/habitats	Loss will be replenished after construction/repair activities	Negligible	Included in Contractor's Budget	PIU and Environmental and Specialist Social Specialist and Gender and GVB Specialist of PIU and E&S specialist of M&E firm
	Clearing the sites is likely to generate some debris, spoils, scraps etc. and create hindrance and encumbrance for the local communities	The debris/spoils/scrapes etc. shall be disposed of timely and properly without creating hindrance and encumbrance for the local communities.			
Pre-Excavation Phase: Re-excavation of khals					
Engagement of Environmental and other technical staff	Without adequate technical staff, it would be difficult to implement EMP as prescribed.	Contractors and BWDB shall hire all technical staff as described in institutional arrangement Section for effectiveimplementation of the EMP. Contractor's staff: Occupational Health and Safety Specialists, Community Liaison Officers, BWDB staff: Environment Specialist, DSC, Resettlement specialist, GRM officer	—	Included in Contractor's Budget	Contractors PIU/ BWDB
Preparation of guidelines for effective handling of excavated/dredged materials	Without proper guidelines for management of excavated/dredged materials, there will be social and environmental problems.	Prior to the mobilization of Contractors, BWDB will ensure that for selection of sites for temporary storage of excavated materials before subsequent beneficial use or permanent on land disposal, arrangement is made for such sites in consultation with local public representatives and concerned land owners.	—	Included in Contractor's Budget	Contractors Supervised by BWDB/ PIU/ DSC
Site preparation for storing/ disposal of	The excavated materials will be stored on banks and then will be disposed	The storing sites shall be compartmentalized with proper protections so that the materials cannot go back to the khal The excavated materials will be used in earthfilling sites		Included in Contractor's Budget	Contractors Supervised by

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
excavated materials					BWDB/ PIU/ DSC
Construction Phase: Bank and slope protection works and embankment repair/re-sectioning					
Noise level	May hamper lives of people, especially in residential areas and educational institutions. It may also disturb fauna, including endangered species.	• Reduce equipment noise at source by isolation of exhaust systems. • Limit the noisy work to daylight hours, where possible. • Inspect and maintain equipment in good working conditions. • Levels of engines or other noise producing sources will be ramped up, so that the noise will slowly increases.	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant, PIU
Air Quality	The air quality may deteriorate due to construction activities, i.e., exhaust emissions from construction machinery, dust generated by the movement of vehicles, production of CC block at the construction yards, sand filling of geo-bags etc.	• Water shall be sprayed at the construction yard and connected road twice a day in order to suppress fugitive dust; • Loading of the construction materials for concrete mixing shall be done carefully to avoid the emission of dust to the extent possible; • Construction materials shall be kept covered to avoid dispersion in air; • Construction equipment, namely batching plant/mixer machine, washing plant and grader, etc. shall be properly maintained; vehicles and equipment shall have proper fitness; • Vehicles and construction equipment shall use clean air technology; • Avoid earthen roads for carrying the construction materials to the extent possible;	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant, PIU

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
		- Switch off / throttle down all site vehicles, construction equipment, generators, and machinery when not in use; - Vehicle speed restriction must be enforced to control dust generation; - Plant different kinds of trees (Timber, Fruit bearing, medicinal) in the project area. - Air quality measurements during dry season for ensuring air quality standards (2 locations, 2 measurements PM_{2.5} & P₁₀ for 8 hours)			
Water Quality	Degradation of surface water quality	- A land fill/ dumping place (for debris/waste generated from construction activities, garbage from labour sheds etc.) shall be selected by BWDB and contractor in consultation with the Local Government Institute and Local Administration, before starting of the project activities, if there is no existing land - The construction wastes shall be segregated into biodegradable & non-biodegradable waste, in separate bins - The contractor shall arrange to transport the bins to the designated land fill site - Biodegradable waste or organic waste shall be disposed of at the land fill site or gathered for composting - The non-biodegradable waste shall be segregated into recyclable and rejected waste. - Recyclable waste like small pieces of rod, steel wire, rubber, plastic bottles, plastic bags, etc. to be collected and shall be sent to licensed traders for	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant, PIU, DOE

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
		recycling - Rejected waste shall be dumped in landfill sites. - Surface water quality measurements during dry season for ensuring water quality standards for irrigation (2 locations, 2 measurements, PH, EC, Salinity, TDS) - Ground water quality measurements during dry season for ensuring water quality standards for irrigation and drinking (2 locations, 2 measurements PH, EC, Salinity, As)			
Soil Erosion	Soil Erosion might occur from the base and surface of embankment.	The construction of embankment shall be completed immediately in the segment where vegetation will be cleared. The embankment surface shall be covered with turf immediately after completion of construction.	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant
Changes in Land Quality and environmental pollution	Haphazardly throwing of construction wastes (waste concrete, washed off aggregates, empty cement bags, litters etc.), WC wastes from labor shed, litters etc. will pollute surrounding environment and change land quality.	The onsite wastes shall be properly contained and prevented from escaping into surrounding lands; The process of disposing of the wastes mentioned under IEC-surface water quality shall be followed.	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant, BWDB, SRDI
Crop Production Loss	Crop production loss may occur, if CC blocks are constructed and stockpiled on the agriculture land.	- The bank protection works shall be done as per the design level. - The contractor shall ensure that no vehicular and equipment movements take place through agricultural fields.	Negligible	-	Contractor Supervision by M&E consultant, PIU

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
		The contractor shall maintain liaison with the communities. Compensation: Compensation shall be made for any standing crop damage. The compensation amount will be calculated after consultation with the local Department of Agriculture Extension (DAE) officials.			and DAE
Terrestrial biodiversity	Impact on terrestrial flora and fauna due to damage of vegetation at the CC block production and stockyard, and embankment construction area.	- Use barren land, if possible, for production and stockpiling of CC blocks, - Carryout tree plantation with native species at the vegetation damaged sites after completion of construction works and other suitable areas. - The embankment shall be covered with grass turf immediately after construction. - Awareness shall be raised among the local people about wildlife and habitat conservation, so that the relocated wildlife may escape easily and take secured shelter in nearer habitat.	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant,
Employment opportunity, livelihood improvement and Poverty reduction	People who live in the Employment opportunities will be created for different construction related activities.	- Local labor shall be given priority in recruitment for the construction activity. - Project authorities shall consider this issue and include a clause in the contract document for local labor recruitment based on their potential and availability for employment in the different project activities.	Negligible	-	Contractor Supervision by M&E consultant,
Occupational Health and Safety	The labours might be injured during various construction activities, some of these injuries may turn into the	- Labors shall be trained before engaging in the construction activity; - PPEs shall be provided to the labors with proper training for using them during the working period;	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant,

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
	casualty, if not timely and properly treated.	- First Aid medical facilities shall be ensured on the construction site; - Contact number of emergency ambulance services shall be hanged at the construction site.			
Construction Phase: Regulator Repair					
Noise level	May hamper lives of people, especially in residential areas and educational institutions. It may also disturb fauna, including endangered species.	- Reduce equipment noise at source by isolation of exhaust systems. - Limit the noisy work to daylight hours, where possible. - Inspect and maintain equipment in good working conditions.	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant
Air Quality	The air quality may deteriorate due to construction activities, i.e., exhaust emissions from construction machinery, dust generated by the movement of vehicles, production of CC block (for regulator apron) at the construction yards, etc.	- Water shall be sprayed at the construction yard and connected road twice a day in order to suppress fugitive dust; - Loading of the construction materials for concrete mixing shall be done carefully to avoid the emission of dust to the extent possible; - Construction materials shall be kept covered to avoid dispersion in air; - Construction equipment shall be properly maintained; vehicles and equipment shall have proper fitness; - Vehicles and construction equipment shall use clean air technology; - Avoid earthen roads for carrying the construction materials to the extent possible; - Switch off / throttle down all site vehicles, construction equipment, generators, and machinery when not in use;	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
		- Plant different kinds of trees (Timber, Fruit bearing, medicinal) in the project area. - Air quality measurements during dry season for ensuring air quality standards (2 locations, 2 measurements PM_{2.5} & P10 for 8 hours)			
Surface and Ground Water Quality	Degradation of surface water quality	- A land fill/ dumping place (for debris/waste generated from construction activities, garbage from labour sheds etc.) shall be selected by BWDB and contractor in consultation with the Local Government Institute and Local Administration, before starting of the project activities, if there is no existing land - The construction wastes shall be segregated into biodegradable & non-biodegradable waste, in separate bins - The contractor shall arrange to transport the bins to the designated land fill site - Biodegradable waste or organic waste shall be disposed of at the land fill site or gathered for composting - The non-biodegradable waste shall be segregated into recyclable and rejected waste. - Recyclable waste like damaged hand railings, rubber seals, small pieces of rod, steel wire, rubber, plastic bottles, plastic bags, etc. to be collected and shall be sent to licensed traders for recycling - Rejected waste shall be dumped in landfill sites - Surface water quality measurements during dry season for ensuring water quality standards for irrigation (2 locations, 2 measurements, PH, EC, Salinity, TDS)	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
		Ground water quality measurements during dry season for ensuring water quality standards for irrigation and drinking (2 locations, 2 measurements PH, EC, Salinity, As)			
Soil Erosion	Soil Erosion might occur from the regulator approach area.	The regulator approach area shall be covered with turf immediately after completion of construction.	Negligible	Included in Contractor's Budget	Contractor supervision by M&E consultant
Changes in Land Quality and environmental pollution	Haphazardly throwing of construction wastes (waste concrete, washed off aggregates, empty cement bags, litters etc.), WC wastes from labor shed, litters etc. will pollute surrounding environment and change land quality.	- The onsite wastes shall be properly contained and prevented from escaping into surrounding lands; - The process of disposing of the wastes mentioned under the issue of surface water quality shall be followed.	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant, PIU, SRDI
Crop Production Loss	Drainage/irrigation may be hampered during regulator repair. Crop production loss may occur, if CC blocks (for regulator aprons) are constructed and stockpiled on the agriculture land.	- The construction period shall be chosen avoiding monsoon or alternate drainage/irrigation option shall be provided during the repair works; - The CC blocks will be constructed on the regulator approach or suitable empty space near the regulator avoiding any cropland; - The contractor shall ensure that no vehicular and equipment movements take place through agricultural fields. - The contractor shall maintain liaison with the communities. Compensation: Compensation shall be made for any standing	Negligible	-	Contractor Supervision by M&E consultant, PIU and DAE

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
		crop damage. The compensation amount will be calculated after consultation with the local Department of Agriculture Extension (DAE) officials.			
Employment opportunity, livelihood improvement and Poverty reduction	Temporary employment opportunities will be created for local people different construction related activities.	- Local labor shall be given priority in recruitment for the construction activity. - Project authorities shall consider this issue and include a clause in the contract document for local labor recruitment based on their potential and availability for employment in the different project activities.	Negligible	-	Contractor Supervision by M&E consultant, PIU
Occupational Health and Safety	The labours might be injured during various construction activities, some of these injuries may turn into the casualty, if not timely and properly treated.	- Labors shall be trained before engaging in the construction activity; - PPEs shall be provided to the labors with proper training for using them during the working period; - First Aid medical facilities shall be ensured on the construction site; - Contact number of emergency ambulance services shall be hanged at the construction site.	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant, PIU
Excavation Phase: Re-excavation of khals					
Noise level	May hamper lives of people, especially in residential areas and educational institutions. It may also disturb fauna, including endangered species.	Reduce equipment noise at source by isolation of exhaust systems of dredgers/excavators. Limit the noisy work to daylight hours, where possible. Inspect and maintain vessels/dredgers/excavators in good working conditions. levels of engines or other noise producing sources will be ramped up, so that the noise will slowly increases.	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant
Air Quality	The air quality may deteriorate due to	Water shall be sprayed at the construction yard and connected road twice a day in order to suppress	Negligible	Included in Contractor's	Contractor Supervision by

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
	construction activities, i.e., exhaust emissions from construction machinery, dust generated by the movement of vehicles, dredger, excavator, production of CC block at the construction yards, sand filling of geo-bags, disposal of excavated materials etc.	fugitive dust; • Loading of the construction materials for concrete mixing shall be done carefully to avoid the emission of dust to the extent possible; • Construction materials shall be kept covered to avoid dispersion in air; • Construction equipment, namely batching plant/mixer machine, washing plant and grader, etc. shall be properly maintained; vehicles and equipment shall have proper fitness; • Vehicles, construction equipment, dredger and excavator shall use clean air technology; • Avoid earthen roads for carrying the construction materials to the extent possible; • Switch off/ throttle down all site vehicles, construction equipment, and excavator, generators, and machinery when not in use; • Vehicle speed restriction must be enforced to control dust generation; • Plant different kinds of trees (Timber, Fruit bearing, medicinal) in the project area. • Air quality measurements during dry season for ensuring air quality standards (2 locations, 2 measurements PM_{2.5} & P10 for 8 hours)		Budget	M&E consultant
Surface and Ground Water Quality	Degradation of surface water quality	• A storage place for excavated materials shall be selected by BWDB and contractor in consultation with the Local Government Institute and Local Administration, before starting of the project activities, if there is no existing land.	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
		- Dredger/excavator shall be properly maintained to minimize release of oil and grease, mobiles, and diesel into water bodies. - Surface water quality measurements during dry season for ensuring water quality standards for irrigation (2 locations, 2 measurements, PH, EC, Salinity, TDS) - Ground water quality measurements during dry season for ensuring water quality standards for irrigation and drinking (2 locations, 2 measurements PH, EC, Salinity, As)			
Fish habitat, quality and fish production	Decline the water and fish habitat quality due to release of oil and grease from the excavator. Furthermore, increased turbidity and decline of DO and PH temporarily in the khals. That increases the fish mortality and decreases fish production.	Bamboo barrier shall be installed to retain suspended sediment within excavated perimeter. This will reduce the occurrence of turbidity.	Minor positive	Included in Contractor's Budget	Contractor Supervision by M&E consultant
Fish movement and migration	Fish migration may be disturbed during excavation and bank protection work.	Avoid the month of May – July for excavation to consider the fish spawning period. If not, then excavation shall be carefully during the spawning period of fish through using barrier.	Minor positive	Included in Contractor's Budget	Contractor Supervision by M&E consultant
Employment opportunity, livelihood improvement and	People who live in the Employment opportunities will be created for different construction related	- Local labor shall be given priority in recruitment for the construction activity. - Project authorities shall consider this issue and include a clause in the contract document for local	Negligible		Contractor Supervision by M&E consultant, PIU

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
Poverty reduction	activities.	labor recruitment based on their potential and availability for employment in the different project activities.			
Occupational Health and Safety	The labours might be injured during various construction activities, some of these injuries may turn into the casualty, if not timely and properly treated.	• Labors shall be trained before engaging in the project activities; • PPEs shall be provided to the labors with proper training for using them during the working period; • First Aid medical facilities shall be ensured on the construction site; • Contact number of emergency ambulance services shall be hanged at the construction site.	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant
Post-Construction/Operation & Maintenance Phase: Bank and slope protection works and embankment repair/re-sectioning					
River bank stability	Riverbank will be stable at Gumati, Muhuri, Kahua, Little Feni, Feni, Haora River and WAPDA khal, Rahmatkhali khal, Matubhuiyan khal and Ruhita khal	• Bank protection works shall be closely monitored and emergency protection work shall be carried out. if failure of bank protection is observed. • O&M for protection works shall be done properly to combat the failure of the bank. • There shall be stockpile of geo-bag and CC block for tackling emergency situation. • Adequate budget shall be provided for operation and maintenance of river bank protection work.	Beneficial	Included in Contractor's Budget	PIU, BWDB
Flood protection	Embankment will protect crops and infrastructures from floods and storm surge.	• Embankment shall be properly monitored and maintained to avoid sudden breach. • Adequate budget shall be provided for operation and maintenance of embankment.	Beneficial	-	PIU, BWDB
Changes in Land Use	Land use and drainage patterns may be changed/improved	Adequate budget shall be provided for operation and maintenance of embankment.	Beneficial	Included in Contractor's Budget	PIU, BWDB and DAE

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
Increase Crop Production	Crop production may be increased.	- Crop land will be saved from river bank erosion. Hence, farmers of the study area and vulnerable locations is likely to be encouraged to apply more irrigation, as they can grow HYV/ Hybrid crop. In this case, the farmers need good support from the Govt. for a timely supply of inputs e.g fertilizers, pesticides, seeds, credits, etc. - Capacity building and awareness-raising of the farmers shall be carried out regarding the use of Integrated Crop Management (ICM) and Good Agricultural Practices (GAP) to minimize the usage of chemical inputs. - The farmers shall be encouraged to use organic and green manure to increase soil fertility as well as avoid water contamination of water sources. - The farmers shall be encouraged to cultivate leguminous crops (N₂ fixing) to enhance the soil quality as well as soil productivity.	Beneficial		PIU, BWDB, DAE
Terrestrial biodiversity	Terrestrial flora and fauna may be enriched due to protection of lands from erosion and flooding.	- A smart plantation plan shall be prepared which shall include the species composition, location of plantation area, number of saplings to be planted. Indigenous plant species shall be given priority in the plan. Native and ornamental plant species shall receive preference for plantation, which will enhance vegetation coverage. - Ensure regular maintenance of green areas and implement plantation in each season of each year to enhance the green cover and complement the vegetation loss.	Minor Positive		PIU, BWDB, Department of Forest

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
		Avoid single species selection or clone monoculture as plantation			
Employment opportunity, livelihood improvement and poverty reduction	Agricultural and commercial activities will increase in the study area consequent to land stability after erosion and flood protection, which will create new opportunities for income generation and livelihood improvement.	- Motivate and train the local people to develop skills to avail the possible scope of employment in industries to be established in the study area. - There shall be a provision in industries/ commercial organizations for ensuring employment opportunities for local people as per their skill. - Local destitute people shall be given priority in recruitment of unskilled laboring activities in the newly developed commercial and industrial activities. - Farmers and labors shall be trained to works in modernized agricultural activities.	Moderate Positive	Included in Contractor's Budget	PIU, BWDB, DAE and different Government Organizations related to Commerce and Industry.
Post-Construction/Operation & Maintenance Phase: Regulator Repair					
Surface water availability	Surface water availability will increase after repair of the proposed regulators.	- Maintenance shall be done as and when required. - Operation of water control structures shall be properly done.	Beneficial	Included in Contractor's Budget	PIU, BWDB
Drainage Improvement	Drainage conditions will improve after repair of the proposed regulators.	- Drainage structures shall be properly operated to ensure smooth drainage. - Regular inspections, particularly following rainfall shall be conducted to ascertain the operation of outlet structures and also ensure smooth flow of runoff through the drainage system. - Adequate budget shall be provided for operation and maintenance of drainage system.	Beneficial	Included in Contractor's Budget	PIU, BWDB
Changes in Land Use and	Land use and drainage patterns may be	Regulators shall be properly monitored and maintained to avoid sudden breakdown. And sdequate budget shall be provided for that.	Beneficial		PIU, BWDB and DAE

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
Drainage Patterns	changed/improved				
Increase Crop Production	Repair of the regulators will enhance drainage and irrigation which is likely to provide subsequent improvement of crop production.	Regulators shall be properly monitored and maintained to avoid sudden breakdown. And sdequate budget shall be provided for that.	Beneficial		PIU, BWDB, DAE
Post-Excavation/Operation & Maintenance Phase: Re-excavation of Khals					
Noise Level	Noise from maintenance excavation works	Mitigation measures similar to construction phase shall be taken.	Negligible	Included in Contractor's Budget	PIU, BWDB and contractor
Air quality	The air quality may deteriorate through maintenance excavation works	Mitigation measures similar to construction phase shall be taken.	Negligible	Included in Contractor's Budget	PIU, BWDB and contractor
Surface water quality	Degradation of water quality from maintenance excavation works	Mitigation measures similar to the construction phase	Negligible	Included in Contractor's Budget	PIU, BWDB and contractor
Surface water availability	Surface water availability will increase after implementation of proposed interventions.	- Maintenance re-excavation of khals shall be carried out as and when required. - Operation of water control structures shall be properly done.	Beneficial	Monitoring budget	PIU, BWDB and contractor
Drainage	Drainage conditions will	Siltation of khals shall be monitored and maintenance excavation shall be done when needed.	Beneficial	Monitoring	PIU, BWDB

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
Improvement	improve.	Adequate budget shall be provided for awareness building for not blocking the khals for fishing or not disposing garbage into khals		budget	and contractor
Changes in Land Use and Drainage Patterns	Land use and drainage patterns may be changed/improved	Materials accumulated from excavation works shall not be dumped on agricultural lands. Such materials shall be spread over the agricultural lands and leveled over properly.	Beneficial	Monitoring budget	PIU, BWDB and DAE
Fish Habitat, quality and fish production	Habitat quality may improve, and incremental fish production is expected after one monsoon of completion.	- Incremental species diversity and fish production is expected. Fish fry of indigenous species will be released into the re-excavated khals by the local Department of Fisheries (DoF) as part of a conservation and stock enhancement initiative. - Restrict the use of high-impact destructive gear and successfully implement closed fishing seasons during spawning periods (May-July) to protect native fish populations. Use some device, red flag and signboard during fish spawning period for awareness raising to the local community. - Management committee shall be formed by (9-11) members by the adjacent village peoples based on selected area including the related Union Chairman / members. Activities shall be monitored by management committee. - Protected area shall selected by the local community and finalized through discussion with the Upazila DoF official. - The related DoF officials through observation of the Fish week, World water day, World Environment	Moderate Positive	Enhancement budget	BWDB in collaboration with related Upazila DoF officials. Financial support shall provide by the BWDB authority.

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
		Day. Provide training to the management committee by the DoF Officials and awareness raising to the local community by the management committee.			
Fish migration and movement	Fish migration and movement may be smooth in the re-excavated khals round the year.	- Fish fry of indigenous species will be into the re-excavated khals by the local Department of Fisheries (DoF) as part of a conservation and stock enhancement initiative. - Awareness activities shall be conducted for the local community of the area to make aware them for protection of wetland and the importance of fish and water bodies in our daily life.	Minor Positive	-	Project authority in collaboration with related Upazila DoF officials.

Table 1-5: Social Mitigation and enhancement measures

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact	Budget	Responsible Agency
Pre-Construction Phase					
Site clearance, fencing, site preparation	Temporary displacement or loss of assets of squatters and non-titled people	- Conduct detailed social screening and census survey before work starts. - Prepare and implement RAP ensuring compensation and resettlement prior to displacement. - Provide relocation and livelihood support to affected persons. - An Indigenous People Plan (IPP) will be developed to address the issues regarding potentially affected ethnic community people	Minor, temporary	Included in RAP budget	BWDB / Social Safeguard Specialist

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact	Budget	Responsible Agency
Land demarcation and boundary setting for embankment alignment	Land ownership dispute and grievances from landowners	• Conduct joint land verification with land office and community representatives. • Ensure transparent disclosure of land maps and compensation rates. • Establish and operationalize GRM for dispute resolution.	Negligible	Administrative cost	BWDB / DC Office
Establishment of labor sheds, stockyard, and construction camps	Social tension, women's safety concerns, GBV/SEA risks	• Locate labor sheds away from schools and residential areas. • Implement labor camp management plan and worker code of conduct. • Conduct SEA/SH and GBV awareness training for all workers. • Restrict unnecessary movement of workers outside camp.	Moderate	Part of ESMP cost	Contractor / BWDB
Mobilization of construction equipment, vehicles, and labor	Increased traffic movement, risk of community accidents	• Inform local administration before equipment mobilization. • Avoid peak school/market hours. • Use flagmen and warning signs during vehicle movement.	Negligible	Included in ESMP	Contractor / CSC
Pre-construction community consultation	Lack of awareness, grievances during project initiation	• Conduct stakeholder meetings before work commencement. • Disclose project schedule, impacts, and mitigation plan. • Maintain grievance redress cell in each site.	Negligible	Administrative cost	BWDB / Social Specialist
Construction Phase					
Riverbank protection,	Temporary livelihood	• Schedule works during non-fishing	Minor,	Included in	Contractor /

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact	Budget	Responsible Agency
embankment and regulator construction, khal re-excavation	disruption of fishermen, traders, and boatmen	season. • Provide temporary access for affected users. • Engage affected community members as unskilled laborers.	short-term	ESMP	BWDB
Construction activities near schools and settlements	Noise and dust disturbance, disruption of education and community life	• Restrict noisy works to daytime hours. • Regular water sprinkling to reduce dust. • Install sound barriers near sensitive areas.	Minor	Included in ESMP	Contractor / CSC
Movement of heavy vehicles and materials	Traffic congestion, road damage, accidents	• Prepare and enforce traffic management plan. • Install safety signage and flagmen. • Coordinate with local authority for alternate routes.	Negligible	Contractor's ESMP budget	Contractor / BWDB
Labor influx and external workforce	Social tension, GBV/SEA risks, disease transmission	• Prefer local hiring to minimize influx. • Enforce code of conduct and labor influx management plan. • Conduct awareness on communicable diseases and gender sensitivity. • Operate grievance mechanism for community.	Moderate	Included in ESMP	Contractor / BWDB / NGO Partner
Restricted access to roads, schools, and markets	Temporary communication disruption and inconvenience	• Provide alternative routes and crossings. • Coordinate with community leaders	Negligible	Part of ESMP	Contractor / CSC

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact	Budget	Responsible Agency
		to minimize disruption. • Inform public in advance about construction schedule.			
Construction site operations	Occupational health and safety risks to workers	• Provide PPE, first-aid facilities, emergency transport, and safety training. • Assign safety supervisor at each site. • Enforce compliance with OHS plan.	Negligible	Included in OHS budget	Contractor / BWDB
Construction near community areas	Risk to community health and safety	• Fence off construction zones and install warning signs. • Restrict unauthorized access. • Conduct awareness sessions for nearby residents.	Minor	Included in ESMP	Contractor / CSC
Waste disposal and storage of construction materials	Nuisance, visual pollution, safety hazards	• Designate approved waste disposal sites. • Ensure timely removal of debris. • Avoid stacking materials on access roads or farmland.	Minor	Included in ESMP	Contractor / BWDB
Post-Construction / Operation & Maintenance Phase					
Demobilization of labor and equipment	Improper site clearance, leftover debris	• Conduct proper site clean-up and waste disposal. • Restore work areas to original or improved condition. • Verify clearance through site inspection.	Negligible	Included in ESMP	Contractor / BWDB

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact	Budget	Responsible Agency
Reinstatement of community access and facilities	Delayed restoration may affect local movement	• Restore access roads, pathways, and community facilities promptly. • Consult local users before reopening routes.	Negligible	Part of O&M cost	BWDB / Contractor
Employment opportunities in O&M activities	Limited engagement of local workforce	• Prioritize local labor for maintenance and monitoring works. • Provide short training on embankment maintenance.	Positive	Part of project benefit	BWDB / Local Authority
Community safety and awareness during operation	Risk of accidents near embankments, regulators, and khal	• Install safety signage and railings near risky zones. • Conduct awareness programs on safe use of infrastructure.	Negligible	Included in O&M budget	BWDB / Local Government
Livelihood restoration and community development	Temporary income loss during project may persist	• Support affected persons through skill training and livelihood grants where applicable. • Link with government social safety programs.	Minor, short-term	Included in RAP	BWDB / Social Development Specialist
Functioning of GRM during O&M	Unaddressed community complaints	• Maintain active grievance redress mechanism throughout operation phase. • Ensure timely resolution and feedback to complainants.	Negligible	Administrative cost	BWDB / Social Specialist
Long-term social benefits from improved protection and access	Enhanced safety, reduced flood risk, improved mobility and livelihoods	• Maintain embankments and drainage channels regularly. • Encourage community participation in maintenance monitoring.	Positive	Part of O&M cost	BWDB / Local Community

1.5 Residual Risks and Monitoring Needs

Residual impacts are environmental and social effects that persist despite mitigation efforts, such as long-term ecosystem changes or risks from extreme events. For instance, khal re-excavation may harm benthic habitats, with partial recovery possible, but full restoration unlikely if maintenance dredging continues. These impacts necessitate ongoing monitoring and adaptive management to protect vulnerable communities and ecosystems throughout the project lifecycle. Residual risks are mostly negligible in the proposed project since most of the interventions are existing ones, only repair and rehabilitation works are proposed.

During the pre-construction, construction and operation & maintenance phases of the project, environmental and social monitoring is essential to ensure compliance with regulations and promote sustainable development. Environmental and social indicators include air quality, noise level, water quality, soil quality, waste generation, drainage congestion and water logging, riverbank erosion, crop production, aquatic ecology, health and safety, resettlement effects etc.

These indicators need to be monitored closely during all phases of the project. Monitoring methodologies involve baseline studies to establish pre-project conditions, regular monitoring through scheduled observations and measurements, participatory monitoring involving local communities, and systematic reporting to inform stakeholders and guide decision-making. These practices help in mitigating adverse effects and ensuring positive outcomes for both the environment and society. The monitoring indicators and methodology are clearly outlined in **Table 1-**

Table 1-6: Environmental and Social Monitoring Plan

VESC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (lac BDT)
Pre-Construction Phase: Bank and slope protection works and embankment repair/re-sectioning					
Construction Wastes	Visual inspection of waste generation and dumping area	Construction sites	Once before the commencement of the construction activities	BWDB and Contractor	
Water Quality deterioration and Waste generation	Sampling and analysis of surface (pH, EC, TDS, temperature, salinity, BOD and major ions) and ground water quality (pH, EC, TDS, temperature, salinity, As)	Construction camp and construction site	Once before the commencement of the construction activities	D&S Consultant through a recognized laboratory	9.60
Air quality	Air quality monitoring of parameters: SPM, PM ₁₀ , and PM _{2.5} , CO, NO _x , SO _x	Close to nearby School/ Madrasa/Hospital/Villages	Once before the commencement of the construction activities	BWDB/D&S Consultant	4.80
Noise level	Quality Assurance and Quality Control (QA/QC) procedures shall be maintained during the monitoring	Close to nearby School/ Madrasa/Hospital/Villages	Once before the commencement of the construction activities	BWDB/D&S Consultant	1.60
Labor selection process	Physical monitoring, daily logbook checking for workers	The entire study area	Daily (during the recruitment process)	BWDB, D&S, Contractor	–
Pre-Construction Phase: Regulator Repair					
Construction Wastes	Visual inspection of waste generation and dumping area	Regulator repair sites	Once before the commencement of the construction activities	BWDB, D&S Consultant and Contractor	
Water Quality	Sampling and analysis of surface	Construction camp and	Once before the	D&S Consultant	2.00

VEESC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (lac BDT)
deterioration and Waste generation	(pH, EC, TDS, temperature, salinity, BOD and major ions) and ground water quality (pH, EC, TDS, temperature, salinity and As)	construction site	commencement of the construction activities	through a recognized laboratory	
Air quality	Air quality monitoring of parameters: SPM, PM ₁₀ , and PM _{2.5} , CO, NO _x , SO _x	Close to nearby School/ Madrasha/Hospital/Villages	Once before the commencement of the construction activities	BWDB/D&S Consultant	1.00
Noise level	Quality Assurance and Quality Control (QA/QC) procedures shall be maintained during the monitoring	Close to nearby School/ Madrasha/Hospital/Villages	Once before the commencement of the construction activities	BWDB/D&S Consultant	0.40
Labor selection process	Physical monitoring, daily logbook checking for workers	Regulator repair sites	Daily (during the recruitment process)	BWDB, D&S, Contractor	-
Pre-Construction Phase: Re-excavation of Khals					
Water Quality deterioration and Waste generation	Sampling and analysis of surface (pH, EC, TDS, temperature, salinity, BOD and major ions) and ground water quality (pH, EC, TDS, temperature, salinity and As)	Construction camp and construction site	Once before the commencement of the construction activities	D&S Consultant through a nationally recognized laboratory	1.00
Air quality	Air quality monitoring of parameters: SPM, PM ₁₀ , and PM _{2.5} , CO, NO _x , SO _x	Close to nearby School/ Madrasha/Hospital/Villages	Once before the commencement of the construction activities	D&S Consultant	0.50
Noise level	Quality Assurance and Quality Control (QA/QC) procedures shall be maintained during the	Close to nearby School/ Madrasha/Hospital/Villages	Once before the commencement of the construction activities	D&S Consultant	0.10

VESC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (lac BDT)
	monitoring				
Construction Phase: Bank and slope protection works and embankment repair/re-sectioning					
Drainage Congestion and Water Logging	Visual inspection and public feedback	Total project area	Yearly	D&S Consultant & Contractor	
Water Quality deterioration and Waste generation	Sampling and analysis of surface (pH, EC, TDS, temperature, salinity, BOD) and ground water quality (pH, EC, TDS, temperature, salinity and As)	Construction camp and construction site	Half yearly (Surface & Ground Water)	Contactor/D&S Consultant	26.00
	Visual inspection of collection, transportation and disposal of solid waste and solid waste is deposited at designated site.		Weekly (Solid Waste)		
Air Quality	Air quality monitoring	Close to nearby School/ Madrasha/Hospital/Villages	Half yearly	Contactor/D&S Consultant	18.00
Noise	Visual inspection to ensure good standard equipment are in use	Close to nearby School/ Madrasha/Hospital/Villages	Quarterly	Contactor/D&S Consultant	8.00
Agriculture					
Soil erosion	Ocular observation and KII	Study area for bank and slope protection works and embankment repair/ re-sectioning	7 days interval during the construction phase	PIU of BWDB/D&S Consultant	—
Changes in land quality	Soil sample collection and laboratory test	Embankment repair and bank protection work (earth fill	Once a year	PIU of BWDB/D&S Consultant	—

VESEC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (lac BDT)
		locations)			
Occupational Health and Safety	Inspection of Emergency Preparedness and Response mechanism and facilities	At interventions sites	Monthly	BWDB, D&S Consultant and Contractor	—
Construction Phase: Regulator Repair					
Drainage Congestion and Water Logging	Visual inspection and public feedback	Total project area	Yearly	BWDB/D&S Consultant and Contractor	—
Water Quality deterioration and Waste generation	Sampling and analysis of surface (pH, EC, TDS, temperature, salinity, BOD) and ground water quality (pH, EC, TDS, temperature, salinity and As)	Construction camp and construction (repair) sites	Half yearly (Surface Water)	Contactor/D&S Consultant	3.20
	Visual inspection of collection, transportation and disposal of solid waste and solid waste is deposited at designated site.		Weekly (Solid Waste)		
Air Quality	Air quality monitoring	Close to nearby School/ Madrasa/Hospital/Villages	Half yearly	Contactor/D&S Consultant	2.00
Noise	Visual inspection to ensure good standard equipment are in use	Close to nearby School/ Madrasa/Hospital/Villages	Weekly	Contactor/D&S Consultant	1.00
Agriculture					
Soil erosion	Ocular observation and KII	Study area	7 days interval during the construction phase	PIU of BWDB/D&S Consultant	—

VESC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (lac BDT)
Occupational Health and Safety	Inspection of Emergency Preparedness and Response mechanism and facilities	At project sites	Monthly	BWDB, D&S Consultant and Contractor	—
Construction Phase: Re-Excavation of khals					
Drainage Congestion and Water Logging	Visual inspection and public feedback	Total project area	Yearly	BWDB/D&S Consultant and Contractor	
Water Quality deterioration	Sampling and analysis of surface (pH, EC, TDS, temperature, salinity, BOD) and ground water quality (pH, EC, TDS, temperature, salinity and As)	One location in each of the proposed khals	Half yearly (Surface Water)	Contactor/D&S Consultant	3.40
Air Quality	Air quality monitoring	Close to nearby School/ Madrasha/Hospital/Villages on the banks of khals	Half yearly	Contactor/D&S Consultant	2.00
Noise	Visual inspection to ensure good standard equipment are in use	Close to nearby School/ Madrasha/Hospital/Villages on the banks of khals	Quarterly	Contactor/D&S Consultant	0.40
Agriculture					
Occupational Health and Safety	Inspection of Emergency Preparedness and Response mechanism and facilities	At intervention sites	Monthly	BWDB, D&S Consultant and Contractor	—
Post-Construction/Operation & Maintenance Phase: Bank and slope protection works and embankment repair/re-sectioning					
Riverbank	Visual inspection of protected areas	Bank protected sites	Monthly and during flood	BWDB/D&S	—

VESEC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (lac BDT)
stability			events	Consultant and Contractor	
Water Quality deterioration and Waste generation	Air quality monitoring of parameters: SPM, PM ₁₀ , and PM _{2.5} , CO, NO _x , SO _x	Construction camp and construction site	Once after completion	D&S Consultant through a recognized laboratory	9.60
			Once after completion		
Air Quality	Air quality monitoring of parameters: SPM, PM ₁₀ , and PM _{2.5} , CO, NO _x , SO _x	Close to nearby School/ Madrasha/Hospital/Villages	Once after completion	BWDB/D&S Consultant	4.80
Noise	Visual inspection to ensure good standard equipment are in use	Close to nearby School/ Madrasha/Hospital/Villages	Once after completion	BWDB/D&S Consultant	1.60
Agriculture					
Soil erosion	Ocular observation and KII	Study area	Half yearly basis for 3-year monitoring plan	PIU of BWDB, D&S	—
Changes in land use and drainage patterns	Ocular observation and KII	Study area	Half yearly basis for 3-year monitoring plan	PIU of BWDB, D&S	—
Land stability	Ocular observation and KII	Footprint area (bank protection area)	Half yearly basis for 3-year monitoring plan	PIU of BWDB and D&S Consultant	—
Post-Construction/Operation & Maintenance Phase: Regulator repair					
Drainage Congestion & Water Logging	Ocular observation and KII	Study area	Half yearly basis for 3-year monitoring plan	PIU of BWDB, D&S	—
Water Quality deterioration and	Sampling and analysis of surface (pH, EC, TDS, temperature,	Construction camp and construction site	Once after completion	BWDB/D&S Consultant through a	2.00
			Once after completion		

VEESC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (lac BDT)
Waste generation	salinity, BOD and major ions) and ground water quality (pH, EC, TDS, temperature, salinity and As)			nationally recognized laboratory	
Air Quality	Air quality monitoring of parameters: SPM, PM ₁₀ , and PM _{2.5} , CO, NO _x , SO _x	Close to nearby School/ Madrasha/Hospital/Villages	Once after completion	BWDB/D&S Consultant	1.00
Noise	Visual inspection to ensure good standard equipment are in use	Construction sites	Once after completion	BWDB/D&S Consultant	0.40
Agriculture					
Soil erosion	Ocular observation and KII	Study area	Half yearly basis for 3-year monitoring plan	PIU of BWDB, D&S	—
Changes in land use and drainage patterns	Ocular observation and KII	Study area	Half yearly basis for 3-year monitoring plan	PIU of BWDB, D&S	—
Post-Construction/Operation & Maintenance Phase: Khal Re-excavation					
Drainage Congestion & Water Logging	Ocular observation and KII	Study area	Once a year for 3-year monitoring plan	PIU of BWDB, D&S	
Water Quality deterioration and Waste generation	Sampling and analysis of surface (pH, EC, TDS, temperature, salinity, BOD and major ions) and ground water quality (pH, EC, TDS, temperature, salinity and As)	One location in each of the proposed khals	Once after completion	BWDB/D&S Consultant through a nationally recognized laboratory	1.00
Air Quality	Air quality monitoring of parameters: SPM, PM ₁₀ , and PM _{2.5} ,	Close to School, Madrasha, Hospital or Villages (2	Once after completion	BWDB/D&S Consultant	0.50

VESC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (lac BDT)
	CO, NO _x , SO _x	locations in each khal)			
Noise	Visual inspection to ensure good standard equipment are in use	Construction sites	Once after completion	BWDB/D&S Consultant	0.10
Agriculture					
Soil erosion	Ocular observation and KII	Study area	Once after completion	PIU of BWDB, D&S	–
Changes in land use and drainage patterns	Ocular observation and KII	Study area	Once after completion	PIU of BWDB, D&S	–
Changes in land quality	Soil sample collection and laboratory test and verified with the previous result	Land reclamation area (excavated earth dumping location)	Once after completion	PIU of BWDB and D&S	-
Total					106.0

Budget for Environmental Management and Monitoring Plan

For successful implementation of EMP, provision of appropriate budget shall be in place in the bid document. Various mitigation and monitoring measures are presented in **Table 1-4** and **Table 1-**. No separate payment shall be made for fulfilling the requirements of ESMP except as specified in the tables.

For items not specified here, all costs shall be deemed to be included in the unit rates and/or lump sum prices of the various other items in the Bill of Quantities. The summary cost of the mitigation and monitoring measures are presented in **Table 1-**.

Table 1-7: Environmental management and monitoring cost

SL	Item	Cost (lac BDT)
1	Environment Mitigation Cost	140
2	Environment Enhancement Cost	08
3	Environment Monitoring Cost	106
	Total	254

Table 1-8: Breakdown of environmental management and monitoring cost

From social survey, in Cumilla there is no relocation required in the bank protection alignment. For re-sectioning, a total of 3,492 entities are affected, including 3,399 households, community public resources (CPRs), and government entities. In B-Baria District, a total of 30 entities are affected, out of which 29 are trees, and only one household is losing an abandoned structure. In Feni District, there are no resettlement issues for bank protection as the work will take place on river land. There are no significant social impacts due to erosion protection measures and other repair works.

Reporting

Monthly Compliance Reports: Contractor ESHS Officers will prepare and submit a monthly compliance report to the DSC and PIU. The short report will contain the compliance activities completed throughout the month and record the resolution of any issues that may have arisen. The reports shall contain the following information:

- Summary of compliance activities;
- The updated list of all ESHS issues that arisen during the project period;
- Follow up information on any past issues that will still being resolved;
- Photographs of project activities related to the implementation of ESMP mitigation measures.

Biannual Compliance Reports: The PIU will prepare and submit an biannual compliance report to the World Bank, detailing the compliance activities completed during the period and tracking the resolution of any issues that may have arisen for the ongoing sub-projects. The PIU will utilize the compliance checklists and monthly reports from the construction contractors and the third-party monitoring consultants to compile the biannual report.

The biannual report shall include the following information:

- Significant follow-up issues, actions, time frame, and responsible parties;
- Introduction, reporting period, and monitoring locations;
- Estimate of remaining construction and schedule;
- Summary of compliance activities;
- Progress made in ESMP implementation including key monitoring indicators;
- Site visits or other oversight activities by PIU and supervisory consultants;
- The updated list of all ESHS incidents occurred during the project, including attached notices of non-compliance issues;
- Follow up information on any outstanding issues that are still being resolved.

1.6 Summary of Stakeholder Engagement

1.6.1 Stakeholder Consultations and Findings

Consulting local communities and stakeholders is vital for effective project planning and implementation. Between December 2024 and February 2025, 33 focus group discussions and consultation meetings were held, alongside interviews with over 10 key informants—including BWDB officials, teachers, displaced residents, and social workers—to gather insights on baseline conditions, potential impacts, and mitigation strategies. These consultations aimed to bridge gaps between project implementers and affected communities, ensuring inclusive and informed decision-making.

Community consultations in the Gumti, Muhuri, and Little Feni River regions have highlighted pressing concerns over embankment vulnerabilities, riverbank erosion, and environmental degradation. Residents reported severe erosion threatening homes, agricultural lands, and infrastructure, particularly in areas like Durgapur, Ratanpur, and Jaypur. In the

Muhuri Project area, unplanned fish farming and sand extraction have exacerbated erosion and disrupted river flows, leading to increased flooding risks. The collapse of the Musapur Closure has intensified tidal surges and erosion along the Little Feni River, endangering nearby communities. Additionally, pollution from industrial discharge into waterways like Ruhita Khal has degraded water quality, affecting agriculture and public health. Local stakeholders have emphasized the urgent need for comprehensive riverbank protection, embankment reinforcement, and environmental management to safeguard their livelihoods and the region's ecological balance.

1.6.2 Grievance Redress Mechanism

A three-tier, community-focused Grievance Redress Mechanism (GRM) will be established under the BWDB's Project Implementation Unit to promptly address project-related concerns, resolve implementation issues, and provide early warnings, ensuring efficient and inclusive stakeholder engagement throughout the project lifecycle.

1.6.3 Stakeholder Engagement Plan

The Stakeholder Engagement Plan (SEP) involves continuous, inclusive communication across all project phases. During preparation, the Bangladesh Water Development Board (BWDB) and Project Implementation Unit (PIU) engaged flood-affected and vulnerable communities through public meetings, targeted sessions for women and vulnerable groups, and dissemination of project documents such as the Environmental and Social Management Framework (ESMF), Labor Management Procedures (LMP), Stakeholder Engagement Plan (SEP), Environmental and Social Commitment Plan (ESCP), and Resettlement Policy Framework (RPF).

Engagement methods includes face-to-face interactions, mass/social media, brochures, posters, and information boards. During construction, quarterly meetings and routine interactions will address health and safety, employment opportunities, and project updates, with special focus on Gender-Based Violence (GBV) awareness involving NGOs, local leaders, and community members. In the operation phase, the PIU continues to outreach through newsletters, the project website, and the Grievance Redress Mechanism (GRM), ensuring feedback collection and issue resolution as needed. Throughout, the PIU will coordinate with internal and external stakeholders, including NGOs and government departments, to maintain transparency and responsiveness.

1.7 Recommendations

Recommendations are made based on baseline conditions, impacts, mitigations measures, stakeholder consultations and importance of the project:

- It is suggested to implement the project interventions in the five districts following the recommended mitigation measures as specified in the ESMP. The ESMP shall be included in the bid document of civil works of all packages and need to become part of the civil works contracts;
- Timely implementation of ESMP shall be ensured by engaging a third-party as the Monitoring Consultant;
- The affected people shall be compensated before start of the project (if raised);
- In order to ensure contractor's compliance with the mitigation measures the Environmental and Social Monitoring Plan shall be strictly followed;
- Both BWDB and the contractor shall abide by relevant environmental rules, regulations including workers' health and safety aspect, prevention of air and water pollution and protection of fauna and flora.

CHAPTER-2: INTRODUCTION

2.1 Background

Flooding in Bangladesh is a recurring and highly devastating natural disaster that affects millions of people annually. Low-lying geography and proximity to major river systems like the Ganges, Brahmaputra, and Meghna, Bangladesh is highly prone to heavy monsoon rains and river overflow. These floods can inundate vast areas, displacing communities, destroying crops, and causing extensive damage to infrastructure. The public health consequences are equally severe, with the proliferation of waterborne diseases and widespread malnutrition in affected regions. Despite continued efforts to enhance flood management and response strategies, Bangladesh faces persistent challenges, underscoring the urgent need for both national and international support to build resilience and adapt to the growing frequency of extreme weather events exacerbated by climate change.

Bangladesh experienced extreme rainfall from mid-August to early September 2024, resulting in severe flooding in late August that impacted 73 upazilas (sub-districts) and 528 unions or municipalities across 11 districts in northeastern and southeastern Bangladesh. These 11 districts are Noakhali, Sylhet, Maulvibazar, Habiganj, Brahmanbaria, Cumilla, Feni, Lakshmipur, Khagrachhari, Chattogram, and Cox's Bazar. The scale of the disaster has led to substantial loss of life, widespread damage to infrastructure, and severe disruption to daily life and economic activities. In response to this urgent situation, an emergency flood response project is proposed to address immediate needs in Noakhali, Brahmanbaria, Cumilla, Feni, and Lakshmipur districts. This project is being prepared by Bangladesh Water Development Board (BWDB) with financing from the World Bank to mitigate the impacts from severe flooding.

2.2 Purpose of the ESIA

The project activities include riverbank protection works, rehabilitation of embankments and water control structures as well as khal excavation which may have impacts on the surrounding environment. Therefore, an Environmental and Social Impact Assessment (ESIA) study is essential prior to implement work, for assessing the impact of the intervention on the surrounding environment and formulate mitigation measures for the potential environmental impacts. BWDB, the implementing agency for this project, is very much concerned about the environmental issues and strict in carrying out the project activities in an environmentally compatible and socially responsible manner with commitment to conserve biodiversity. In view of the above, BWDB has undertaken this environmental and social impacts study including an environmental management plan and monitoring plan.

2.3 Legal and Institutional Framework

Bangladesh Water Development Board (BWDB) operates under the legal framework established by the Water Development Board Act, 2000 (Act No. XXVI). This act mandates BWDB to undertake both structural and non-structural measures for water resources management. BWDB is guided by National Water Policy (1999), National Water Management Plan (2001) and Bangladesh Delta Plan 2100 (2018). BWDB is responsible for flood control, riverbank protection, irrigation and water harvesting, construction and maintenance of embankments, water control structures and so on. Most of the BWDB projects, including the proposed project, fall under the ‘red’ category project stipulated by Environment Conservation Rules, 2023 since this project is within or on the banks of the rivers, khals and waterbodies etc. Therefore, detailed EIA is needed for the project. Moreover, compliance with World Bank Environmental and Social Standards (ESSs) is required as this is a World Bank funded project. The Legal and institutional frameworks are discussed in details in **Chapter-4**.

2.4 Scope of the Study

The present ESIA study is carried out to ensure that the environmental and social issues are adequately considered in designing and implementation of the project. The study follows the Guidelines of Department of Environment (DoE) and Water Resources Planning Organization (WARPO). Stakeholder consultations are carried out with consideration of local beneficiaries, affected persons, local government agencies, and gender balance in different phases of the study.

The scope of works of the study includes:

- Assessment of the baseline physical, biological and socio-economic environment;
- Selection of Valued Environmental and Social Components (VESC) which are likely to be impacted by the proposed interventions for drainage improvement;
- Identification of any possible impacts of the proposed project on the identified VESC;
- To recommend an Environmental Management Plan (EMP) to minimize and mitigate the adverse impacts to revive the VESC and to improve or at least restore their pre project condition;
- To devise a monitoring plan for proper implementation of the EMP;
- To carry out social survey including questionnaire survey, Focus Group Discussions (FGD), Community Consultations (CC), Key Informant Interviews (KII) for assessment of social impacts and potential mitigation measures.

2.5 ESIA Team

The study team has been formed for carrying out the current ESIA study successfully, having their areas of expertise in the related field. The positions are assigned to each team members accordingly in order to accomplish the work smoothly and timely. The team composition is shown in **Table 2-1**.

Table 2-1: Study Team Composition

Sl No.	Name	Position
1	Zahirul Haque Khan	Team Leader
2	Farhana Akhter Kamal	Senior Environmental Specialist
3	Md. Nesaruddin	Social/People's Participation Specialist
4	Dr Md Golam Mustafa	Ecologist/ Fisheries Expert
5	Dr Mohammad Abdus Salam Sikder	Senior Disaster Management and Emergency Response Specialist
6	Shaikh Nahiduzzaman	Hydrologist/Drainage and Flood Management Specialist
7	Md Zahid Hasan Siddiquee	GIS Expert
8	Md. Mainul Islam	Junior Environmental Specialist
9	Md. Sakibuzzaman	Junior Environmental Specialist
10	Md Anamul Hoque Helal	Junior Social Specialist
11	Md. Arifur Rahman	Field Engineer
12	Md Jafrul Islam	Junior Environmental Specialist

2.6 Structure of the Report

The report is divided into eleven chapters that follow the activities stipulated in the TOR of the ESIA study:

Chapter 1 - Executive Summary

Chapter 2 - Introduction: this chapter describes the background, purpose of the ESIA, legal and institutional framework, scope of the study, and structure of the report;

Chapter 3 - Project Description: this chapter contains project location and components, project activities during different phases, project alternatives considered, and associated facilities etc.;

Chapter 4 – Policy, Legal, and Regulatory Framework: it discusses on relevant national environmental and social legislations, applicable World Bank environmental and social Standards and other relevant international obligations.

Chapter 5 – Environmental and Social Baseline: this chapter presents baseline conditions of physical, biological and socio-economic environment in the Project Influence area. It also includes the cultural heritage present in the project influence area and a summary of data sources and methods used.

Chapter 6 – Environmental and Social Impacts: this chapter identifies Valued Environmental and Social Components (VESC), key risks and impacts of the project interventions on the

VESCs, impact assessment methodology, significance of impacts and cumulative impacts in the project influence area.

Chapter 7 – Mitigation Measures and Impact Management: the chapter outlines the environmental and social mitigation hierarchy, residual impacts after mitigation, climate change consideration and adaptation measures, and resource efficiency and pollution prevention.

Chapter 8 – Environmental and Social Management Plan (ESMP): the chapter presents the detailed ESMP including the mitigation and monitoring measures, roles and responsibilities, implementation schedule, capacity building and training needs and budget estimates for ESMP implementation.

Chapter 9 – Stakeholder Engagement: this chapter contains stakeholder identification and analysis, engagement activities, consultation process, key issues raised and responses, Grievance Redress Mechanism (GRM) and future engagement plan.

Chapter 10 – Institutional Arrangement and Capacity: the chapter presents the implementation structure, roles of the government, [proponent contractors etc., environmental and social capacity assessment and recommendations for institutional strengthening.

Chapter 11 – Monitoring and Reporting: the chapter outlines monitoring indicators, methodology, frequency and responsibility, reporting requirements and adaptive management measures.

Chapter 12 - Conclusions and Recommendations

CHAPTER-3: PROJECT DESCRIPTION

3.1 Project Location and Components

The project location is concentrated in five districts that bore the brunt of the recent flood disaster, as illustrated in **Table 3-1** and **Figure 3-1**. These districts represent some of the most flood-affected regions within the Chittagong division, where inundation caused widespread damage to infrastructure, livelihoods, and natural ecosystems. The chosen focus on these areas aligns with the project's aim to prioritize interventions where they are most urgently needed and will have the greatest impact.

Table 3-1: Location of the Study

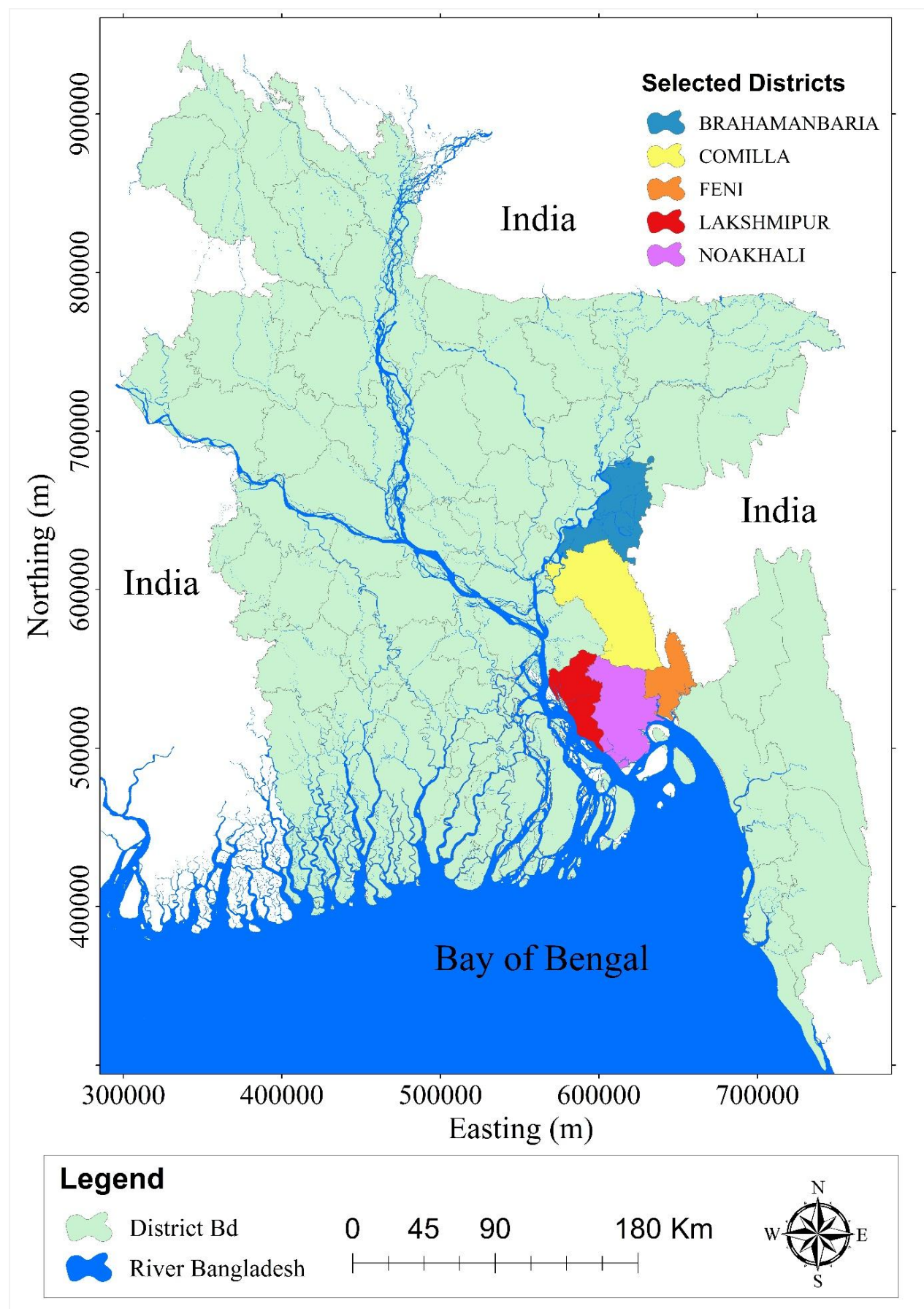
Division	District
Chattogram	Brahmanbaria
	Cumilla
	Feni
	Noakhali
	Lakshmipur

The project activities include riverbank protection works, rehabilitation of embankments and water control structures as well as khal excavation in response to the damages due to devastating flood in August 2024 and protect the infrastructure from future floods. The proposed interventions of the project are highlighted in **Table 3-2**.

Table 3-2: Proposed interventions

Interventions	Unit	Quantity in individual district					Total
		Feni	Noakhali	Cumilla	Laxmipur	Brahmanbaria	
Permanent bank protection works	km	3.14		2.40		0.25	5.79
Precautionary bank protection works	km	10.13	9.85		10.40		30.38
Slope protection works	km			2.555			2.56
Permanent bank and slope protection works	km					1.13	1.13
Regulator repair	No.	20.00			1		21

Repair of Embankment	km	24.55		46.00		2.00	72.55
Khal re-excavation	km			7	12.6		19.60



3.1.1 Bank and Slope Protection Works

The catastrophic 2024 flood in Feni has led to extensive riverbank erosion, endangering critical infrastructure, agricultural lands, and the establishments of residents. The immediate threat posed by continued erosion requires a rapid and effective response to stabilize the riverbanks and prevent further damage. Sand-filled Polypropylene geo-bags and sand-cement polyester geo-textile bag offer an ideal immediate solution for this purpose. These durable and cost-effective structures can be quickly deployed to create a protective barrier, dissipating the energy of river currents and shielding vulnerable areas from erosion. A key factor in the success of this method is the availability of sand in the region, which ensures the timely implementation of this protection work considering the long-term solution is on process.

Feni District

Bank protection measures have been proposed at various locations across Feni district. The interventions include both permanent and precautionary works, covering a total length of 13.27 kilometres (3.14 km permanent and 10.13 km precautionary). Targeted rivers include the Feni River, Little Feni River, Selonia River, Muhuri River, Kahua River, and Matubhuiyan River. The focus is on mitigating erosion and flood risks, with measures implemented in key areas such as Char Koaj, Lemua Bridge, and other vulnerable sites. These efforts aim to reinforce flood defences, stabilize slopes, and protect local communities and infrastructure from future disasters. **Figure 3-2, Figure 3-3 and Figure 3-5** shows the bank protection locations in Feni River, Little Feni and Matubhuiyan River, and Selonia River, respectively.

Table 3-3: Proposed Bank and Slope Protection Works in Feni District

Sl	Upzaila	Union	River Name	Bank Side (Left/Right)	Chainage (km)	Type of Interventions	Length (m)	
							Permanent	Pre-cautionary
1	Mirsharai	Karerhat	Feni	Left	KM 44+650 to KM 45+150	Pre-cautionary		500
2	Feni Sadar	Farhadnagar	Feni	Right	KM 54+600 to KM 54+750	Permanent	150	
3	Feni Sadar	Farhadnagar	Feni	Right	KM 54+830 to KM 54+872	Permanent	42	
4	Mirsharai	Osmanpur	Feni	Right	KM 66+350 to KM 66+550	Permanent	200	
5	Mirsharai	Ichchakhali	Feni	Right	KM 66+650 to KM 66+710	Permanent	60	
6	Mirsharai	Ichchakhali	Feni	Right	KM 67+050 to KM 67+200	Permanent	150	
7	Daganbhuiyan	Sindurpur	Little Feni	Right	KM 56+315 to KM 56+525	Pre-cautionary		210

Sl	Upzaila	Union	River Name	Bank Side (Left/Right)	Chainage (km)	Type of Interventions	Length (m)	
							Permanent	Pre-cautionary
8	Feni Sadar	Baligaon	Little Feni	Left	KM 36+715 to KM 36+835	Pre-cautionary		120
9	Feni Sadar	Char Majlishpur	Little Feni	Right	KM 35+140 to KM 35+400	Pre-cautionary		260
10	Sonagazi	Char Majlishpur	Little Feni	Left	KM 32+650 to KM 32+900	Pre-cautionary		250
11	Sonagazi	Char Majlishpur	Little Feni	Right	KM 32+150 to KM 32+250	Permanent	100	
12	Sonagazi	Char Majlishpur	Little Feni	Right	KM 49+050 to KM 49+150	Permanent	100	
13	Sonagazi	Char Majlishpur	Little Feni	Left	KM 31+560 to KM 31+785	Pre-cautionary		225
14	Sonagazi	Char Majlishpur	Little Feni	Left	KM 29+520 to KM 29+970	Permanent	450	
15	Sonagazi	Char Majlishpur	Little Feni	Left	KM 28+140 to KM 28+380	Pre-cautionary		240
16	Sonagazi	Char Majlishpur	Little Feni	Right	KM 27+520 to KM 27+670	Pre-cautionary		150
17	Sonagazi	Char Majlishpur	Little Feni	Left	KM 25+925 to KM 26+070	Permanent	145	
18	Sonagazi	Char Majlishpur and Daganbhuiyan	Little Feni	Left	KM 24+730 to KM 25+040	Pre-cautionary		310
1	Daganbhuiyan	Daganbhuiyan	Little Feni	Right	KM 24+975 to KM 25+375	Pre-cautionary		400
2	Sonagazi	Char Majlishpur	Little Feni	Right	KM 23+550 to KM 24+050	Pre-cautionary		500
3	Sonagazi	Char Majlishpur	Little Feni	Left	KM 22+220 to KM 22+520	Pre-cautionary		300
4	Sonagazi	Bagadana	Little Feni	Left	KM 19+830 to KM 19+980	Pre-cautionary		150
5	Sonagazi	Char Darbesh	Little Feni	Left	KM 18+975 to KM 19+325	Pre-cautionary		350
6	Daganbhuiyan	Daganbhuiyan	Little Feni River	Left	KM 43+165 to KM 43+365	Permanent		200
7	Daganbhuiyan	Mathu bhuiyan	Matu-bhuiyan Khal	Right	KM 01+350 to KM 01+480	Permanent	130	
8	Daganbhuiyan	Mathu bhuiyan	Matu-bhuiyan Khal	Right	KM 02+650 to KM 03+050	Permanent	400	

SI	Upzaila	Union	River Name	Bank Side (Left/Right)	Chainage (km)	Type of Interventions	Length (m)	
							Permanent	Pre-cautionary
9	Dagan-bhuiyan	Mathu bhuiyan	Matu-bhuiyan Khal	Left	KM 03+525 to KM 03+837	Permanent	312	
10	Dagan-bhuiyan	Char Majlishpur	Matu-bhuiyan Khal	Left	KM 05+670 to KM 05+790	Permanent	120	
11	Dagan-bhuiyan	Mathu bhuiyan, Char Majlishpur and Dagan bhuiyan	Matu-bhuiyan Khal	Right	KM 05+970 to KM 06+370	Permanent	400	
12	Dagan-bhuiyan	Char Majlishpur	Matu-bhuiyan Khal	Left	KM 06+250 to KM 06+500	Permanent	250	
13	Dagan-bhuiyan	Char Majlishpur	Matu-bhuiyan Khal	Left	KM 07+580 to KM 07+650	Permanent	70	
1	Feni Sadar	Sanua	Selonia	Right	KM 45+425 to KM 45+665	Pre-cautionary		240
2	Feni Sadar	Sanua	Selonia	Left	KM 45+680 to KM 45+725	Pre-cautionary		45
3	Feni Sadar	Sanua and Lemua	Selonia	Right	KM 45+720 to KM 45+780	Permanent	60	
4	Feni Sadar	Lemua	Selonia	Right	KM 45+790 to KM 45+990	Pre-cautionary		200
5	Feni Sadar	Lemua	Selonia	Right	KM 46+120 to KM 46+445	Pre-cautionary		325
6	Feni Sadar	Lemua	Selonia	Left	KM 46+500 to KM 46+850	Pre-cautionary		350
7	Feni Sadar	Sanua	Selonia	Left	KM 45+550 to KM 45+615	Pre-cautionary		115
8	Feni Sadar	Lemua	Selonia	Right	KM 47+525 to KM 47+664	Pre-cautionary		139
9	Feni Sadar	Lemua	Selonia	Left	KM 47+975 to KM 48+315	Pre-cautionary		340
10	Fulgazi	Anandapur	Selonia	Left	KM 28+655 to KM 28+735	Pre-cautionary		80
11	Fulgazi	Munshirhat	Selonia	Left	KM 23+320 to KM 23+380	Pre-cautionary		60
12	Fulgazi	Munshirhat	Selonia	Left	KM 24+385 to KM 24+485	Pre-cautionary		100
1	Feni Sadar	Lemua	Selonia	Right	KM 48+550 to KM 48+850	Pre-cautionary		300
2	Feni Sadar	Lemua	Selonia	Left	KM 48+900 to	Pre-		320

Sl	Upzaila	Union	River Name	Bank Side (Left/Right)	Chainage (km)	Type of Interventions	Length (m)	
							Permanent	Pre-cautionary
					KM 49+220	cautionary		
3	Feni Sadar	Nawabpur	Selonia	Right	KM 49+920 to KM 50+040	Pre-cautionary		120
4	Feni Sadar	Lemua and Nawabpur	Selonia	Left	KM 51+050 to KM 51+130	Pre-cautionary		80
5	Feni Sadar	Lemua	Selonia	Left	KM 51+550 to KM 52+110	Pre-cautionary		560
6	Feni Sadar	Farhadnagar and Nawabpur	Selonia	Left	KM 53+450 to KM 54+050	Pre-cautionary		600
7	Sonagazi	Nawabpur	Selonia	Right	KM 54+900 to KM 55+030	Pre-cautionary		130
1	Parshuram	Mirzanagar	Muhuri River	Right	KM 08+850 to KM 09+220	Pre-cautionary		370
2	Parshuram	Chithalia	Muhuri River	Left	KM 09+275 to KM 09+425	Pre-cautionary		150
3	Fulgazi	Fulgazi	Muhuri River	Left	KM 14+405 to KM 14+485	Pre-cautionary		80
4	Fulgazi	Fulgazi	Muhuri River	Right	KM 20+050 to KM 20+090	Pre-cautionary		40
5	Fulgazi	G. M. Hat	Muhuri River	Right	KM 28+668 to KM 28+733	Pre-cautionary		65
6	Fulgazi	G. M. Hat	Muhuri River	Right	KM 29+875 to KM 29+980	Pre-cautionary		105
7	Parshuram	Chithalia	Muhuri River	Left	KM 12+726 to KM 12+850	Pre-cautionary		124
8	Fulgazi	Fulgazi	Kahua River	Right	KM 10+120 to KM 10+260	Pre-cautionary		140
9	Fulgazi	Baksh Mohammad	Kahua River	Left	KM 12+100 to KM 12+140	Pre-cautionary		40
10	Fulgazi	Amzadhat	Kahua River	Right	KM 16+366 to KM 16+466	Pre-cautionary		100
11	Parshuram	Parshuram	Kahua River	Right	KM 04+320 to KM 04+400	Pre-cautionary		80
12	Fulgazi	Baksh Mohammad	Kahua River	Left	KM 12+610 to KM 12+740	Pre-cautionary		130
13	Parshuram	Parshuram	Kahua River	Left	KM 01+262 to KM 01+322	Pre-cautionary		60
14	Fulgazi	Baksh Mohammad	Kahua River	Left	KM 08+960 to KM 09+140	Pre-cautionary		180
15	Fulgazi	Baksh Mohammad	Kahua River	Left	KM 06+330 to KM 06+530	Pre-cautionary		200

Sl	Upzaila	Union	River Name	Bank Side (Left/ Right)	Chainage (km)	Type of Interventions	Length (m)	
							Permanent	Pre- cautionary
	BSTR/W DB/FEN/ PW/W-05	Construction of 1.864 km River bank protection on the Bank of Muhuri and Kahua River of Parshuram and Fulgazi upazila in Feni district						
Permanent bank protection works (km)							3.14	
Precautionary bank protection works (km)								10.13
Total bank protection work (Pre-cautionary+permanent) (km)							13.27	

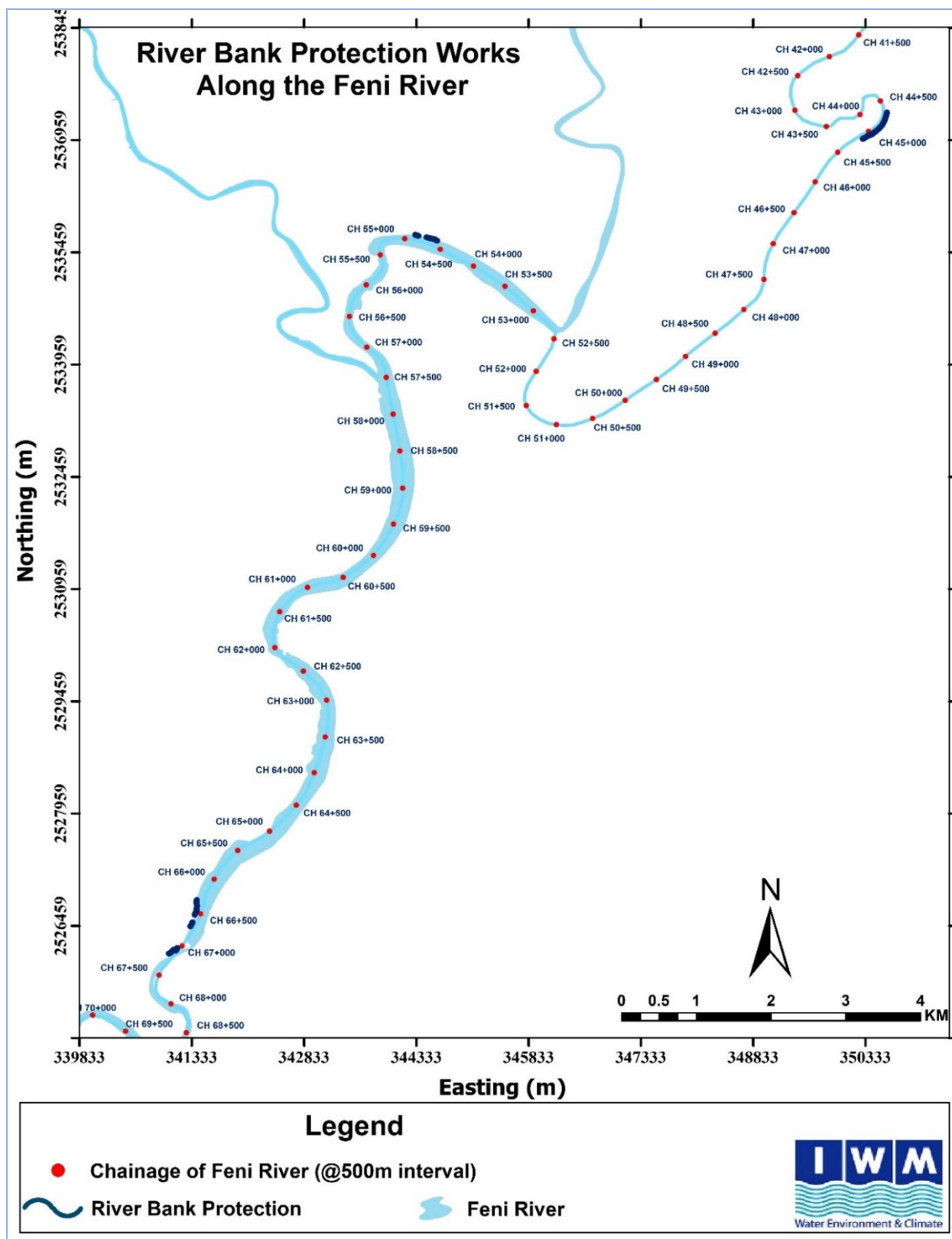


Figure 3-2: Bank protection in Feni River

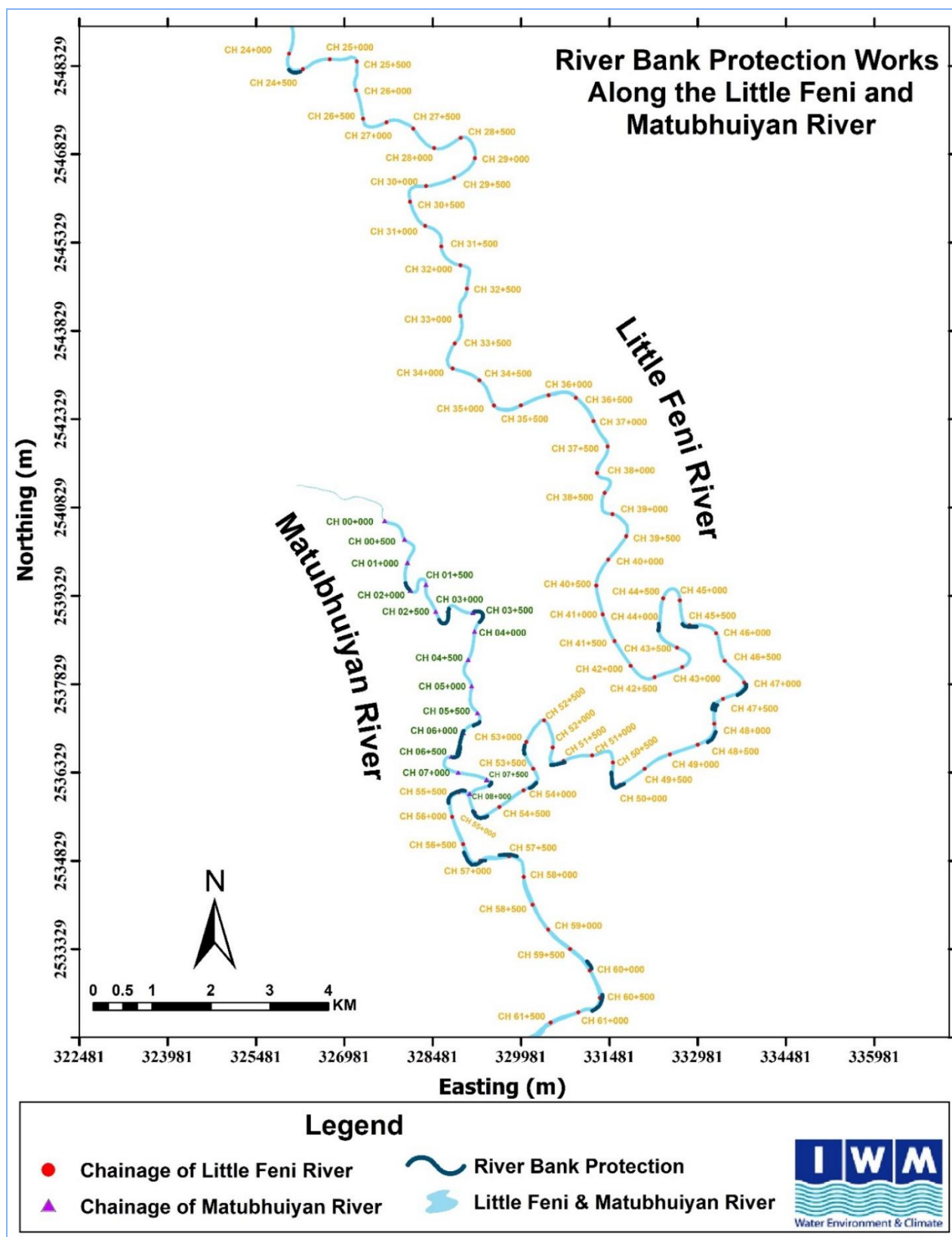


Figure 3-3: Bank protection in Little Feni & Matubhuiyan River

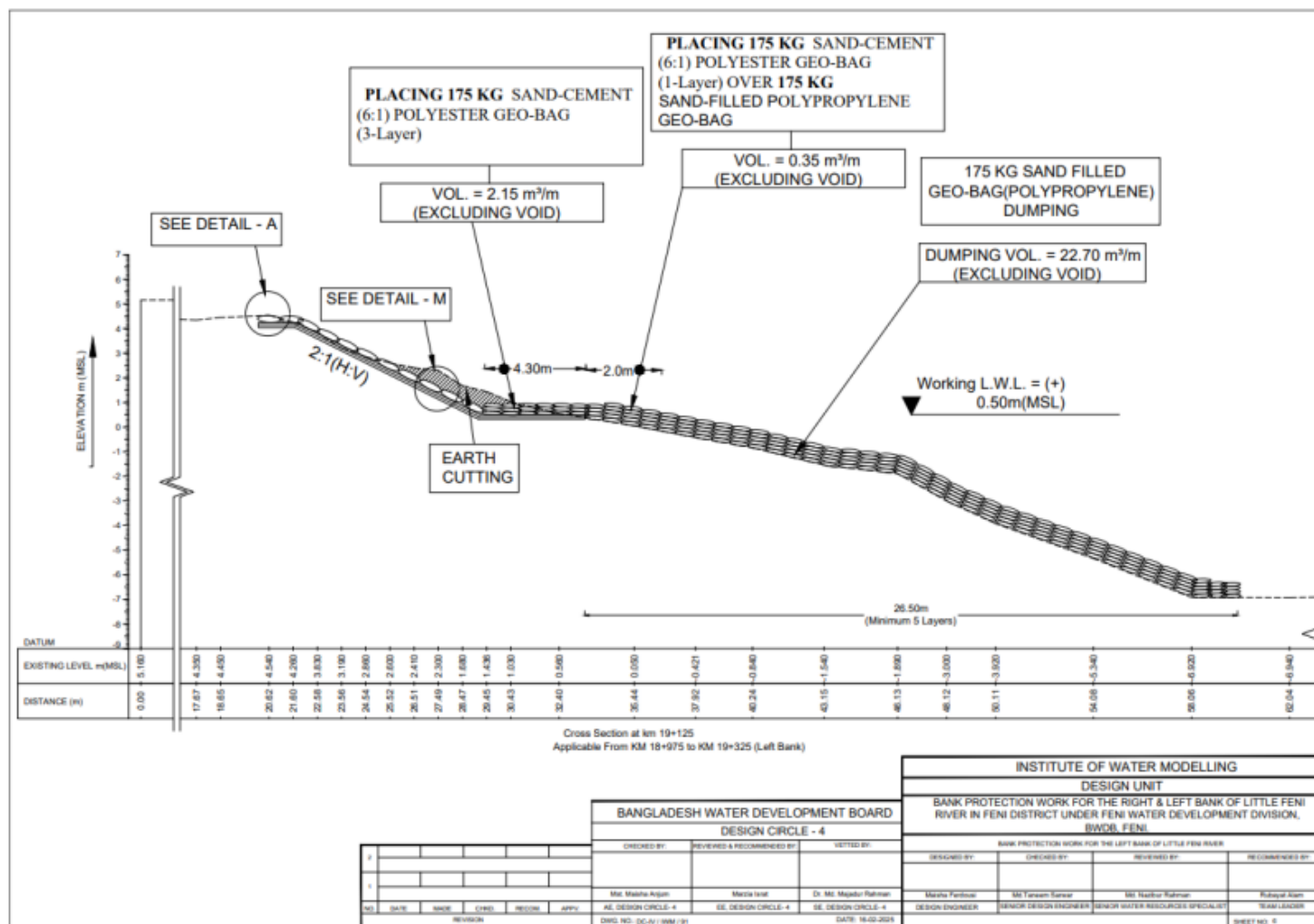


Figure 3-4: Cross section of protective measures in Little Feni River

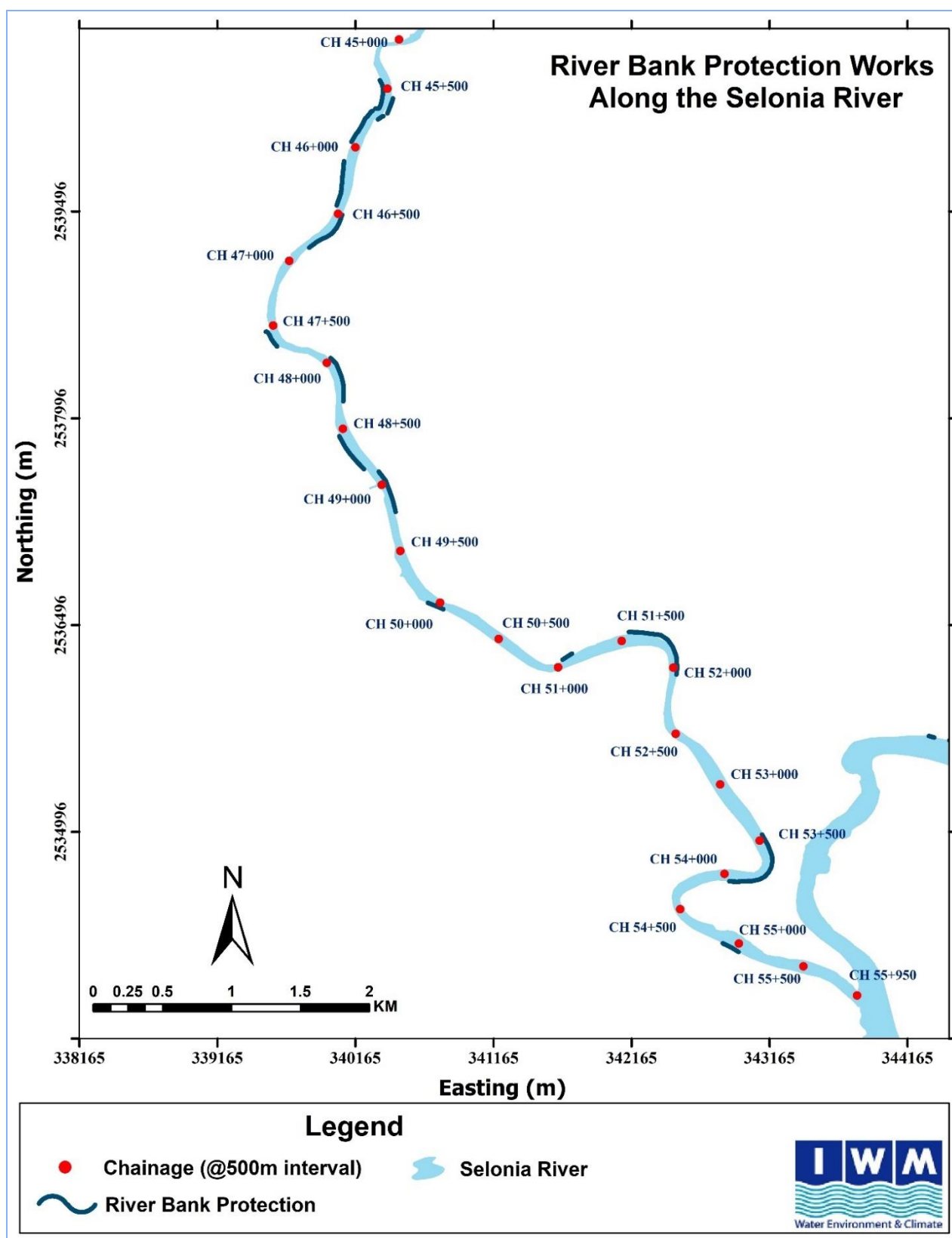


Figure 3-5: Bank Protection in Selonia River

Noakhali District

The outfall of the Little Feni River was regulated by a 23-vent structure at Musapur (locally known as the Musapur Regulator), which was destroyed during the extreme flood event of 2024. Following its collapse, the river's opening underwent significant changes, allowing flood tides to enter unimpeded. This influx of tidal currents suggests that the interplay between flood and ebb tides is likely to enhance the channel's dynamism. Consequently, homestead, infrastructure, and land in the surrounding areas have become highly vulnerable as the flood tide entry path continues to expand rapidly.

In response, the Bangladesh Water Development Board (BWDB) has initiated precautionary protective measures at select locations. However, immediate interventions are required for the remaining reaches in the lower part of the Little Feni River. Decisions regarding these interventions have been made by field visits, discussions with the residents, and consultations with BWDB officials. The Institute of Water Modelling (IWM) has proposed riverbank protection measures, as shown in **Figure 3-6**.

Figure 3-7 shows the proposed and existing bank protection work at the Noler Char Coast. The project includes the most vulnerable 6.0 km stretch of the Noler Char coast. However, BWDB has initiated CC block protection for only 4.9 km. Additional protection is needed, but these sections are not covered under this project due to the project budget limitations.

Table 3-4: Proposed precautionary bank protection works in Noakhali District

Union	Upazila	River	Location	Chainage (km - km)	Intervention	Pre-cautionary bank protection (km)
Musapur	Compani - ganj	Little Feni River	At Musapur near the eastside point of Musapur Closure Little Feni River Left Bank Bankline Ch km 1.50 to Ch km 2.50 = 1.00 km	Bankline Ch km 1.50 to Ch km 2.50 = 1.00 km	Precautionary bank protection works	1.00
Musapur	Compani- ganj	Little Feni River	At Musapur union upstream of the previous regulator diversion cannal Little Feni River right bank Bankline Ch km 2.00 to Ch km 3.50 = 1.50 km (river Ch km. 2.250 to km. 3.730)	Bankline Ch km 2.00 to Ch km 3.50 = 1.50 km	Precautionary bank protection works	1.50

Union	Upazila	River	Location	Chainage (km - km)	Intervention	Pre-cautionary bank protection (km)
Musapur	Compani-ganj	Little Feni River	At Musapur union 7 no. War, 1 no Sluice and 2 no sluice gate adjacent area polder 59/3C regulator diversion cannal Little Feni River right bank Bankline Ch km 4.00 to Ch km 5.350 = 1.350 km (River Ch. Km 4.230 to Ch km 5.050)	Bankline Ch km 4.00 to Ch km 5.350 = 1.350 km	Precautionary bank protection works	1.35
Chand nandi	Hatiya	Meghna River	Noler Char	Ch km 17+980 to Ch km 23+980	Precautionary bank protection works	6.00
Total precautionary bank protection work (km)						9.85

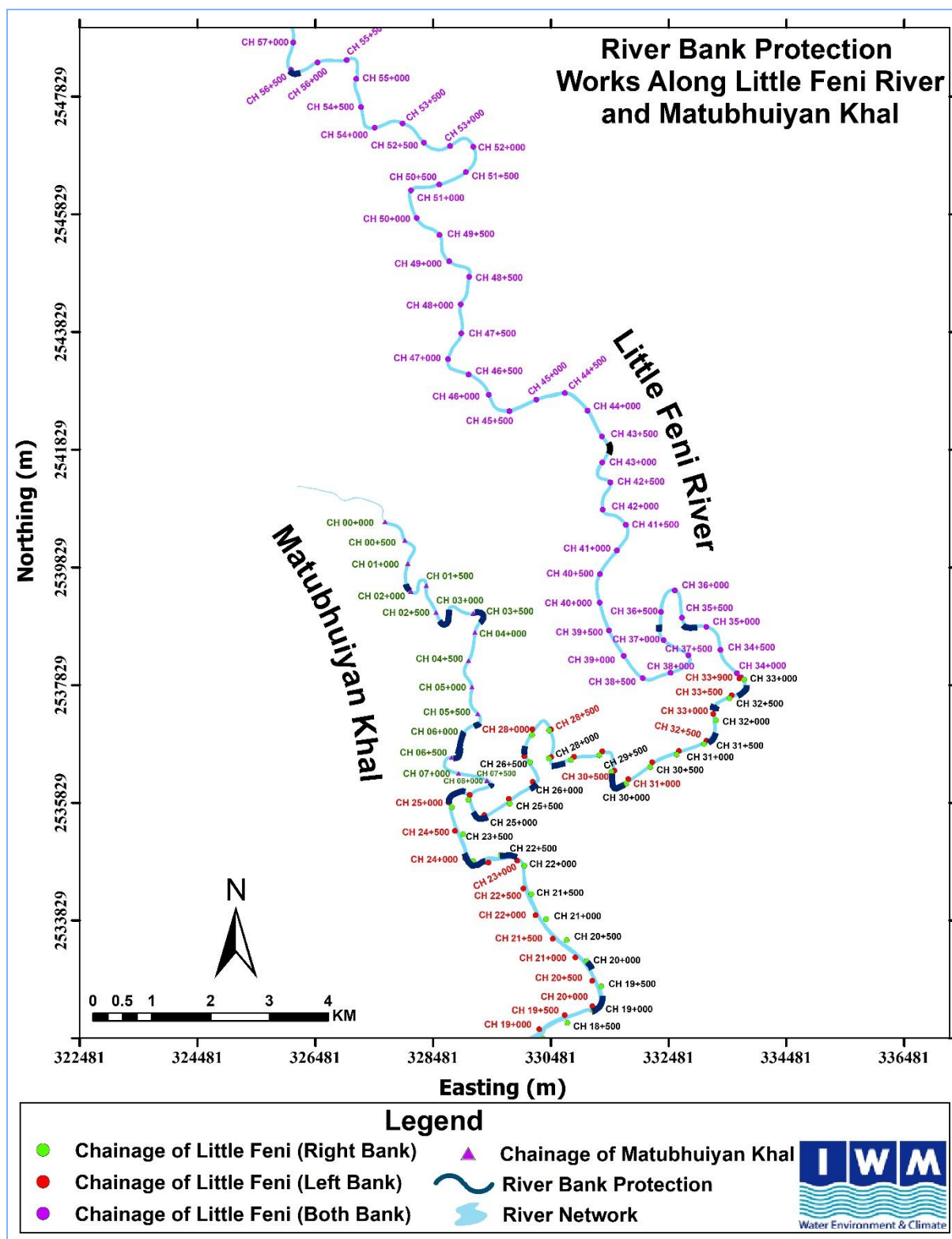


Figure 3-6: Proposed bank protection works for Little Feni River and Matubhuiyan Khal

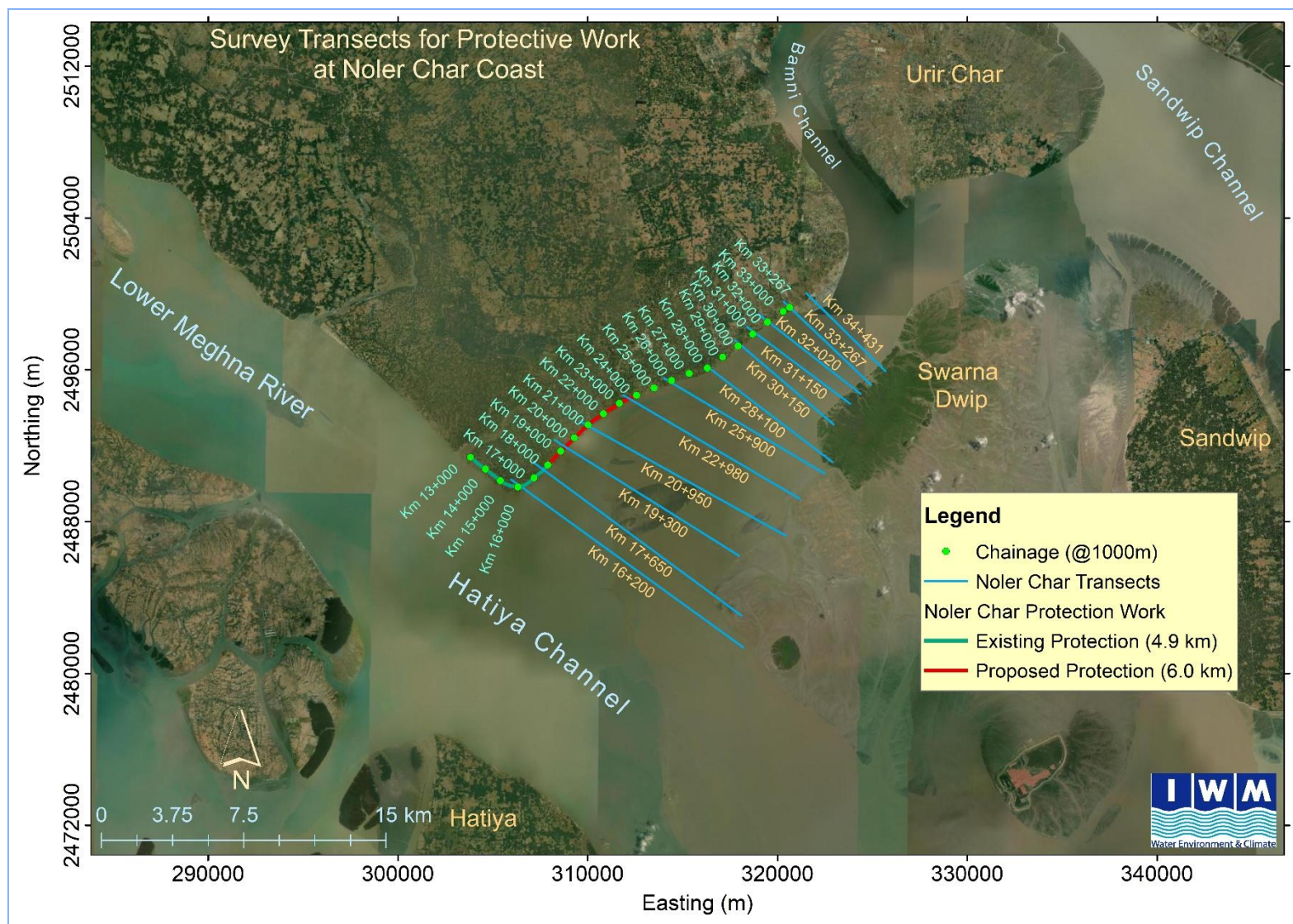


Figure 3-7: Proposed bank protection works for Noler Char Coast

Lakshmipur District

Rahmatkhali Khal and Wapda Khal have numerous bends that experienced severe erosion during the extreme flood event of 2024. The river's conveyance capacity is highly limited, and infrastructure development along both banks has further increased its vulnerability. IWM has identified these at-risk sites and recommended protective measures for 2.98 km of Rahmatkhali Khal and 7.02 km of Wapda Khal to prevent further erosion next monsoon. The details of the bank protection work for Lakshmipur district are shown in **Figure 3-8**.

Table 3-5: Proposed precautionary bank protection works in Lakshmipur District

Union	Upazila	River/ Canal	Location	Chainage (km - km)	Precautionary bank protection (km)
Shak Char	Lakshmipur Sadar	Rahmat khali Khal	Left bank	Km 00+300 to Km 00+550	0.250
Shak Char	Lakshmipur Sadar		Left bank	Km 03+400 to Km 03+945	0.546
Shak Char	Lakshmipur Sadar		Left bank	Km 08+800 to Km 09+300	0.500
Shak Char	Lakshmipur Sadar		Left bank	Km 09+800 to Km 10+286	0.487
Shak Char	Lakshmipur Sadar		Right bank	Km 04+100 to Km 04+600	0.500
Shak Char	Lakshmipur Sadar		Right bank	Km 04+900 to Km 05+300	0.401
Shak Char	Lakshmipur Sadar		Right bank	Km 09+200 to Km 09+500	0.300
Laharkandi	Lakshmipur Sadar	Wapda Khal	Left bank	Km 00+600 to Km 00+900	0.300
Laharkandi	Lakshmipur Sadar		Left bank	km 01+000 to Km 01+194	0.194
Laharkandi	Lakshmipur Sadar		Left bank	Km 01+850 to Km 02+050	0.200
Laharkandi	Lakshmipur Sadar		Left bank	Km 03+000 to Km 03+400	0.400
Laharkandi	Lakshmipur Sadar		Left bank	Km 05+200 to Km 05+580	0.381
Laharkandi	Lakshmipur Sadar		Left bank	Km 05+800 to Km 06+000	0.201
Laharkandi	Lakshmipur Sadar		Left bank	Km 06+400 to Km 06+600	0.201
Laharkandi	Lakshmipur Sadar		Left bank	Km 07+200 to Km 07+458	0.258
Laharkandi	Lakshmipur Sadar		Left bank	Km 07+830 to Km 08+160	0.330
Laharkandi	Lakshmipur Sadar		Left bank	Km 08+400 to Km 08+520	0.120
Laharkandi	Lakshmipur Sadar		Left bank	Km 08+800 to Km 09+132	0.333
Laharkandi	Lakshmipur Sadar		Left bank	km 09+580 to Km 09+845	0.265
Mandari	Lakshmipur Sadar		Right bank	Km 00+000 to Km 00+975	0.976
Mandari	Lakshmipur Sadar		Right bank	Km 01+400 to Km 01+900	0.500
Mandari	Lakshmipur Sadar		Right bank	Km 02+200 to Km 02+700	0.500
Mandari	Lakshmipur Sadar		Right bank	Km 03+500 to Km 03+808	0.308
Mandari	Lakshmipur Sadar		Right bank	Km 04+000 to Km 04+200	0.200
Mandari	Lakshmipur Sadar		Right bank	Km 04+800 to Km 05+564	0.764
Mandari	Lakshmipur Sadar		Right bank	Km 07+600 to Km 07+885	0.286
Mandari	Lakshmipur Sadar		Right bank	Km 09+100 to Km 09+400	0.300
Total precautionary bank protection work (km)					10.40



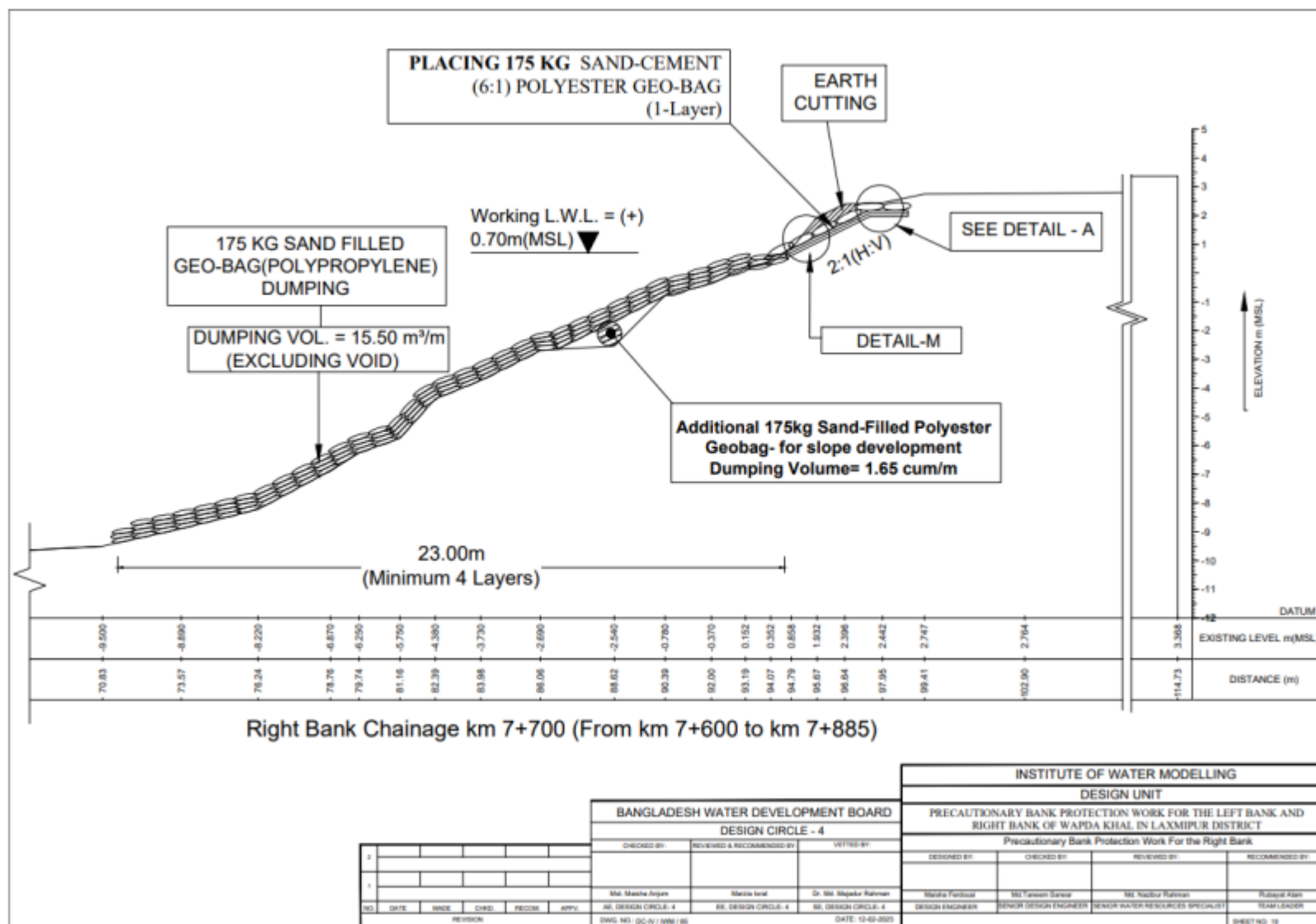


Figure 3-9: Proposed bank protection works for Lakshmipur district

Cumilla District

In Cumilla district, most of the damage occurred along both the left and right banks of the Gumti River. The embankment top and side slopes were eroded during the flooding period. Additionally, severe riverbank erosion was observed along the right embankment, while the side slopes of the left embankment sustained damage.

To address safety concerns, 2.56 km of slope protection and 2.40 km of riverbank protective work have been proposed. **Figure 3-10** illustrates the location and chainage of the proposed protection work along the left and right embankments in Cumilla district.

Table 3-6: Proposed River bank and Embankment slope protection works in Cumilla

Union	Upazila	River Name	Embankment	Protection Type	Chainage (km to km)	Protective length (Km)
Panchthubi	Cumilla Sadar (Kotwali)	Gumati	Left Bank	Slope Protection	Km 02+640-Km 02+740	0.10
Uttar Durgapur	Burichang	Gumati	Left Bank	Slope Protection	Km 15+940-Km 16+340	0.40
Mainamati	Burichang	Gumati	Left Bank	Slope Protection	Km 17+940-Km 18+340	0.40
Mainamati	Burichang	Gumati	Left Bank	Slope Protection	Km 19+000-Km 19+440	0.44
Mainamati	Burichang	Gumati	Left Bank	Slope Protection	Km 21+420-Km 21+920	0.50
Bharella	Burichang	Gumati	Left Bank	Slope Protection	Km 22+145-Km 22+250	0.10
Bharella	Burichang	Gumati	Left Bank	Slope Protection	Km 23+690-Km 23+810	0.12
Dakshin Jafarganj	Burichang	Gumati	Left Bank	Slope Protection	Km 28+565-Km 28+760	0.20
Uttar Jafarganj	Debidwar	Gumati	Left Bank	Slope Protection	Km 33+140-Km 33+440	0.30
Slope protection length (km)						2.56
Jagannathpur	Comilla Sadar (Kotwali)	Gumati	Right Bank	Bank Protection	Km 00+000-Km 00+200	0.20
Paurashava	Comilla Sadar (Kotwali)	Gumati	Right Bank	Bank Protection	Km 02+100-Km 02+300	0.20
Paurashava	Comilla Sadar (Kotwali)	Gumati	Right Bank	Bank Protection	Km 04+050-Km 04+250	0.20
Amratali	Comilla Sadar (Kotwali)	Gumati	Right Bank	Bank Protection	Km 08+400-Km 08+600	0.20
Mainamati	Burichang	Gumati	Right Bank	Bank Protection	Km 11+800-Km 12+050	0.25
Mainamati	Burichang	Gumati	Right Bank	Bank Protection	Km 15+825-Km 15+925	0.10
Bharella	Burichang	Gumati	Right Bank	Bank Protection	Km 18+975-Km 19+075	0.10
Uttar Jafarganj	Debidwar	Gumati	Left Bank	Bank Protection	Km 31+000-Km 31+150	0.15

Union	Upazila	River Name	Embankment	Protection Type	Chainage (km to km)	Protective length (Km)
Bharella	Burichang	Gumati	Right Bank	Bank Protection	Km 46+800- Km 47+007	0.20
Amratali	Comilla Sadar (Kotwali)	Gumati	Left Bank	Bank Protection	Km 66+100- Km 66+300	0.20
Mainamati	Burichang	Gumati	Left Bank	Bank Protection	Km 67+670- Km 67+770	0.10
Dakshin Jafarganj	Burichang	Gumati	Right Bank	Bank Protection	Km 50+720- Km 50+820	0.10
Uttar Jafarganj	Debidwar	Gumati	Right Bank	Bank Protection	Km 51+450- Km 51+550	0.10
Muradnagar	Muradnagar	Gumati	Right Bank	Bank Protection	Km 53+800- Km 54+000	0.20
Muradnagar	Muradnagar	Gumati	Submersible Embankment	Bank Protection	Km 57+480- Km 57+580	0.10
Bank protection length (km)						2.40
Total protective length (km)						4.96

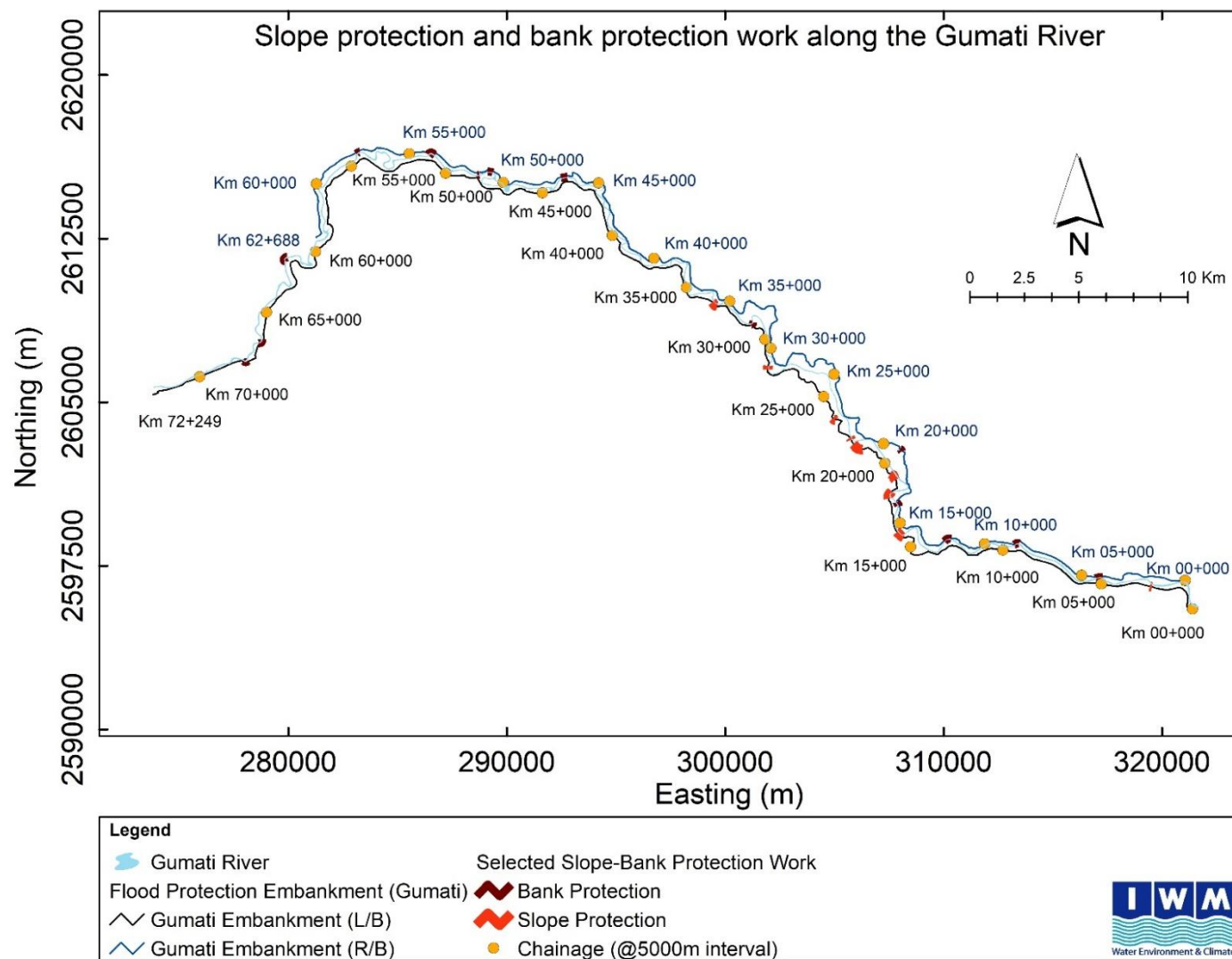


Figure 3-10: Slope and bank protection work along the left and right bank of the Gumati River

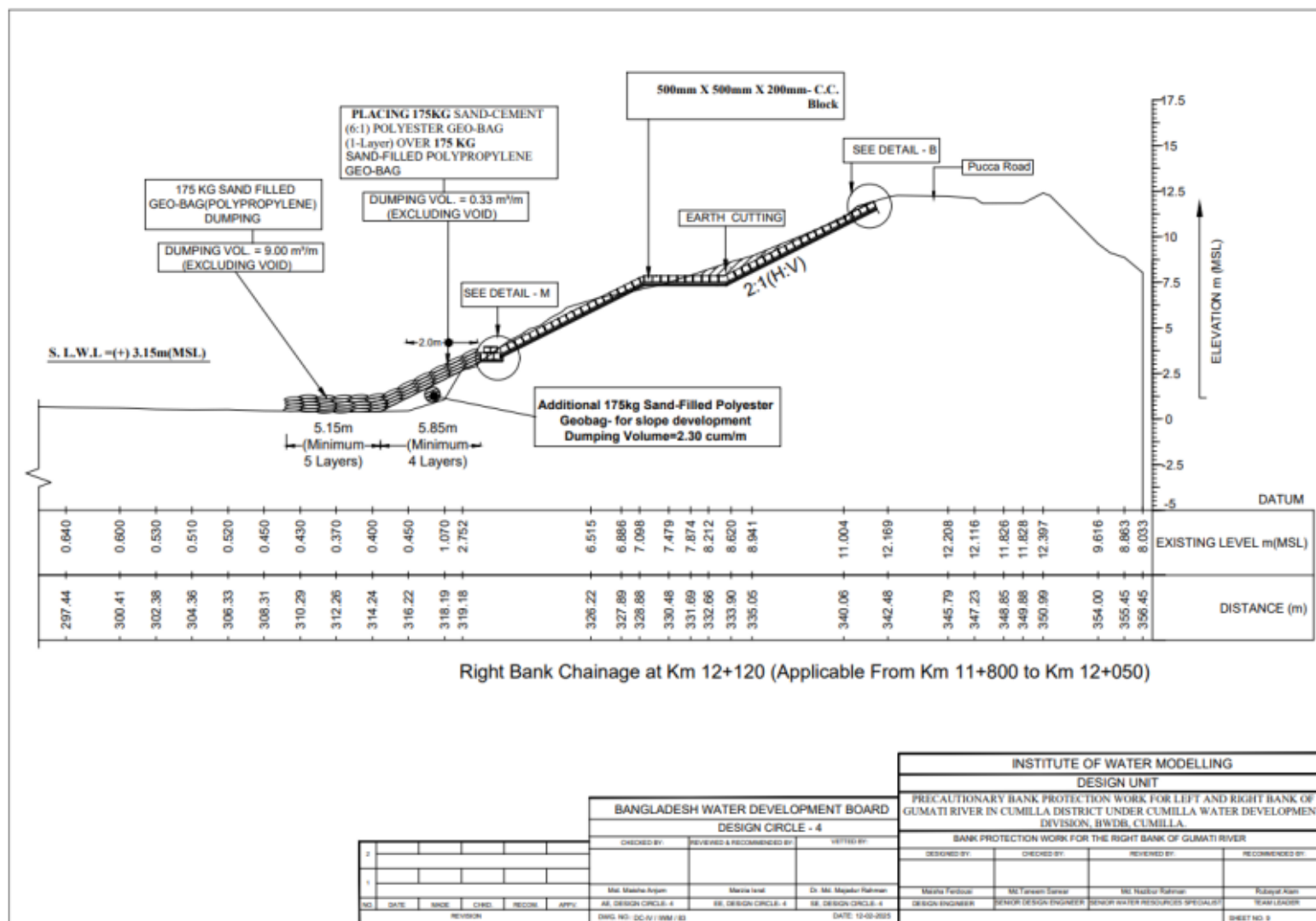


Figure 3-11: Protective works along Gumati River

Brahmanbaria District

The majority of the flood damage in Brahmanbaria district occurred along the Hawra River. Based on field visits, consultations with local stakeholders, and a detailed multicriteria analysis, bank protection was identified as a necessary intervention. Notably, the implementation of this intervention requires no resettlement, ensuring compliance with ES requirements.

The proposed measures include 1.134 kilometers of permanent bank and slope protection on both the left and right banks, along with an additional 0.250 kilometers of permanent bank protection on the left bank. These interventions aim to stabilize the riverbanks, mitigate erosion, and protect vital infrastructure and nearby communities from future flood risks. **Figure 3-12** shows the location of the slope protection and bank protection work along the Hawra River.

Table 3-7: River bank and slope protection works in Brahmanbaria

SL ID	Union	Upazila	River Name	Protection Type	Chainage (km to km)	Embankment	Protective length (Km)
1	Mogra	Akhaura	Hawra River	Permanent bank and slope protection works	Km 08+118-Km 08+270	Left Bank	0.152
2	Mogra	Akhaura	Hawra River		Km 10+680-Km 10+780	Left Bank	0.100
3	Mogra	Akhaura	Hawra River		Km 11+415-Km 11+815	Left Bank	0.400
Permanent bank and slope protection works (L/B)							0.652
1	Mogra	Akhaura	Hawra River	Permanent bank and slope protection works	Km 10+870-Km 11+270	Right Bank	0.400
2	Mogra	Akhaura	Hawra River		Km 11+485-Km 11+567	Right Bank	0.082
Permanent bank and slope protection works (R/B)							0.482
Total Permanent bank and slope protection works (km)							1.134
1	Mogra	Akhaura	Hawra River	Permanent bank protection works	Km 09+690-Km 09+940	Left Bank	0.250
Total Permanent bank protection works (km)							0.250
Total							1.384

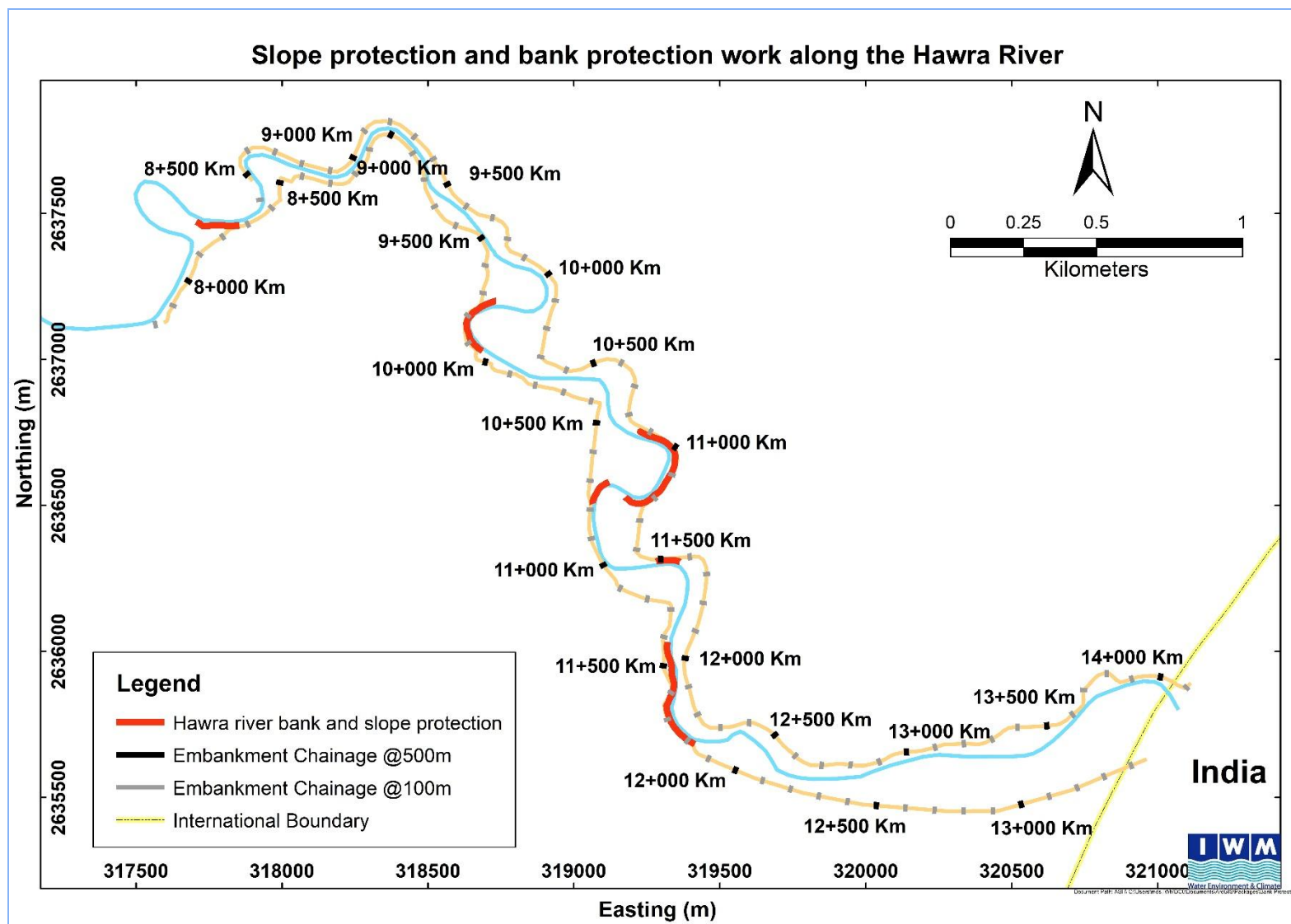


Figure 3-12: Slope protection and bank protection work along the Hawra River

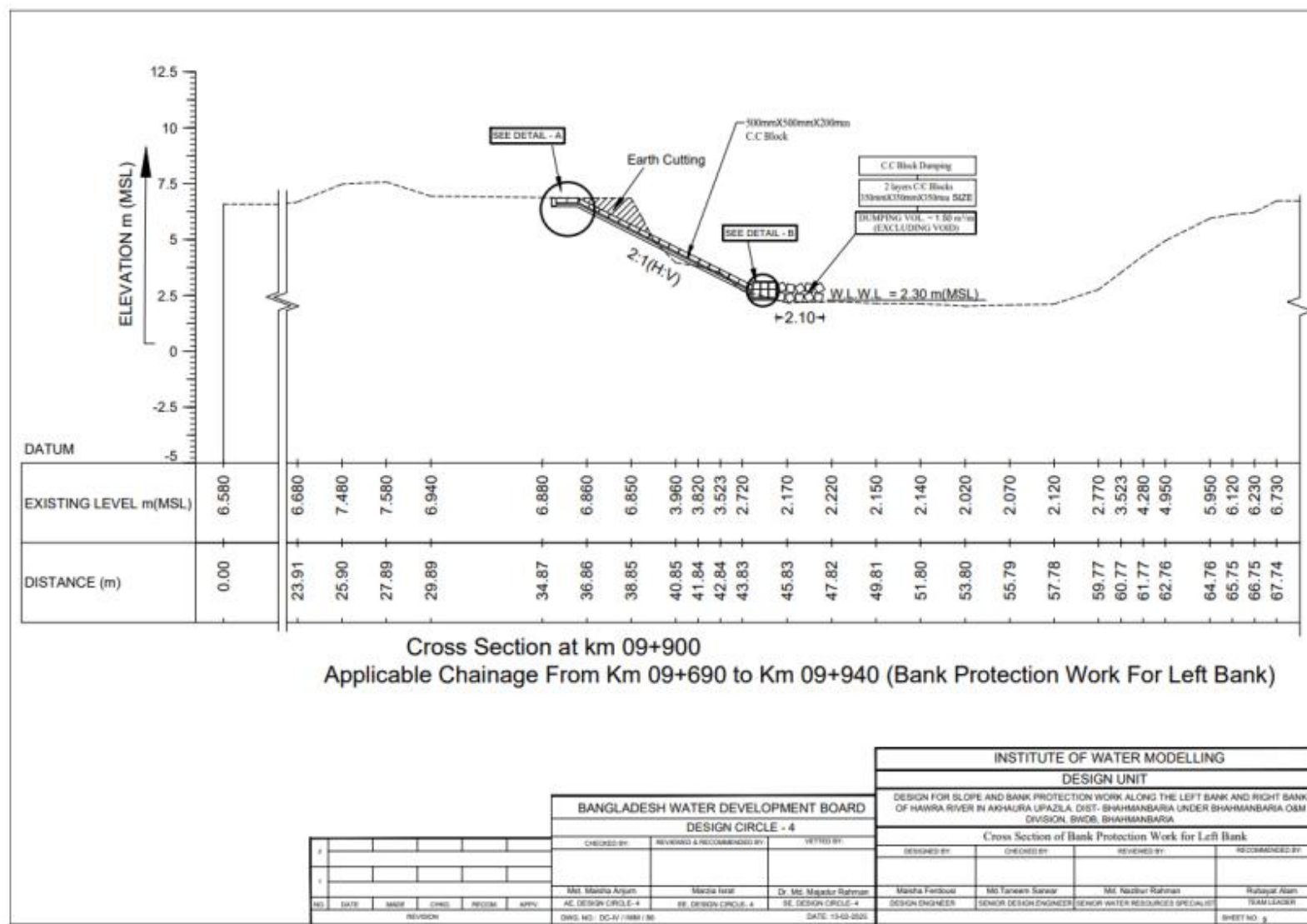


Figure 3-13: Slope protection and bank protection works cross section

3.1.2 Embankment Re-sectioning Work

Feni District

Kahua River, Muhuri River, and Selonia River left bank embankment

The 2024 flood severely impacted multiple villages in Feni's Fulgazi and Parshuram upazilas after heavy rainfall and an upstream torrent surge caused the Muhuri River embankment to breach. The embankment failed at three points, with the Muhuri River and surrounding catchments rising 150 cm above the danger level. This led to widespread inundation, affecting Feni, Parshuram, and Fulgazi upazilas. BWDB investigated the damaged embankment sections, and IWM prioritized the most severely affected reaches, identifying 24.55 km for re-sectioning. **Figure 3-14, Figure 3-15, and Figure 3-16** shows the locations of the embankment re-sectioning along the Kahua River, Muhuri River, and Selonia River left bank, respectively.

Table 3-8: River bank and slope protection works in Feni

Union	Upazila	Settlement	Gumati River Bank	Chainage	Embankment re-sectioning length (km)
Mogra	Akhaura	Hawra River	Right Bank Embankment	km 08+730 to km 09+210	0.48
Mogra	Akhaura	Hawra River	Right Bank Embankment	km 12+920 to km 13+050	0.13
Mogra	Akhaura	Hawra River	Right Bank Embankment	km 12+980 to km 13+770	0.79
<i>Embankment repair length at Hawra Embankment (R\B) (km)</i>					
Mogra	Akhaura	Hawra River	Left Bank Embankment	Km 11+190 to Km 11+790	0.60
<i>Embankment repair length at Hawra Embankment (R\B) (km)</i>					
Total Embankment repair (km)					2.00

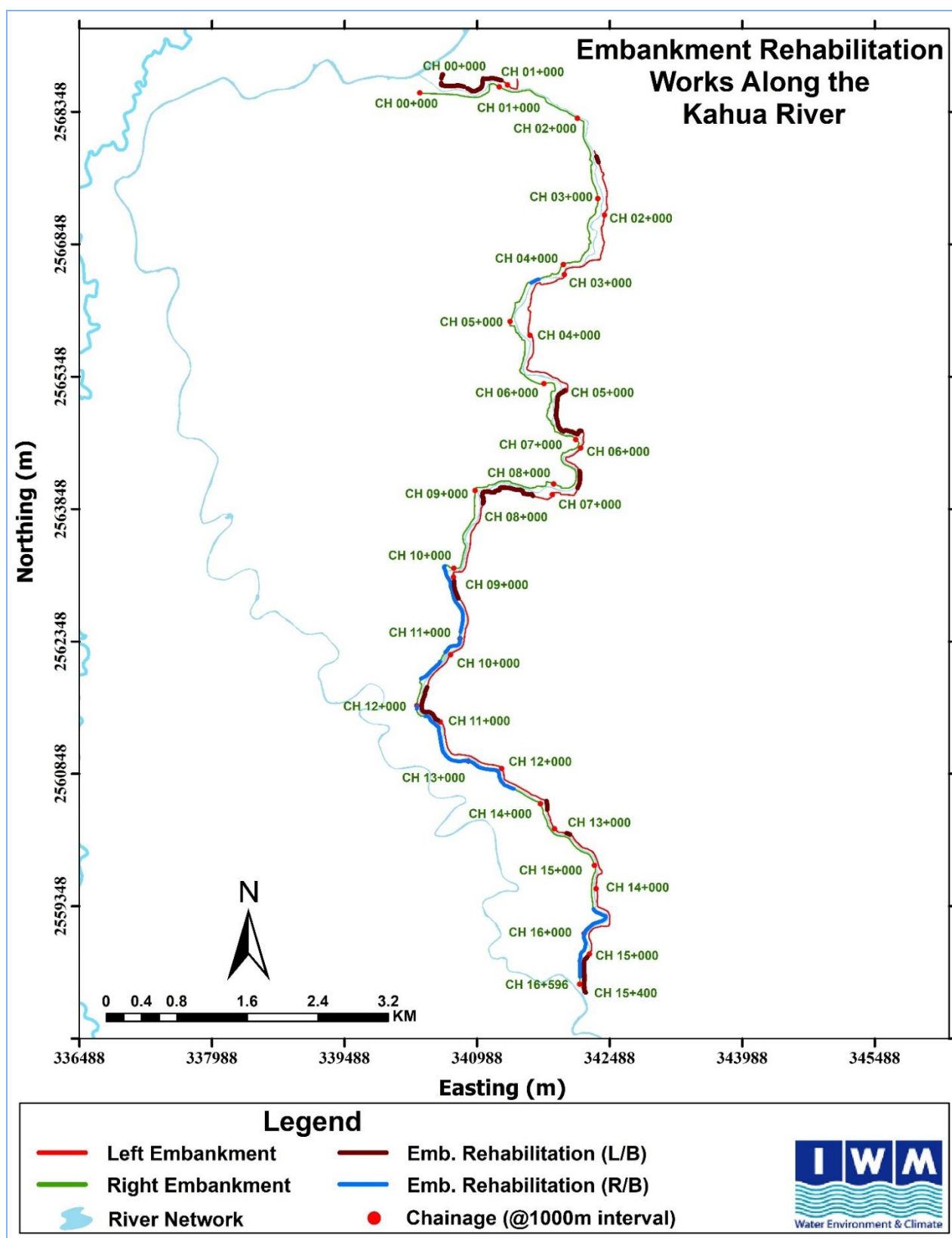


Figure 3-14: Embankment rehabilitation along the Kahua River

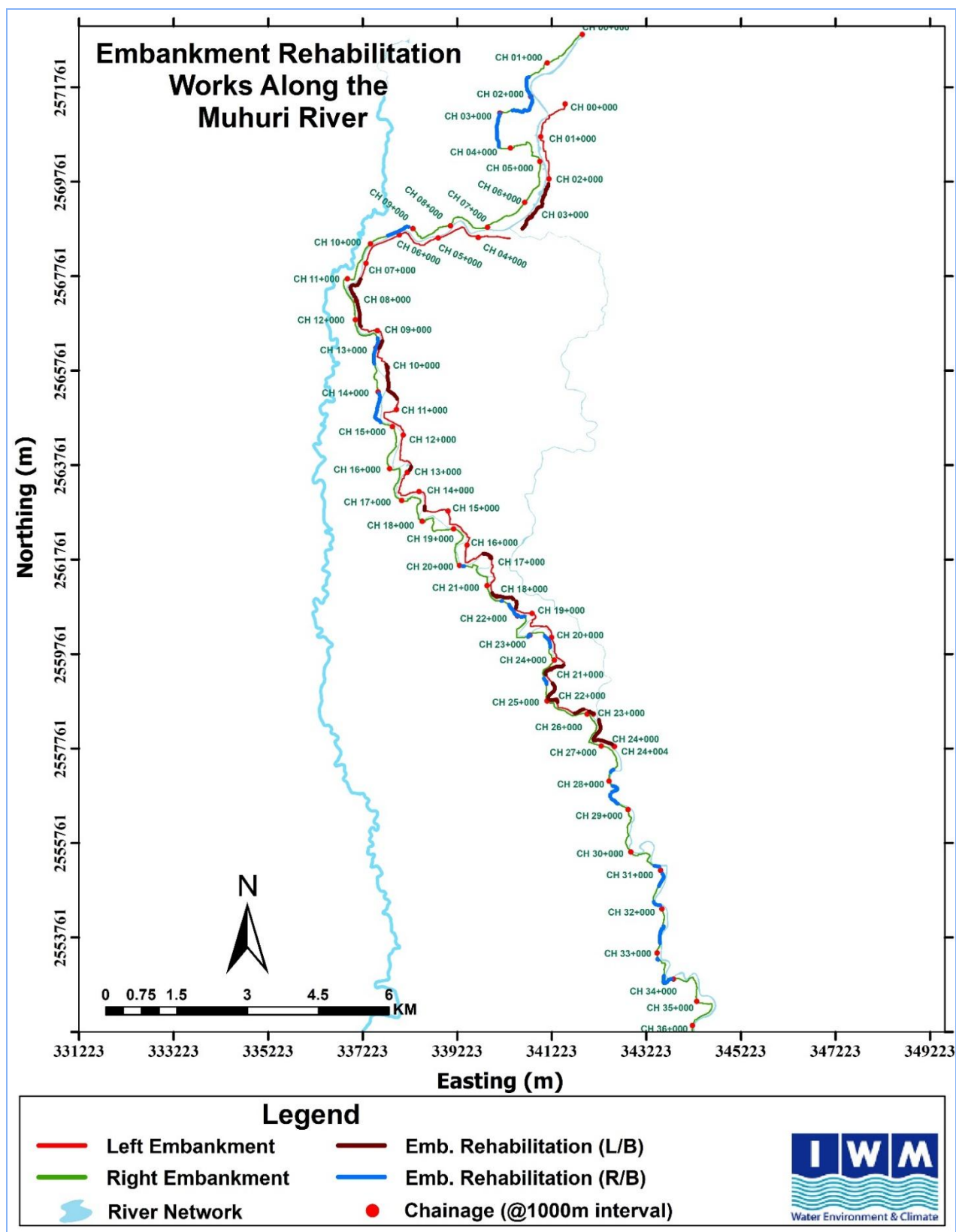


Figure 3-15: Embankment rehabilitation along the Muhuri River

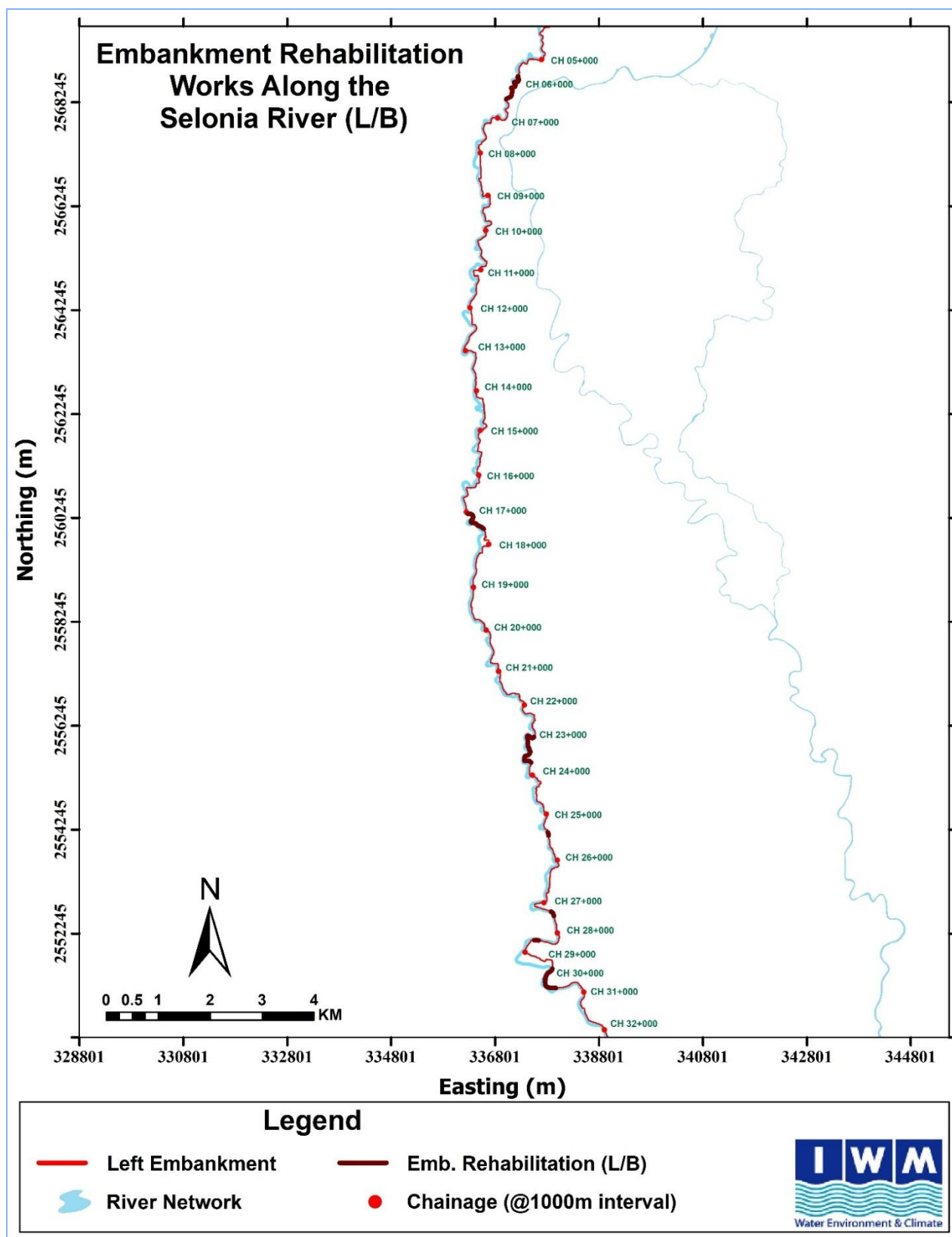


Figure 3-16: Embankment rehabilitation along the Selonia River left bank

Cumilla District**Gumati River Embankment**

The flood protection embankment along the Gumati River in Cumilla collapsed due to excessive rainfall and water inflow from India, affecting hundreds of families. The right embankment failed on 22 August 2024 at approximately 11:45 PM in the Buraburia area of Burichang Upazila. Additionally, other sections of the right and left embankments exceeded the danger level by 113 centimeters on the same day, breaking a 27-year record.

IWM identified several vulnerable reaches where BWDB had dumped geo-bags to prevent erosion of the embankment slopes. However, several sections were found to be under-designed and at risk of future flooding. It was recommended that both embankments be re-sectioned in areas with under-designed conditions. In this regard, IWM proposed re-sectioning 32.17 km of embankments (18.59 km on the left and 13.58 km on the right) where minor settlement issues exist. Additionally, about 15.83 km (7.05 km on the left and 8.77 km on the right) were considered for re-sectioning in areas with settlement issues and under-designed embankments.

Figure 3-17 shows the locations of the embankment re-sectioning work along the left and right embankment of the Gumati River.

Table 3-9: Proposed embankment repair works in Cumilla

River	Bank	Remarks	Union	Upazila	Chainage	Length (km)	Volume (m ³)
Gumati River	Right Bank	without settlement	Amratali	Burichang	km 10+300 to Km 11+523	1.223	7224
Gumati River	Right Bank	without settlement	Sholanal	Burichang	Km 12+200 to Km 12+805	0.606	21169
Gumati River	Right Bank	without settlement	Sholanal	Burichang	Km 14+300 to Km 15+900	1.600	32427
Gumati River	Right Bank	without settlement	Sholanal	Burichang	Km 15+900 to Km 16+500	0.600	16700
Gumati River	Right Bank	without settlement	Sholanal	Burichang	Km 17+100 to Km 17+500	0.400	10001
Gumati River	Right Bank	without settlement	Sholanal	Burichang	Km 17+500 to Km 18+300	0.800	26848
Gumati River	Right Bank	without settlement	Sholanal	Burichang	Km 19+300 to Km 19+700	0.400	18504
Gumati River	Right Bank	without settlement	Pir Jatrapur	Burichang	Km 20+500 to Km 21+641	1.141	14810
Gumati River	Right Bank	without settlement	Pir Jatrapur	Burichang	Km 25+500 to Km 26+064	0.565	8494
Gumati River	Right bank	with settlement	Fatehabad	Debidwar	Km 38+305 to Km 39+207	0.902	7351
Gumati River	Right Bank	without settlement	Fatehabad	Debidwar	Km 39+207 to Km 39+705	0.498	4059
Gumati River	Right bank	with settlement	Fatehabad	Debidwar	Km 39+705 to Km 39+906	0.201	1638
Gumati River	Right Bank	without settlement	Fatehabad	Debidwar	Km 39+906 to Km 40+109	0.203	1654

River	Bank	Remarks	Union	Upazila	Chainage	Length (km)	Volume (m ³)
Gumati River	Right bank	with settlement	Subil	Debidwar	Km 40+109 to Km 40+406	0.297	2569
Gumati River	Right Bank	without settlement	Subil	Debidwar	Km 40+406 to Km 41+507	1.101	9524
Gumati River	Right Bank	without settlement	Debidwar	Muradnagar	Km 43+900 to Km 44+601	0.701	16698
Gumati River	Right bank	with settlement	Debidwar	Muradnagar	Km 44+601 to Km 44+904	0.303	13123
Gumati River	Right Bank	without settlement	Purba Nabipur	Muradnagar	Km 44+904 to Km 45+409	0.505	19816
Gumati River	Right Bank	without settlement	Paschim Nabipur	Muradnagar	Km 47+000 to Km 47+700	0.699	8736
Gumati River	Right bank	with settlement	Muradnagar	Muradnagar	Km 52+800 to Km 55+300	2.500	117801
Gumati River	Right Bank	without settlement	Muradnagar	Muradnagar	Km 55+300 to Km 55+700	0.412	25292
Gumati River	Right bank	with settlement	Muradnagar	Muradnagar	Km 55+700 to Km 57+754	2.054	82971
Gumati River	Right Bank	without settlement	Muradnagar	Muradnagar	Km 57+800 to Km 57+950	0.195	5939
Gumati River	Right Bank	without settlement	Muradnagar	Muradnagar	Km 58+000 to Km 58+370	0.363	14648
Gumati River	Right bank	with settlement	Muradnagar	Muradnagar	Km 58+370 to Km 58+900	0.530	27387
Gumati River	Right Bank	without settlement	Amratali	Muradnagar	Km 58+900 to Km 59+027	0.127	6370
Gumati River	Right bank	with settlement	Muradnagar	Muradnagar	Km 59+027 to Km 59+593	0.566	28391
Gumati River	Right Bank	without settlement	Jahapur	Muradnagar	Km 59+593 to Km 60+295	0.709	36862
Gumati River	Right bank	with settlement	Bitikandi	Daudkandi	Km 60+295 to Km 62+676	2.381	117388
Gumati River	Right Bank	with settlement	Bitikandi	Daudkandi	Km 62+676 to Km 63+093	0.418	19466
Gumati River	Left Bank	without settlement	Sholanal	Comilla Sadar (Kotwali)	Km 14+421 to Km 14+837	0.416	20496.3
Gumati River	Left Bank	without settlement	Sholanal	Burichang	Km 14+837 to Km 15+437	0.599	16098.0
Gumati River	Left Bank	with settlement	Uttar Durgapur	Burichang	Km 15+437 to Km 15+624	0.187	5647.4
Gumati River	Left Bank	without settlement	Uttar Durgapur	Burichang	Km 15+624 to Km 16+024	0.401	37562.0
Gumati River	Left Bank	without settlement	Mainamati	Burichang	Km 16+024 to Km 17+033	1.009	50581.2
Gumati River	Left Bank	without settlement	Mainamati	Burichang	Km 17+033 to Km 17+232	0.199	6801.8
Gumati River	Left Bank	with settlement	Mainamati	Burichang	Km 17+232 to Km 17+399	0.167	5043.4
Gumati River	Left	without	Mainamati	Burichang	Km 17+399 to	0.236	8066.5

River	Bank	Remarks	Union	Upazila	Chainage	Length (km)	Volume (m ³)
	Bank	settlement			Km 17+635		
Gumati River	Left Bank	without settlement	Mainamati	Burichang	Km 17+635 to Km 17+735	0.100	3418.0
Gumati River	Left Bank	without settlement	Mainamati	Burichang	Km 17+735 to Km 17+942	0.207	7075.3
Gumati River	Left Bank	without settlement	Mainamati	Burichang	Km 17+942 to Km 18+531	0.590	10119.0
Gumati River	Left Bank	with settlement	Mainamati	Burichang	Km 18+543 to Km 18+993	0.450	13590.0
Gumati River	Left Bank	without settlement	Mainamati	Burichang	Km 18+993 to Km 20+635	1.642	47462.0
Gumati River	Left Bank	without settlement	Mainamati	Burichang	Km 20+635 to Km 21+135	0.499	8590
Gumati River	Left Bank	with settlement	Mainamati	Burichang	Km 21+135 to Km 21+199	0.064	1644.8
Gumati River	Left Bank	without settlement	Mainamati	Burichang	Km 21+199 to Km 21+937	0.738	19729.2
Gumati River	Left Bank	without settlement	Bharella	Burichang	Km 21+937 to km 22+810	0.873	21475.8
Gumati River	Left Bank	with settlement	Bharella	Burichang	Km 22+810 to Km 23+056	0.246	6322.2
Gumati River	Left Bank	without settlement	Bharella	Burichang	Km 23+056 to Km 23+320	0.264	5195.52
Gumati River	Left Bank	with settlement	Bharella	Burichang	Km 23+320 to Km 23+448	0.128	1196.8
Gumati River	Left Bank	without settlement	Bharella	Burichang	Km 23+448 to Km 23+810	0.362	7124.16
Gumati River	Left Bank	with settlement	Bharella	Burichang	Km 23+810 to Km 23+933	0.123	1150.05
Gumati River	Left Bank	without settlement	Bharella	Burichang	Km 23+933 to Km 24+539	0.606	11926.08
Gumati River	Left Bank	with settlement	Bharella	Burichang	Km 24+539 to Km 24+680	0.141	1318.35
Gumati River	Left Bank	without settlement	Bharella	Burichang	Km 24+680 to Km 25+350	0.670	14137
Gumati River	Left Bank	without settlement	Dakshin Jafarganj	Burichang	Km 28+230 to Km 28+830	0.600	7836
Gumati River	Left Bank	without settlement	Dakshin Jafarganj	Burichang	Km 28+900 to Km 29+300	0.410	5446.02
Gumati River	Left Bank	without settlement	Malapara	Debidwar	Km 29+300 to Km 29+516	0.216	1572.48
Gumati River	Left Bank	with settlement	Uttar Jafarganj	Debidwar	Km 29+516 to Km 32+080	2.564	24123
Gumati River	Left Bank	without settlement	Uttar Jafarganj	Debidwar	Km 32+080 to Km 32+727	0.647	4608.24
Gumati River	Left Bank	with settlement	Uttar Jafarganj	Debidwar	Km 32+727 to Km 33+100	0.373	4524.49
Gumati River	Left Bank	without settlement	Uttar Jafarganj	Debidwar	Km 33+100 to Km 33+710	0.606	3916.64

River	Bank	Remarks	Union	Upazila	Chainage	Length (km)	Volume (m³)
Gumati River	Left Bank	without settlement	Uttar Jafarganj	Debidwar	Km 33+730 to Km 34+029	0.299	2176.72
Gumati River	Left Bank	with settlement	Fatehabad	Debidwar	Km 34+029 to Km 35+224	1.195	20876.65
Gumati River	Left Bank	without settlement	Uttar Jafarganj	Debidwar	Km 35+224 to Km 35+754	0.530	12130.6
Gumati River	Left Bank	without settlement	Chhaliakandi	Muradnagar	Km 57+530 to Km 59+028	1.498	83888
Gumati River	Left Bank	without settlement	Bitikandi	Muradnagar	Km 59+870 to Km 60+831	0.961	66309
Gumati River	Left Bank	without settlement	Bitikandi	Daudkandi	Km 61+100 to Km 62+352	1.252	64352.8
Gumati River	Left Bank	without settlement	Narayana	Daudkandi	Km 66+100 to Km 66+600	0.500	29480
Gumati River	Left Bank	without settlement	Purba Gauripur	Daudkandi	Km 68+200 to Km 68+629	0.429	59189.13

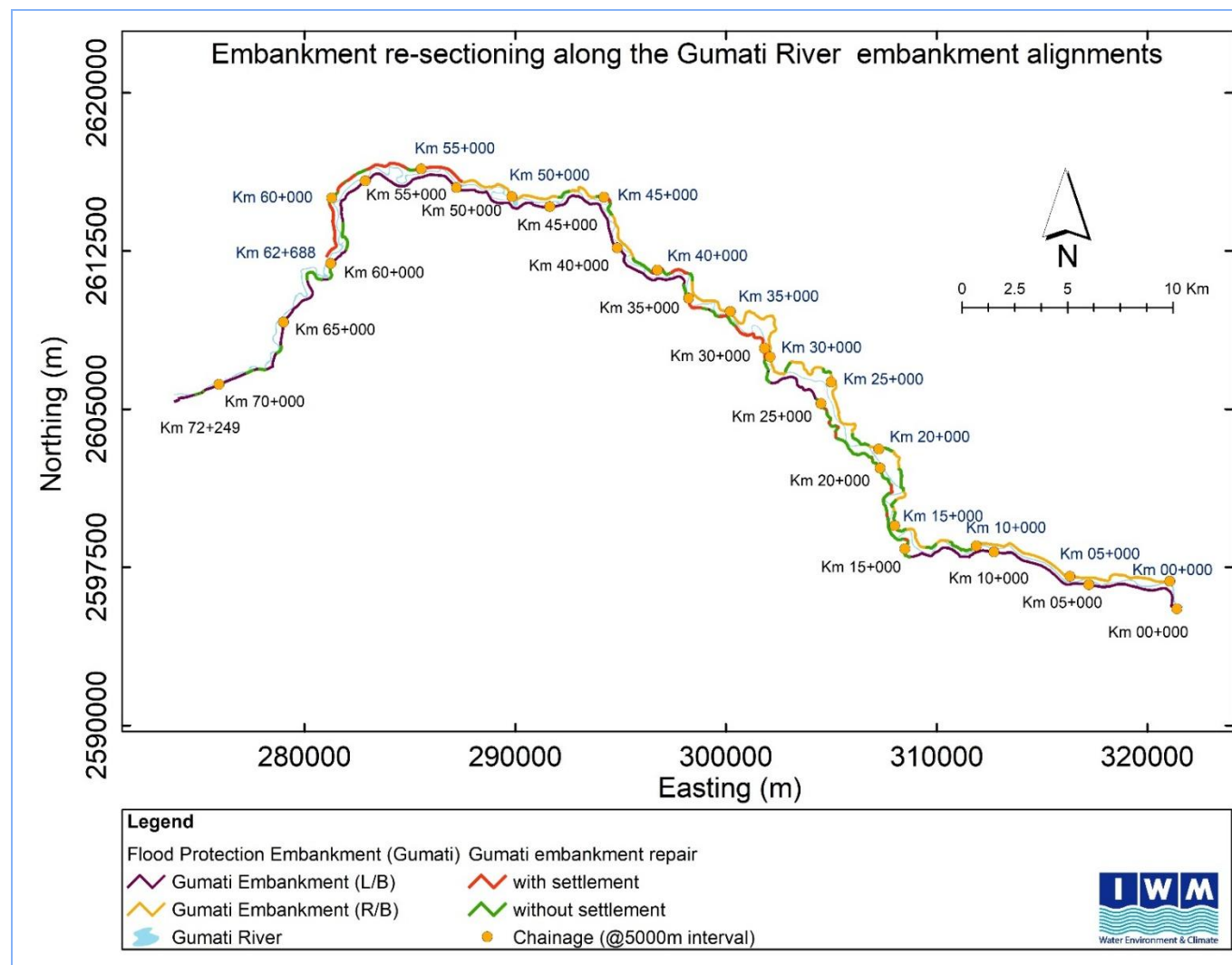


Figure 3-17: Embankment re-sectioning work along the left and right embankment of the Gumati River

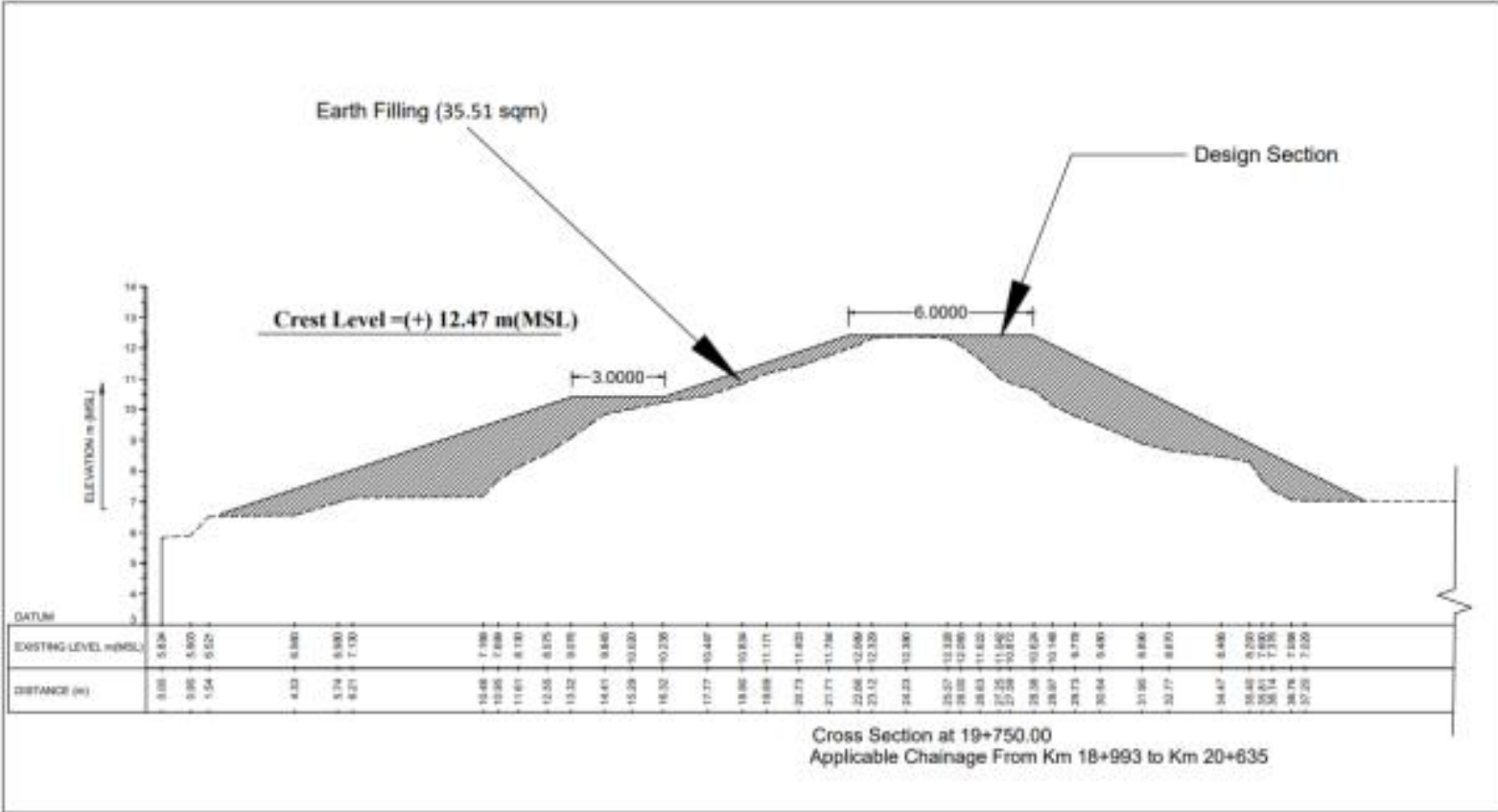


Figure 3-18: Design of re-sectioning work along the left and right embankment of the Gumati River

Brahmanbaria District

Embankment of Hawra River breached at several locations in Mogra union, Akhaura Upazilla, Brahmanbaria district during the flood. **Table 3-10** presents the locations of the embankment re-sectioning along the Kahua River, Muhuri River, and Selonia River left bank, respectively.

Table 3-10: Proposed embankment repair works in Brahmanbaria

Union	Upazila	Settlement	Gumati River Bank	Chainage	Embankment re-sectioning length (km)
Mogra	Akhaura	Hawra River	Right Bank Embankment	km 08+730 to km 09+210	0.48
Mogra	Akhaura	Hawra River	Right Bank Embankment	km 12+920 to km 13+050	0.13
Mogra	Akhaura	Hawra River	Right Bank Embankment	km 12+980 to km 13+770	0.79
Embankment repair length at Hawra Embankment (R\B) (km)					1.40
Mogra	Akhaura	Hawra River	Left Bank Embankment	Km 11+190 to Km 11+790	0.60
Embankment repair length at Hawra Embankment (R\B) (km)					0.60
Total Embankment repair (km)					2.00

3.1.3 Regulator Repair Works**Feni District**

A total of 20 regulators are proposed for repair works in Feni as presented in **Table 3-11**.

Table 3-11: Proposed regulator repair works in Feni

SL.	District	Structure Type	Easting (m)	Northing (m)	No. of Vent	Barel Width (m)	Opening Height (m)	Width (m)	Dia (m)	Sill level (mMSL)
1	Feni	Sluice #6	336090	2526132	1V	17.5	1.81	1.55		1.95
2	Feni	Sluice #5	337388	2525389	2V	13.5	0.9	0.9	0.9	0.68
3	Feni	Sonagazi Regulator	339897	2526459	3V	7.2	1.8	1.5		0.08
4	Feni	Badamtoly Regulator	341399	2528909	2V	12	1.4	1.4		1.37
5	Feni	Katakhali Vent Regulator	335342	2524093	1V	9.5	0.8	0.8		1.93
6	Feni	Sluice #7	334262	2523163	3V	7.05	1.6	1.6		1.39
7	Feni	Sluice #8	332123	2524606	2V	13.6	1.25	1.25	1.25	0.09
8	Feni	Sluice #10	330393	2529598	2V	13.5	1.25	1.25	1.25	0.02
9	Feni	Shoven Bazar Regulator	337805	2569769	2V	13	1.9	1.8		6.52
10	Feni	Bash Padula Sluice	342422	2567645	1V	10.8	1.89	1.65		7.40
11	Feni	Gutuma Regulator	342091	2564018	1V	14.6	1.9	1.69		5.34

SL.	District	Structure Type	Easting (m)	Northing (m)	No. of Vent	Barel Width (m)	Opening Height (m)	Width (m)	Dia (m)	Sill level (mMSL)
12	Feni	Chatuliya Regulator	340624	2563207	3V	4.45	1.85	1.5		5.40
13	Feni	Dakkin Malipathor pip sluice	336436	2562864	1V	21	1.24	1.24	1.24	4.32
14	Feni	Gotia Sonapur Regulator	344100	2550418	4V	15.02	1.85	1.53		0.85
15	Feni	Uttar Dhormopur Regulator	342483	2559149	2V	12.74	1.85	1.55		3.57
16	Feni	Talbari Regulator	342402	2559733	3V	15.95	1.85	1.55		3.66
17	Feni	Sluice #09	330725	2527293	3V	7.10	1.85	1.84		1.50
18	Feni	Bodor Mokam sluice	331061	2532075	4V	6	3.17	1.5		1.00
19	Feni	Hugli Sluice	330144	2534778	1V	4.75	2.13	2.1		0.66
20	Feni	Kuthirhat Sluice	333200	2536819	1V	6	2.48	1.7		0.53

Lakshmipur District

One seven-vent regulator is proposed for repair works in Ramgati, Lakshmipur as presented in **Table 3-12**.

Table 3-12: Proposed regulator repair works in Lakshmipur

Upazila	River/ Canal	Location	Chainage (km - km)	Repair structures
Ramgati	Gabtolli Khal	Gabtolli (7-Vent regulator)	km 2.800 to km 3.200	1

3.1.4 Khal Re-excavation Works

Lakshmipur District

About 12.6 km re-excavation works is proposed C- Khal in Lakshmipur District.

Cumilla District

About 7 km re-excavation works is proposed Ruhita Khal in Cumilla District.

3.2 Project Activities and Phases

3.2.1 Pre-construction Phase

- Geotechnical investigation at the river bank protection and slope protection work sites;
- Carrying out surveys for identifying the correct chainage of rehabilitation embankment, and repair regulator site;
- Site preparation, labor shed construction including toilets and material stockyard;
- Mobilization of equipment and construction material and placing in stockyard;
- Mobilization of labor forces;
- Installation of awareness and information billboards at project sites;

3.2.2 Construction Phase

- Permanent riverbank protection works (5.79 km) in Feni, Cumilla, and Brahmanbaria;
- Precautionary bank protection works (30.38 km) in Feni, Noakhali, and Lakshmipur;
- Slope protection works (2.56 km) in Cumilla and combined bank-slope protection (1.13 km) in Brahmanbaria;
- Repair of 21 existing and damaged regulators, mainly in Feni and Lakshmipur;
- Rehabilitation of 72.55 km of embankments, especially in Cumilla, Feni, and Brahmanbaria;
- Re-excavation of 19.60 km of khals in Cumilla and Lakshmipur for drainage improvement;
- Compliance with environmental, social and occupational health and safety standards during all field operations;

3.2.3 Post-construction/ Operation and Maintenance Phase

- Routine maintenance of rehabilitated embankments, excavated khals, and slope protection works;
- Operational maintenance of repaired regulators;
- Periodic inspection of protective works (as applicable to project scope);
- Monitoring environmental recovery and hydraulic efficiency of interventions.

3.3 Project Alternatives Considered

At the onset, the study team thoroughly reviewed the project Terms of Reference (ToR), the proposed interventions, and the outputs from the modeling study conducted by IWM to appreciate the overall project context and strategy. A detailed review of national policies, legal frameworks, and institutional mandates related to flood management, environmental conservation, and infrastructural rehabilitation was carried out to ensure legal alignment and compliance.

As part of the project planning process, a structured *Alternative/Options Analysis* was undertaken using a prioritized multi-criteria analysis (MCA) framework. Initially, a comprehensive list of flood-damaged locations was pre-screened based on critical red-flag criteria such as requirements for land acquisition, risks of resettlement, presence of illegal

sand mining, and interventions involving excavation. Locations failing to meet these criteria were excluded from further consideration to streamline project focus.

For the shortlisted sites, a district-wise mini-MCA was conducted. This included location-specific details—such as Upazila, Union, geographic coordinates, and damage types—and evaluation based on eight criteria: (1) severity of damage, (2) number of potential beneficiaries, (3) urgency of intervention, (4) availability of construction materials, (5) estimated costs, (6) stakeholder preferences including BWDB insights, (7) availability of contractors, and (8) prospects for additional funding.

The MCA enabled scoring and ranking of all interventions, ensuring an objective basis for selection of the most feasible and impactful rehabilitation works. This method supported a transparent and resource-efficient decision-making process aligned with stakeholder priorities and technical constraints

3.4 Associated Facilities and Ancillary Projects

To complement the core structural interventions under the Emergency Flood Response Project in the five flood-affected districts (Feni, Noakhali, Cumilla, Lakshmipur, and Brahmanbaria), several associated facilities and ancillary components have been integrated into the overall project framework. These supportive elements are critical to ensure the effectiveness, sustainability, and operational longevity of the main works.

Regulator Repair and Water Control Structures

- A total of 21 regulators are scheduled for repairs (20 in Feni and 1 in Lakshmipur), which will restore flood regulation capacity and ensure better water flow and drainage control during monsoon events.
- These works include gate, hoist, and slab repairs, along with site-specific erosion protection.

Support Facilities for Construction and Supervision

- Establishment of temporary labor sheds, material stockyards, and machinery yards near embankment and regulator repair sites.
- Installation of billboards, construction signage, and information boards to ensure public awareness and contractor accountability.

Access and Operational Infrastructure

- Construction of access road (Feni District, access road of 40-vent regulator) and embankment maintenance roads are integrated within the 72.55 km embankment repair scope (notably 46 km in Cumilla and 24.55 km in Feni).
- These facilitate movement of materials and ensure future inspection and maintenance access.

Drainage and Canal Support Works

- **19.60 km of Khal re-excavation** (in Cumilla and Lakshmipur) will be supported by small-scale drainage culverts, desilting structures, and service crossings where applicable.
- Associated desilting and canal-side embankment strengthening will ensure continuous drainage flow.

Riverbank Stabilization Measures

- In addition to the **30.38 km precautionary** and **5.79 km permanent bank protection**, the project will integrate minor ancillary works such as:
 - Toe protection and transition slabs,
 - Turfing and bioengineering where applicable,
 - CC block storage and staging yards.

Environmental and Social Support

- Designated zones for waste management, sediment disposal, and noise/dust mitigation during construction.
- Temporary relocation support for any informal dwellers during regulator or embankment work phases (if applicable).

3.5 Implementation Schedule

The implementation schedule of a project serves as a detailed roadmap, outlining the timeline and sequence of activities from initiation to completion. It includes key milestones, deadlines, and responsibilities to ensure timely and coordinated execution.

Chart 3.13: Implementation Schedule of project activities

SL. No.	Description	Year-1				Year-2				Year-3				Year-4			
		Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
A.	Pre-Construction Activities																
A1	Discussion with local stakeholders about the project and interventions																
A2	Display Billboard on the intervention site for public awareness																
A3	Preparation of Stockyard for construction materials																
A4	Mobilization and site preparation																
A5	Acquisition of Land																
A6	Hire Contractors through tendering procedure																
B.	Construction Activities																
	Feni WD Division																
B1	Embankment Re-sectioning/ Repair work in Fulgazi, Parshuram, Shonagazi Upzila in Feni district																
B2	Repair/ strengthening/ Precautionary River Bank Protection Work in Muhuri, Kahua, Selonia and Feni River in Feni District																
B3	Hydraulic Structure Repair/ Rehabilitation/ Reconstruction in Feni District																
	Noakhali WD Division																
B4	Precautionary protective work in Left Bank of Little Feni River																
B5	Precautionary protective work in Right Bank of Little Feni River																
B6	Precautionary protective work in Lower Meghna River																
	Comilla WD Division																
B7	Embankment Re-sectioning / Repair work in Gumti River Embankment in Cumilla																
B8	River Bank Protection work in left and right bank of Gumti River in Cumilla District																
B9	Slope protection work in left and right bank of Gumti River Embankment in Cumilla District																
B10	Canal Re-excavation work in Ruhita khal in Comilla district																
	Lakshmipur WD Division																
B11	Repair/ strengthening/ Precautionary River Bank Protection Work in both banks of Rahmatkhali and WAPDA Khal in Lakshmipur district																
B12	Canal Re-excavation work in C Khal in Lakshmipur district																
B13	Rehabilitation of Gabtoli Sluice in Lakshmipur district																
	Brahmanbaria WD Division																
B14	Repair/ strengthening/ Precautionary River Bank Protection Work in both banks of Haora River in Brahmanbaria																
B15	Embankment Repair work																

CHAPTER-4: POLICY, LEGAL, AND REGULATORY FRAMEWORK

4.1 National Environmental and Social Laws

The implementation of the proposed interventions will be governed by the relevant environmental and social Acts, Rules, Policies, and Regulations of Bangladesh. **Table 4-1** presents precise description of the applicable national laws, regulations and policies for the environmental and social management of the project interventions.

Table 4-1: Summary of applicable environmental, social regulations of GoB

Sl. No.	Policies, Laws and Regulations	Key Provisions and Purpose	Applicability to the Project
1.	Environment Conservation Rules, 2023	- National Environment Quality Standards for surface water (inland and marine/ coastal), drinking water, sewage effluent, industrial effluents, liquid waste discharge standards industry wise, etc.; - Categorization of industries, development projects, and other activities based on actual and anticipated pollution load; - Procedure for obtaining Environment Clearance Certificate (ECC); - Requirements for undertaking IEE and EIA's as well as formulating EMP according to categories of industries/ development projects/ activities; - Procedure for damage claim by persons affected or likely to be affected due to polluting activities or activities causing hindrance to normal civic life.	Applicable as the environmental conservation rules will ensure conservation of the natural resources and the project needs to be complied with the compliance requirements of ECR, 2023. The project falls in "red" category.
2.	Environment Conservation Rules 1997 and Subsequent amendments in 2002,2003 and	- Declaration of Ecologically critical areas; - Requirement of environmental clearance certificate for various categories of projects; - Requirement of IEE/EIA as per category;	Applicable as the rules aims at the prevention of pollution and degradation of resources. Site clearance shall be

Sl. No.	Policies, Laws and Regulations	Key Provisions and Purpose	Applicability to the Project
	2010	• Renewal of the environmental clearance certificate within 30 days after the expiry; • Provides standards for quality of air, water and sound and acceptable limits for emissions/discharges from vehicles and other sources	taken before operation where applicable.
3.	Bangladesh Environmental Conservation Act (ECA), 1995 and subsequent amendments in 2000 2002, 2010	• Define Applicability of environmental clearance; • Regulation of development activities from environmental perspective; • Framing applicable limits for emissions and effluents; Framing of standards for air, water, and noise quality; • Formulation of guidelines relating to control and mitigation of environmental pollution, conservation, and improvement of environment; • Declaration of Ecologically Critical Area (ECA)	Applicable as the proposed project activities are likely to be associated with some environmental and social issues.
4.	National Environmental Policy, 2018	• Major elements of the policy are- Natural equilibrium provision and overall development of the country through environmental protection and sustainable management; • Encourage collection and promotion of low carbon emission technology in the country; • Identifying and controlling all types of environmental pollution and degradation activities; • Ensure environmental development in all fields; Ensure sustainable, long term, and environmentally friendly use of all-natural resources; • Maintain and streamline the environmental policies and strategies among other policy strategies in the interest of	Applicable as the environmental policy aims to prevent pollution and degradation of resources.

Sl. No.	Policies, Laws and Regulations	Key Provisions and Purpose	Applicability to the Project
		sustainable development; • Ensure the Environmental Impact Assessment and Strategic Environmental Assessment in all necessary sectors; • Actively involved as much as possible with all international environmental initiatives and take necessary actions at local and national levels.	
4.	Bangladesh Environment Court Act, 2000 and subsequent amendments in 2019	• GoB has given the highest priority to environmental pollution; • Passed 'Environment Court Act, 2000 for completing environment related legal proceedings effectively; • Provides the jurisdictions of the environment court, penalty for violation, trial procedure in special magistrate's court, power of entry and search, procedure for investigation, power and authority of the environment court to inspect, appeal procedure and formation of the environment appeal court.	Applicable for completing environmental legal requirements effectively. According to this act, government can take legal actions if any environmental problem occurs due to project interventions.
7.	National Biodiversity Strategy and Action Plan (2004)	• Conserve and restore the biodiversity of the country for the well-being of the present and future generations; • Maintain and improve environmental stability for ecosystems; • Ensure the preservation of the unique biological heritage of the nation for the benefit of the present and future generations; • Guarantee the safe passage and conservation of globally endangered migratory species, especially birds and mammals in the country; • Stop the introduction of invasive alien species, genetically modified organisms and living	Applicable for conservation of biodiversity in the study area including water body.

Sl. No.	Policies, Laws and Regulations	Key Provisions and Purpose	Applicability to the Project
		modified organisms.	
9.	Biodiversity Act, 2017	It provides for the creation of the National Committee and the Biodiversity Management and Surveillance Committees at local levels (i.e., Districts, Upazilas, Municipalities, and Unions). In general, all these committees are mandated to assist the Government in implementing the National Biodiversity Strategy and Action Plan (NBSAP) and to visit the biodiversity enriched areas in their respective territories; and monitor the progress of implementation of the NBSAP.	Projects need to include these local committees, so that they can monitor project impact on the local biodiversity.
10.	Forest Act 1927 (Amendment 2000)	The act empowers the government to regulate the felling, extraction, and transport of forest produce in the country.	Project activities are not likely to include cutting of trees.
8.	The Protection and Conservation of Fish Act (1950) and subsequent amendments in 1982	Protection and conservation of fish in Government-owned water bodies.	Applicable for the conservation of fish as the project construction/repair activity may impact nearby water bodies.
12.	National Fisheries Policy, 1998	• Preservation, management, and exploitation of fisheries resources; • Fish cultivation and management; • Prawn and fish cultivation in coastal areas; • Preservation, management, and exploitation of sea fishery resources	Applicable for the preservation of fisheries resources since the project activities include structures in rivers/khals and some khal excavation works.
13.	Bangladesh Water Act, 2013	As per this Act, all forms of water (e.g., surface water, ground water, sea water, rainwater, and atmospheric water) within the territory of Bangladesh belong to the government on behalf of the people.	Applicable as the project is bound to comply with or consider the

Sl. No.	Policies, Laws and Regulations	Key Provisions and Purpose	Applicability to the Project
		Without prior permission issued by the Executive Committee, no individuals or organizations will be allowed to extract, distribute, use, develop, protect, and conserve water resources, nor they will be allowed to build any structure that impede the natural flow of rivers and creeks.	requirements under this policy in its design.
11.	The National Water Policy, 1999	• Protection, restoration, and enhancement of water resources; • Protection of water quality, including strengthening regulations concerning agrochemicals and industrial effluent; • Sanitation and potable water; • Fish and fisheries; • Participation of local communities in all water sector development.	Applicable for the reservation of water quality.
17.	The Ground Water Management Ordinance (1985)	• Management of GW resources; • Installation of tube- wells at any place after licensing from Upazilla Parishad only.	The proposed Project is likely be related to groundwater.
14.	Bangladesh Labor Act, 2006, Bangladesh Labor Rules, 2015	Provides health, safety, and well-being of the workforce during the project life cycle. In addition, it also stipulated that children under 18 years are not allowed to be employed during the project life cycle.	Applicable as skilled, semi-skilled and day labour will be utilized in project activities.
15.	The Noise Pollution Control Rules, 2006	The Noise Pollution Control Rules have been established in order to manage noise generating activities which have the potential to impact the health and wellbeing of workers and the surrounding communities.	Applicable as noise may be generated during the construction phase of the project.
18.	Acquisition and Requisition of Immovable	The principal legal instrument governing land acquisition in Bangladesh is the Acquisition and Requisition of Immovable	The project is not likely to acquire any land

Sl. No.	Policies, Laws and Regulations	Key Provisions and Purpose	Applicability to the Project
	Property Act, 2017	Property.	since the proposed interventions are primarily repair/rehabilitation works. However, A RPF has been prepared for this project.
20.	Disaster Management Act, 2012	To make the activities about disaster management coordinated, object oriented, and strengthened and to formulate rules to build up the infrastructure of effective disaster management to fight all types of disaster	Applicable, as the project is in a flood prone area and some areas are also cyclone prone.

4.2 Applicable World Bank ESF Standards

This ESIA Report is prepared according to the requirements set in Environmental and Social Standards (ESS) of World Bank's Environmental and Social Framework (ESF, 2017). It covers the E&S instruments for assessment of the risks and impacts associated with proposed Project interventions. Moreover, separate ESMF documents are prepared for this project. World bank have ten (10) ESSs which *supports green, resilient and inclusive development by strengthening protections for people and the environment and making important advances in areas such as labor, inclusion and non-discrimination, gender, climate change, biodiversity, community health and safety, and stakeholder engagement*. The standards, presented in **Figure 4-1**, ensure adaptive risk management and stakeholder engagement in the development projects. **Table 4-2** presents the relevance of the study objectives and the proposed project.



Figure 4-1: Environmental and Social Standards of World Bank's ESF

Table 4-2: ESS objectives and relevance to the project

WB ESS	Objectives	Relevance to the Project
ESS1: Assessment and Management of Environmental and Social Risks and Impacts	Identification, evaluation and management of environment and social risks & impacts of the project; adopting mitigation measures and compensating significant residual impacts; ensuring sharing of development benefits and opportunities resulting from the project with the disadvantaged or vulnerable communities; abiding relevant national environmental and social policies, laws, regulations and procedures in the assessment, development and implementation of projects; promoting improved environmental and social performance.	E&S risks and impacts are identified based on consultations with stakeholders, including communities, civil society, local government, NGOs, and implementing agencies. Appropriate mitigation measures are suggested for avoiding or mitigating the environmental and social impacts. Moreover, the environmental and social parameters will be monitored during the project implementation. Detailed ESIA is prepared.
ESS2: Labor and Working Conditions	Promoting safety, health, fair treatment, non-discrimination and equal opportunity for project workers; protecting project workers including vulnerable workers; preventing all forms of forced labour and child labour; supporting the principles of freedom of association, collective bargaining and providing accessible means for raising workplace concerns consistent with national law.	This is a large project, and that's why the project will need many labourers in construction and repair works of the roads, multipurpose cyclone shelters, growth centres, landing stations/ghats, street lighting etc. during the works, accidents, health issues, gender-based violence, conflict among workers etc. may occur. The project needs to be careful and a LMP and a GAP will be prepared to tackle these issues effectively.
ESS3: Resource Efficiency and Pollution Prevention	Promoting sustainable use of resources; avoiding or minimizing adverse impacts on human health and the environment, project-related emissions of climate pollutants, and generation of hazardous and non-	<i>Resource Efficiency:</i> The project and the ESA process will identify feasible measures for efficient (a) energy use; (b) minimization and management water usage and maintain balance for the demand of water resources; (c)

WB ESS	Objectives	Relevance to the Project
and Management	hazardous waste; minimizing and managing the risks and impacts associated with pesticide use.	raw materials use by exploring local materials, recycled aggregates, and innovative technology. <i>Pollution Management:</i> The project will develop prevention and mitigation measures to offset risks and impacts of pollution from potential sources such as dust and emission during project activities, effluents and wastewater from labour/construction camps; spillage or leakage during handling of chemical admixtures, hazardous materials during the project construction/implementation period.
ESS4: Community Health and Safety	Anticipating and avoiding adverse impacts on the health and safety; promoting quality and safety and considering climate change impacts in design and construction of infrastructure; avoiding or minimizing community exposure to project-related traffic safety risks, diseases and hazardous materials; contingency measures; maintenance of personnel and property to minimize risks to the project-affected communities.	The project will implement measures to protect public health and safety. The project will construct water supply and sanitation facilities in the project areas to mitigate health and safety risks.
ESS5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement	Avoiding or minimizing involuntary resettlement by alternative analysis; avoiding forced eviction. Mitigating unavoidable adverse impacts from land acquisition or restrictions on land use by: (a) providing timely compensation (b) improve, or at least restore livelihoods and living standards of displaced persons; executing	The project will follow proper rules and guidelines for resettlement and ensure lawful compensation for each Project Affected Person (PAP). The project is strictly considering the social issues. Impacts on non-titled individuals will be addressed following the provisions of the RPF and RAP

WB ESS	Objectives	Relevance to the Project
	resettlement activities as sustainable development programs; ensuring appropriate disclosure, meaningful consultation, and informed participation of affected persons in resettlement activities.	
ESS6: Biodiversity Conservation and Sustainable management of Living Natural Resources	Protecting & conserving biodiversity and habitats; applying mitigation hierarchy and pre-cautionary approach in design and implementation of projects that may impact on biodiversity; promoting sustainable management of living natural resources; supporting livelihoods of local communities by adopting practices that integrate conservation needs & development priorities.	The coastal zone of Bangladesh has various natural resources, including coastal fisheries, shrimp, forests, salt and minerals. Moreover, there are several ecosystems such as estuaries and brackish ecosystems etc. with important conservation values. Proper mitigation measures will be adopted in order to avoid or minimizing adverse impacts on these ecosystems. If triggered in any intervention site during project implementation, the project will prepare a site-specific plantation plan, Biodiversity Management, and Conservation Plan.
ESS7: Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities	Ensuring that project implementation process fosters full respect for human rights, dignity, aspirations, identity, culture, and natural resource-based livelihoods of Ethnic Community Peoples/ Sub-Saharan African Communities; avoiding or mitigating adverse impacts on them; promoting sustainable development benefits opportunities for them; establishing and maintaining an ongoing relationship based on meaningful consultation with them.	The project assesses the nature and degree of the expected direct and indirect economic, social, cultural (including cultural heritage), and environmental impacts on ethnic community peoples present in, or have a collective attachment to, the project area. The project will prepare a consultation strategy and identify how Indigenous or ethnic community Peoples will participate in project design and implementation. If ethnic community people are within project area and/or affected then an Indigenous People Plan may need to be

WB ESS	Objectives	Relevance to the Project
		prepared. Provision or Requirements for this may be indicated
ESS8: Cultural Heritage	Not relevant	Not relevant
ESS9: Financial Intermediaries (Fis)	Not relevant	Not relevant
ESS10: Stakeholder Engagement and Information Disclosure	Preparation and implementation of a Stakeholder Engagement Plan (SEP) ensuring meaningful consultation with the stakeholders and inclusion of their views in project design; ensuring appropriate and timely disclosure of the project information on environmental and social risks and impacts and redressing the issues and grievances of the stakeholders.	The project will engage in meaningful consultations with all stakeholders and ensure their spontaneous participation in project implementation. The project will disclose timely, relevant, and accessible information about the project activities that may have significant impacts.

4.3 Other Relevant International Obligations

Bangladesh has signed many international treaties, conventions, and protocols on the environmental and social aspects. The international obligations mostly focus on environmental pollution control, biodiversity conservation, climate change mitigation and adaptation, occupational health and hazards, social, heritage and cultural rights, labour and gender issues and so on. A list of the relevant international treaties signed by GoB is listed below.

- Ramsar Convention
- Protocol on Waterfowl Habitat
- CITES Convention (Washington)
- Prevention and Control of Occupational hazards (Geneva)
- Occupational hazards due to air pollution, noise & vibration (Geneva)
- Occupational safety and health in the working environment (Geneva)
- Occupational Health services (Geneva)
- Bonn Convention
- Civil liability on the transport of dangerous goods (Geneva)
- UN framework convention on climate change (Rio de Janeiro)
- Convention on Biological Diversity (Rio de Janeiro)
- International Convention on Climate Changes (Kyoto Protocol)
- Protection of birds (Paris)
- World Cultural and Natural Heritage (Paris)
- ILO Convention No 29 on Forced Labour
- Convention on the Elimination of All Forms of Discrimination Against Women
- International Covenant on Economic, Social and Cultural Rights (ICESCR)

Table 4.3 presents a precise description of these relevant international treaties and their potential compliance in project activities.

Table 4.3: International Treaties, Conventions and Protocol

Treaty or Convention	Brief Description	Project Compliance
Ramsar Convention	Protection of wetlands. Broadly applicable for wetlands in and around the project influence area.	The operation may affect wetland habitat though the wetlands are usually avoided for any new interventions. Mitigation measures included in EMP to address potential impacts on wetlands and associated resources as well.
Protocol on Waterfowl Habitat	Amendment of Ramsar Convention to protect specific habitats for waterfowl.	Broadly applicable for wetlands in and around the project influence area. Mitigation measures included in EMP address potential impacts on wetlands and associated ecological resources as well.
CITES Convention (Washington)	Ban and restrictions on international trade in endangered species of wild fauna and flora.	Not directly relevant to the the project intervention since the project does not involve in any international trade of endangered species of wild fauna and flora. General restrictions have however been included in the Environmental Code of Practice.
Prevention and Control of Occupational hazards (Geneva)	Protect workers against occupational exposure to carcinogenic substances and agents.	Compliance to this is taken care of in the EMP of the ESIA report due to the fact that interventions involve occupational risks to some extent.
Occupational hazards due to air pollution, noise & vibration (Geneva)	Protect workers against occupational hazards in the working environment.	Relevant as there may be pollution due to gaseous emission from construction equipment, vehicle movement, construction activities etc. as well as noise. Appropriate mitigation and protective measures have been included in the EMP and vibration.

Treaty or Convention	Brief Description	Project Compliance
Occupational safety and health in working environment (Geneva)	Prevent accidents and injury to health by minimizing hazards in the working environment.	Broadly applicable to the project activities under the project. Compliance is attached in the ESIA to ensure health and safety to workers through the prevention of accidental risks. Appropriate mitigation and protective measures have been included in the EMP.
Occupational Health Services (Geneva)	To promote a safe and healthy working environment.	Broadly applicable to the project activities under the project. Compliance to this will be adopted as there will be involvement of both skilled and unskilled manpower. Appropriate mitigation and protective measures have been included in the EMP.
Bonn Convention	Conservation of migratory species of wild animals.	Broadly applicable to the migratory birds in and around the project influence area. Project activities are not likely to have any significant impacts on these species; precautionary measures have nonetheless been included in EMP.
Civil liability on transport of dangerous goods (Geneva)	Safe methods for transport of dangerous goods by road, railway and inland vessels.	Broadly applicable to transportation of substances such as fuels during the project construction phase. Appropriate mitigation measures are included in the EMP.
UN framework convention on climate change (Rio de Janeiro)	Regulation of greenhouse gases emissions (GHGs).	The study will take due care of the convention as the intervention area is located within climate vulnerable zone. Appropriate mitigation and protective measures have been included in the EMP to minimize emissions of GHGs.

Treaty or Convention	Brief Description	Project Compliance
Convention on Biological Diversity (Rio de Janeiro)	Conservation of bio-diversity, sustainable use of its components and access to genetic Resources.	The ESIA is prepared addressing conservation of biological species as these are subject to be affected by the project intervention. Appropriate mitigation and protective measures are included in the EMP for the conservation of biodiversity.
International Convention on Climate Changes (Kyoto Protocol)	International treaty on climate change and emission of greenhouse gases.	The ESIA is prepared with due note to the Kyoto Protocol as the project interventions are in the climate vulnerable area. Appropriate mitigation and protective measures are included in the EMP to minimize emissions of GHGs.
Protection of birds (Paris)	The Convention sets forth the principle that all bird species, with only a few exceptions, must be protected. It does not provide a specific list of protected species. Member states are obligated to enforce closed seasons for game birds—primarily during the spring migration—adhere to specific hunting method regulations, and are encouraged to create bird reserves.	The construction activities may hamper bird habitats by creating air pollution and noise. Appropriate mitigation and protective measures have been included in the EMP and vibration.
World Cultural and Natural Heritage (Paris)	The convention focuses on “Convention Concerning the Protection of the World Cultural and Natural Heritage”	There are Archaeological sites of Lalmai-Mainamati inside the project districts which is included in the indicative list of world heritage sites. However, it is vely unlikely to be impacted by the project activities. General restrictions have, however, been included in the Environmental Code of Practice.

Treaty or Convention	Brief Description	Project Compliance
ILO Convention No 29 on Forced Labour	Suppressing the use of forced labour in all its forms irrespective of the nature of the work or the sector of activity in which it may be performed.	The ESIA is prepared addressing issue of restricting forced labour in the project activities. Appropriate mitigation and protective measures are included in the EMP.
Convention on the Elimination of All Forms of Discrimination Against Women	Includes the economic and social rights of women, particularly focusing on education, employment, and health. It also includes special protections for rural women and the problems they face.	The ESIA is prepared addressing issue of protecting economic and social rights of women in the project activities. Appropriate mitigation and protective measures are included in the EMP for ensuring women rights.
International Covenant on Economic, Social and Cultural Rights (ICESCR)	The Covenant outlines a comprehensive framework for economic, social, and cultural rights through five parts. It affirms the right to self-determination, prohibits discrimination, and outlines rights such as work, health, education, and adequate living standards, emphasizing their progressive realization. It also establishes mechanisms for monitoring implementation and sets procedures for ratification and amendment.	The project will take due care of protecting economic, social and cultural rights of people involved in the project activities.

CHAPTER-5: BASELINE ENVIRONMENTAL AND SOCIAL CONDITIONS

The baseline information on the physical, biological and socioeconomic environment are very important for estimating the potential impacts of the project interventions and recommending mitigation measures. The information is collected from literature review, collection of data from primary survey and secondary sources and stakeholder consultations.

5.1 Physical Environment

5.1.1 Air Quality

Ambient Air quality measurements have been carried out under the present study at five locations in the five study districts near the proposed interventions and the results are shown in **Table 5.1**. The key air quality parameters (particulate matter- PM₁₀ and PM_{2.5}, oxides of sulfur - SO₂, carbon monoxide – CO, oxides of nitrogen – NO_x,) and wind directions were analyzed from samples collected over an eight (8) hour period at the sampling site.

Table 5.1: Ambient Air Quality Parameters in Project Area

SN	Monitoring Locations	GPS Coordinates	Concentration of different parameters in ambient air						
			SPM	PM _{2.5}	PM ₁₀	SO ₂	NO _x	CO	W. D
1	AAQM-2- Fulgazi, Feni	23° 7'20.18"N 91°27'26.65"E	215.6	43.39	152.14	2.42	14.19	1.58	→
2	AAQM-3-Noakhali-Sadar	22°50'51.01"N 91° 3'5.69"E	45.6	12.71	20.36	1.52	5.22	0.84	→
3	AAQM-4- Ramganj, Lakshmipur	23° 2'10.61"N 90°51'1.59"E	73.7	21.94	40.37	1	11.28	1.14	↗
4	AAQM-5- Brahmanpara, Cumilla	23°41'32.90"N 91° 3'36.71"E	95.39	28.71	54.69	1.46	4.87	1.45	↗
5	AAQM-6- BijoyNagar, Brahmanbaria	24° 0'47.05"N 91°16'20.88"E	136.15	37.88	88.74	1.71	11.03	1.7	→

SN	Monitoring Locations	GPS Coordinates	Concentration of different parameters in ambient air						
			SPM	PM _{2.5}	PM ₁₀	SO ₂	NO _x	CO	W. D
Unit			µg/m³	µg/m³	µg/m³	mg/m³	µg/m³	mg/m³	-
Monitoring Duration as per APCR’2022 (BD Standard)			NYS	24	24	24	24	8	-
Method of Analysis				Light Scattering Nephotometer		High Sensitivity Electrochemical			Vertical Flat Plate
Bangladesh (BD) Standard			NYS	65	150	80	80	5	-
WHO Standard (24h average)				15	45	0.04	25	4	

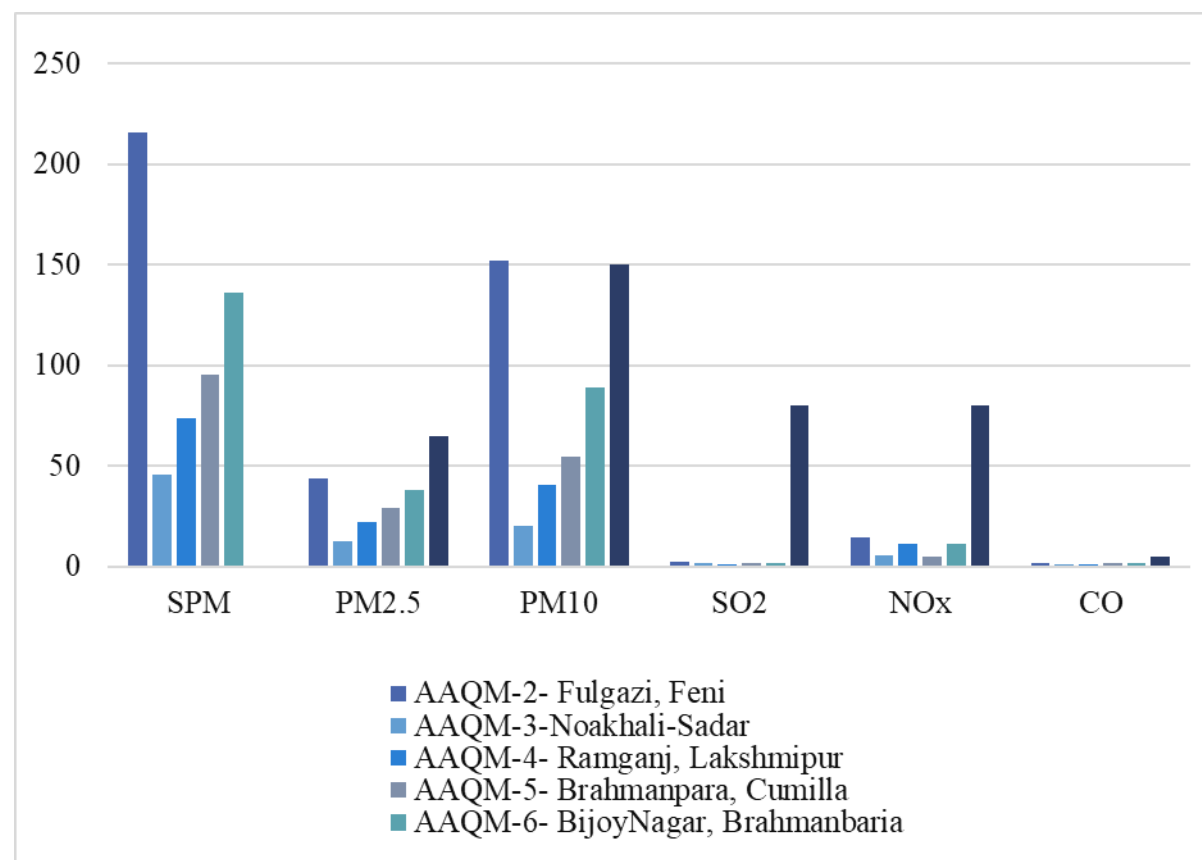
*Air Pollution Control Rules (APCR) On 26th July 2022; Vide S.R.O No. 255-Law/2022, Schedule 1 (Ambient Air Quality Standards). **Primary Data Source:** (ECIL) Laboratory, January 2025. W.D = Wind Direction



Below the Standard



Cross the Standard



From the above table, it is evident that all the parameters for ambient air quality is within the DOE standards except PM₁₀ at Fulgazi, Feni. Most particles form in the atmosphere as a result of complex reactions of chemicals such as sulfur dioxide and nitrogen oxides, which are pollutants emitted from, traffic burning, fuel burning, automobiles and industries. Particulate matter contains microscopic solids or liquid droplets that are so small that they can be inhaled and cause serious health problems. PM₁₀ poses the greatest problems, because they can get deep into people's lungs, and some may even get into your bloodstream. Fine particles (PM_{2.5}) are the main cause of reduced visibility (haze). The air quality parameters indicate good air quality in the project area.

Methodology

Methodology of Ambient Air Quality Monitoring Including Parameters as per APCR 2022 Ambient air quality has been monitored on 28-30 January, 2025 at Six (06) locations in the project site. The portable OCEANUS AQM-09 Air Quality Monitoring Station shown in Figure-2 was used to collect, measure and document critical pollutants including SPM, PM₁₀, PM_{2.5}, SO₂, NO_x, CO. Sampling and analysis of ambient air quality was conducted by referring to the recommendation of the United States Environmental Protection Agency (USEPA). Air quality data was measured automatically every one hour and directly recorded onsite for measured parameters (SPM, PM₁₀, PM_{2.5}, SO₂, NO₂, CO). Appropriate testing methods for different parameters were used, such as Particulates 90° Infrared Light Scattering for particulate matters (SPM, PM₁₀, PM_{2.5}), electrochemical sensors for toxic gases (NO₂, SO₂, and CO) are integrated in the device.

As per the national standard of ambient air quality, monitoring duration has been set out by DoE for all the parameters. However, other parameters such as Particulate Matter (SPM, PM₁₀, and PM_{2.5}), gaseous pollutants (NO₂ and SO₂), and CO, were monitored for adequate duration. Afterwards, the data were analyzed following the descriptive statistical method using MS Excel. The analyzed data were compared with up-to-date DoE Standard.

5.1.2 Water Quality

Surface Water Quality

The surface water quality assessment in the project influence area has been carried out for the most important parameters namely, pH, DO, BOD, TDS, TSS and various ions. The tests were undertaken in dry season, the month of January and March 2025 are shown in Table 5.2 and the detailed analyses are incorporated with the standard values set by the DoE are presented in Table 5.3 13 water samples were collected and tested from different channels within the project influence area. Water samples were collected using clean HDPE sample bottles. Table 5.2: Surface Water Quality of Rivers in Project Influence Area

Location	Gomati River	Dakatia River	Selonia River	Muhuri River	Haora River B.Barua	Musapur Regulator	Noler Char	Boyer Char	Char Maksumul Hakim	Rahmatkhali Regulator Laxmipur	Wapda Khal, Laxmipur	C Khal, Lakshmipur	Ruhita Khal, Cumilla
PH	7.95	8.72	8.40	8.17	8.39	6.98	6.88	7.32	6.91	7.73	7.67	8.25	7.91
EC (µS/cm)	116.7	725.00	185.10	139.9	95.5	27300		13210	20200	3470	880	212.2	384.00
Salinity (ppt)	0.06	0.36	0.09	0.07		16.14	11.56	7.35	15.47	1.76			0.19
DO mg/L	6.06	1.87	2.22	4.7	3.63	7.36	7.4	7.04	6.87	6.5	6.99	3.17	2.17
BOD (mg/L)	1.4	4.6	2.80	0.2		1.2	1.5	1.4	1.6				6.00

TDS (mg/L)	56.9	364.00	91.10	68.3	51.5	15780	11280	7140	16060	1741	496	115.1	192.00
Temperature	23.7	23.70	23.70	23.7									23.30
TSS (mg/L)	47.0	1394.00	5.00	17	45	10	18	7	25	4	7	8	58.00
Turbidity (NTU)	38.9				3.48	255	821	230	1131	42	9.92	7.2	76.80
Fluoride (mg/L)					0.05	0.85	0.53	0.62	1.08	0.13	0.2	0.41	
Potassium (mg/L)					3.5	62.9	88.5	72.2	77.6	38.1	13.7	7.7	
Magnesium (mg/L)	0.86	0.25	0.74	0.69									0.54
Calcium (mg/l)	2.58	1.71	5.05	1.14									1.35
Ca as CaCO₃ (mg/l)	2.91	1.07	5.99	4.71									3.68
Bromine (mg/L)					0.09	0.06	0.06	0.63	0.13	0.07	2.28	0.05	
Nitrate NO₃ (mg/L)	3.68	0.30	0.11	0.11	1.34	0.35	0.49	0.15	0.85	1.8	0.04	0.16	3.86
Orthophosphate (mg/L)					0.62	0.54	0.28	0.55	0.2	0.68	3.5	1.54	
Nitrite (mg/L)					0.139	0.003	0.05	0.005	0.005	0.132	0.007	0.014	
Iron (mg/L)					1.74						0.03	0.32	
Ammonia (mg/L)					1.25						0.4	2.28	
Chloride (mg/L)	34.50	200.00	49.50	40	53	19500	7625	5750	9375	1550	594	89	103.00
Color (PtCo)					530						59	99	
Magnnganese (mg/L)					0.149						0.065	0.259	

Table 5.3: Bangladesh Water Quality Standards

Sl No.	Best Practices Based Classification	Parameters			
		Temperature (°C)	pH	DO (mg/l)	BOD ₅ (mg/l)
1	Water usable for fisheries	25 - 30	6.5- 8.5	5 or more	6 or less
2	Water usable for irrigation	25 - 30	6.5- 8.5	5 or more	10 or less

Source: Environmental Conservation Rule (ECR) '97

Notes:

- In water used for pisciculture, maximum limit of presence of ammonia as Nitrogen is 1.2 mg/l.
Electrical conductivity for irrigation water– 2250 mhos/cm (at a temperature of 25°C);
Sodium less than 26 percent; boron less than 0.2 percent.



Wapda Khal (surface water sampling)



C-Khal (surface water and bed material sampling)

Figure 5.1: Water and sediment quality sample collection from the study area

Here for the surface water quality, pH level exceeds in Dakatia river.

DO level is high in Dakatia River, Selonia River, Muhuri River, Haora River B.Barua, Lakshipur khal and Ruhita khal.

For turbidity parameter, in Char Maksumul Hakim it exceeds the standard.

For other parameters, all the collected surface water sample quality are within the permitted limit.

Ground Water Quality

Water for human consumption needs to be undergone regular physico-chemical tests. Physico-chemical properties are high priorities in determining acceptability, although they may have little bearing on whether the water is safe to drink or not. Generally, the standards used to evaluate the suitability of water for drinking and domestic purposes are more restrictive than those that would be applied to water for other purposes.

The groundwater quality parameters, measured in the project area during dry season, the month of January and March 2025. The ground water quality of the area is presented in **Table 5.4.**

A number of water samples were collected and tested from different locations within project influence areas.

Table 5.4: Ground Water Quality in Project Influence Area

Parameter	GW near Gomti R.	GW near Ruhita K.	RGW near Rahmatkhali Regulator Laxmipur	GW near Haora R. B.Barua	GW near Musapur Regulator	Noler Char	Boyer Char	Char Maksumul Hakim	GW near Little Feni	GW near Selonia River	GW near Muhuri River	GW near C.Khal	DPHE Standard for Drinking Water
pH	8.05	7.84	7.8	8.56	7.71	8.36	7.29	7.87	7.68	7.71	7.68	8.47	6.5 – 8.5
EC (µS/cm)	143.10	123.50	1492	164	1326	716	4240	1211	950	1038	1071	274	–
TDS (mg/L)	70.10	60.30	729	88.6	640	338	2155	584	458	500	523	153.6	1000
DO mg/L			6.4	1.78	1.65	7.13	4.54	6.12	5.55	5.98	3.57	4.29	
Temperature (deg C)	23.40	23.60											20 - 30
Salinity (ppt)	0.07	0.06	0.73		0.64	0.34	2.19	0.58	0.46	0.5	0.52		1
TSS (mg/L)				7								2	10
Turbidity (NTU)			47.5	26.3	5.81	20.5	100	1.79	3.17	9.27	2.05	6.27	10
Potassium (mg/L)			12.5	3.2	50.7	7.5	33.3	30.4	14.2	25.7	2.2	6.1	12
Chloride (mg/l)			536	41	386	204	1475	259	272	369	453	47	150 – 600
Nitrate (mg/l)			4.47	0.08	1.19	4.36	4.44	4.33	4.48	4.49	0.15	0.04	10
Nitrite (mg/L)			0.536	0.012	0.521	0.522	0.533	0.402	0.54	0.533	0.01	0.029	1
Iron (mg/L)	0.04	1.06	0.77	1.19	0.09	0.15	0.45	0.01	0.46	0.01	0.01	0.22	0.3 – 1.0
Magnanese (mg/L)	0.07	0.24		0.393								0.05	0.1
Fluoride (mg/L)			0.32	0.34	1.29	0.22	0.19	0.59	2.03	0.88	0.44	0.31	1
Bromine (mg/L)			0.1	0.02	0.1	0.05	0.48	0.07	0.13	0.28	0.09	0.01	
Orthophosphate (mg/L)			0.69	5.08	3.5	0.51	0.26	0.81	3.5	1.99	1.12	3.5	
Ammonia (mg/L)			0.13	0.91	3.5	0.01	0.57	0.02	0.14	0.03	0.73	0.34	0.5
Color (PtCo)				120								18	

For, ground water quality:

- pH exceeds near Haora,
- TDS exceeds in Boyer Char,
- Turbidity exceeds near Rahmatkhali Regulator Laxmipur, Boyer char, Noler Char, Potassium exceeds in Rahmatkhali Regulator, Musapur regulator, Boyer Char, Char Maksumul Hakim and near Selona river,
- Chloride exceeds in Boyer Char, Ammonia exceeds near Haora river, Musapur regulator, Boyer Char and near Muhuri river.

It is evident that the ground water quality is extremely poor in Boyer Char as several parameters are found to be exceeds the standard limit here.

5.1.3 Soil Quality

The study area is situated in the south eastern zone of Bangladesh. The soil in the study area is primarily *silty clay loam soil*, especially in Cumilla region (**Figure 5.2**). Moreover, there are also silty loam soil in Brahmanbaria and feni districts, silt and clay loam in Noakhali, Lakshmipur districts. The soil quality in the study districts is summarized in the following table.

Table 5.5: Soil quality in project districts

District	Soil Types	Soil Texture	Soil pH	Fertility Status	Agricultural Practices
Cumilla	Predominantly grey piedmont soils and non-calcareous grey floodplain soils	Loamy to clayey	Generally acidic to strongly acidic	Medium to high, with moderate organic matter content	Intensive rice cultivation; organic amendments like vermicompost, rice husk ash, and poultry litter improve soil health and yields
Noakhali	Old Brahmaputra floodplain series, including olive silty loam and gray soil	Silty loam to clayey	Acidic to slightly acidic	Medium, with variations across regions	Rice and jute cultivation; better soil quality in rural areas compared to urban zones
Feni	Old Brahmaputra floodplain series, primarily olive silty loam and gray soil	Silty loam to clayey	Acidic to slightly acidic	Medium, with variations across regions	Rice and jute cultivation; better soil quality in rural areas compared to urban zones
Brahmanbaria	Surma-Kusiyara floodplain soils, including grey silty loam and silty clay loam	Silty loam to clayey	Acidic to slightly acidic	Medium to high, with moderate organic matter content	Rice cultivation; limited soil fertility studies indicate need for further research

Lakshmipur	Coastal alluvial soils influenced by tidal actions	Silty loam to clayey	Slightly acidic to neutral	Medium, affected by salinity and tidal influences	Rice and shrimp farming; soil quality influenced by coastal salinity and tidal flooding
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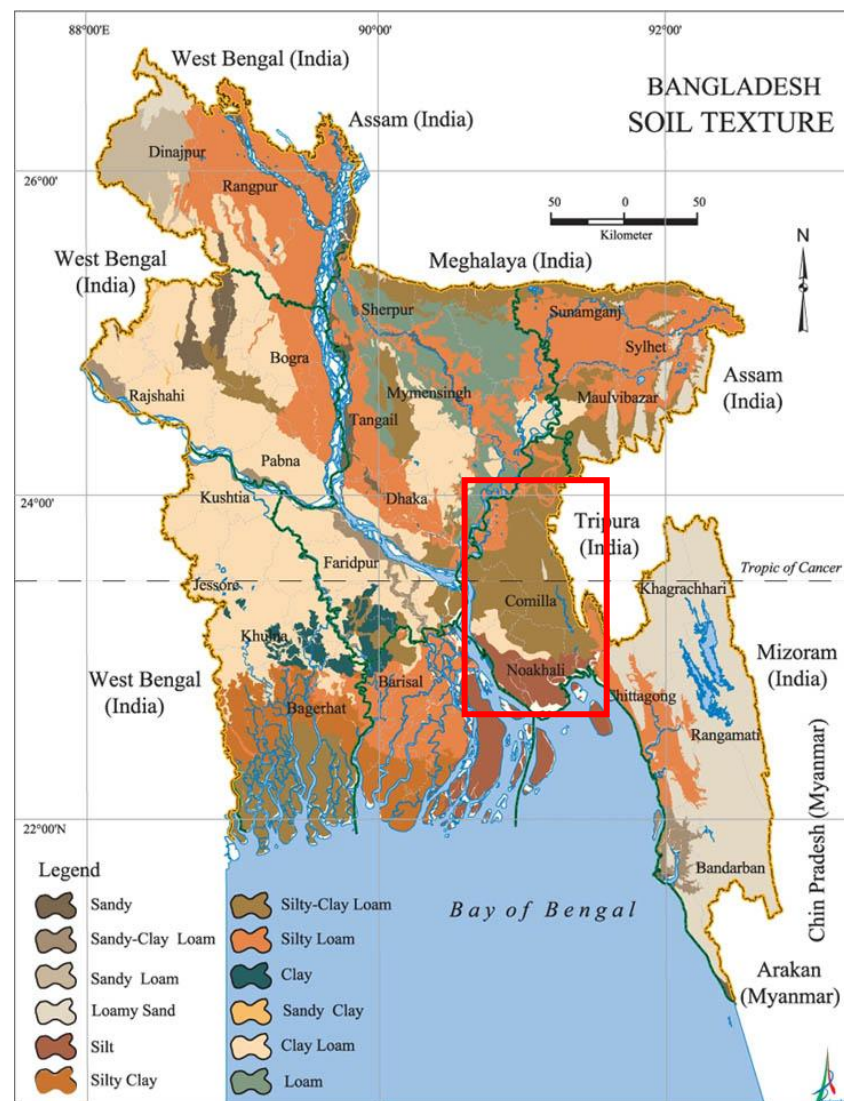
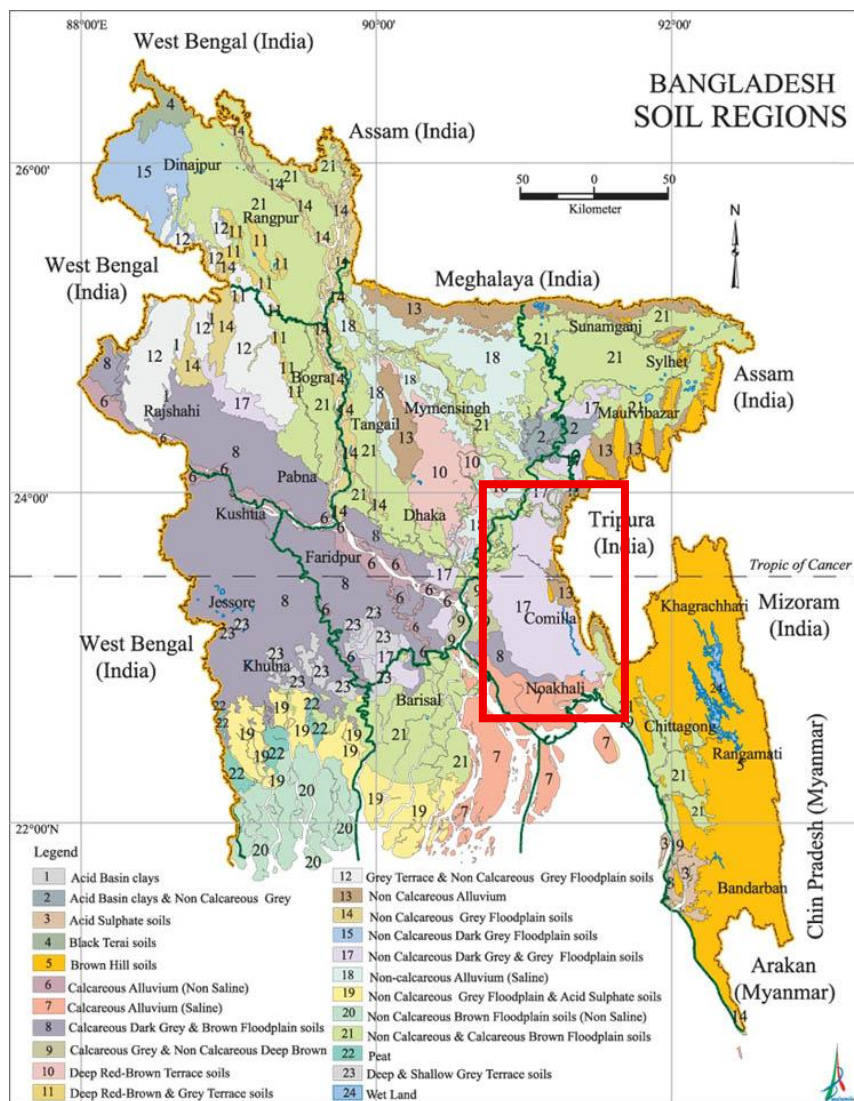


Figure 5.2: Soil type and soil texture of Bangladesh (Source: Wikipedia)

Primary soil quality data have been collected from Ruhita Khal in Cumilla district and C-khal in Lakshmipur district where re-excavation works are proposed. The sampling location is presented in **Figure 5.9** and the test results are presented in **Table 5.6**.

Table 5.6: Soil quality in the project area (tested at INARS, BCSIR)

Parameter	Unit	Soil 1 (C-khal)	Soil 2 (Ruhita Khal)	Guideline Value (FAO)
Magnesium (Mg)	mg/kg	2,646	848	—
Potassium (K)	mg/kg	1,002	678	—
Total Organic Carbon (TOC)	%	3.35	2.28	—
Cadmium (Cd)	mg/kg	<0.001	<0.001	5
Lead (Pb)	mg/kg	6.37	8.37	100

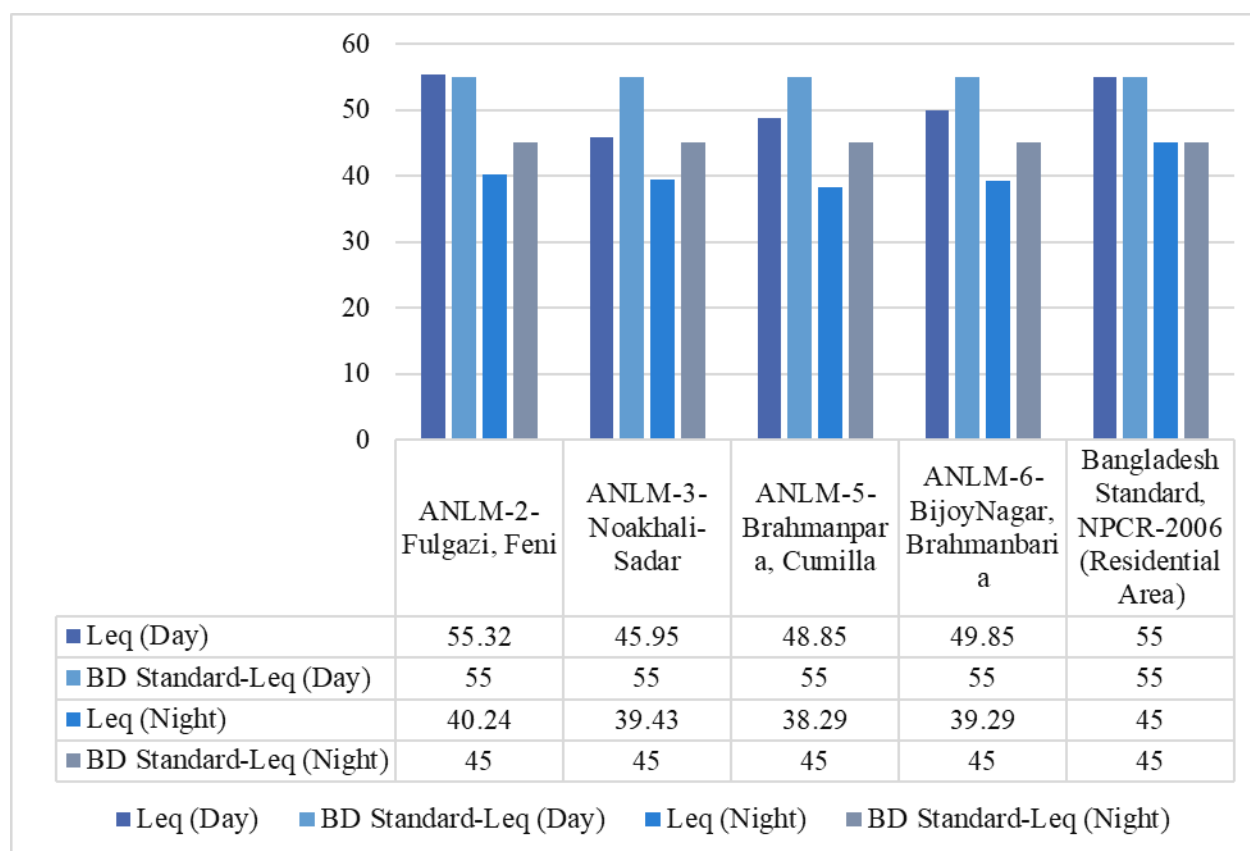
5.1.4 Noise

Noise level were measured at five (05) locations in the monitoring period from the project boundary on 28-30 January, 2025. The Lutron SL-4033SD noise level meter was used for noise level monitoring. The parameters were L-max, L-min, Leq-day, Leq-night. Noise level monitoring was carried out at both day time and at night time. The sampling duration was 24 hours. Measurements were taken at 1-min intervals over the period. After getting the raw data from the device, descriptive statistical analysis was applied to calculate L_{eq} for each monitoring location. All the measurements locations are residential areas in nature.

Table 5.7: Noise levels in the Project Area

Location	Analyzed Value (Decibel)						Category	
	Day			Night				
	Leq	Lmax	Lmin	Leq	Lmax	Lmin		
ANLM-2- Fulgazi, Feni	55.32	72.57	39.17	40.24	58.5	30.1	Residential	
ANLM-3- Noakhali-Sadar	45.95	63.2	30.2	39.43	57.5	31.1	Residential	
ANLM-4- Ramganj, Lakshmipur	51.25	68.5	35.5	40.53	58.7	32.2	Residential	
ANLM-5- Brahmanpara, Cumilla	48.85	66.1	33.1	38.29	56.4	32.1	Residential	
ANLM-6- BijoyNagar, Brahmanbaria	49.85	70.1	37.1	39.29	57.4	33.1	Residential	
Bangladesh Standard, Noise Pollution Control Rules 2006							Day Time	Night Time
Industrial area							75	70
Commercial							70	60
Mixed area							60	50
Residential area							55	45
Silent Area							50	40
World Bank / IFC Standard								
Industrial area							70	70
Residential; Intuitional; Educational							55	45

Analyzing the noise monitoring data, it is found that the average noise level value (Leq) in all location at day and night time has been observed below the BD standard except the Leq of day time at ANLM-2- Fulgazi, Feni. At ANLM-2- Fulgazi, Feni L_{eq} was found 55.32 dB which is slightly above the standard level of 55 dB in residential area. The higher value is likely occurred due to people's movement and loud discussions, high wind speed creating noise as well as vehicular movement and horns.



Methodology

Noise level were measured in the monitoring period from the project boundary on 28-30 January, 2025. The Lutron SL-4033SD noise level meter shown in Figure 3 was used for noise level monitoring. Therefore, the survey team conducted the noise measurements from different areas over a standard period at the same locations as the Air Quality Monitoring. The parameters were L-max, L-min, Leq day, Leq-night. Noise level monitoring was carried out at both day time and at night time. The sampling duration was 24 hours. Measurements were taken at 1-min intervals over the period. The device was recorded data throughout the monitoring period. After getting the raw data from the device, descriptive statistical analysis was applied to calculate Leq for every monitoring location. The Leq measure is usually used in the environmental noise analysis. The Equivalent Level of Sound (Leq) is the level of continuous noise that people can be exposed.

5.1.5 Climate

The study area in Brahmanbaria, Cumilla, Feni, Lakshmipur and Noakhali districts share a tropical monsoon climate characterized by hot summers, mild winters, high humidity, and

significant monsoon rainfall. Historical climate data of an adequate period has been analysed to formulate a usable average climate scenario data.

Statistical analysis of temperature data in these locations shows that the annual average temperature is approximately 26°C. The summer months (March to June) are hot with maximum temperatures often exceeding 30°C. The winter months (December to February) are mild, with minimum temperatures ranging between 12°C to 20°C. January is usually the coolest month.

Heavy rainfall occurs in monsoon season, especially from June to September, and the winter months, December, January and February remain mostly dry. Rainfall during the monsoon season contributes to the majority of the annual precipitation. Minimal rainfall is observed from November to February. March to May is also relatively dry but can have occasional pre-monsoon showers.

Bangladesh Meteorological Department (BMD) measure climate data regularly. They maintain climate monitoring stations in Feni, Noakhali, and Cumilla. Climatic data information about temperature, rainfall, humidity, and wind speed are provided in **Table 5-8** to **Table 5-10**.

Table 5-8: Climatic Data at Feni Station

Climatic Data at Feni												
Particulars	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max Temp (°C)	26.0	28.3	31.5	32.2	32.3	31.3	30.5	31.1	31.4	31.6	29.9	27.0
Min Temp (°C)	12.7	15.7	20.5	23.4	24.4	25.3	25.1	25.2	25.1	23.6	19.3	14.3
Avg Temp (°C)	19.35	22	26	27.8	28.35	28.3	27.8	28.15	28.25	27.6	24.6	20.7
Avg Rain (mm)	8.0	35.0	76.8	192.9	383.6	529.9	731.5	536.1	324.8	200.2	52.9	9.9
Normal Humidity (%)	76	73	74	79	81	85	87	86	86	84	80	78
Normal Wind Speed (m/s)	0.84	1.26	1.97	2.95	2.75	3.17	3.43	3.02	2.01	1.00	0.70	0.63

(Data Source: BMD)

Table 5-9: Climatic Data at Maijdi Court (Noakhali) Station

Climatic Data at Maijdi Court												
Particulars	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max Temp (°C)	25.4	27.7	31.2	32.3	32.3	31.1	30.2	30.4	31.0	31.2	29.2	26.2
Min Temp (°C)	13.5	15.6	19.9	23.3	24.7	25.6	25.4	25.4	25.5	24.4	20.4	15.7
Avg Temp (°C)	19.45	21.65	25.55	27.8	28.5	28.35	27.8	27.9	28.25	27.8	24.8	21
Avg Rain (mm)	12.1	30.0	81.2	135.1	340.5	532.7	790.2	637.1	359.1	169.8	58.5	8.8
Normal Humidity (%)	79	76	76	78	81	86	88	87	86	83	80	80
Normal Wind Speed (m/s)	0.71	1.08	1.81	2.91	2.84	3.41	3.45	3.01	1.98	1.08	0.71	0.60

(Data Source: BMD)

Table 5-10: Climatic Data at Cumilla Station

Climatic Data at Cumilla												
Particulars	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max Temp (°C)	25.4	27.7	31.0	32.2	32.2	31.6	30.9	31.3	31.6	31.4	29.6	26.6
Min Temp (°C)	12.1	15.2	19.7	22.8	24.2	25.3	25.4	25.4	25.2	23.4	18.7	13.3
Avg Temp (°C)	18.75	21.45	25.35	27.5	28.2	28.45	28.15	28.35	28.4	27.4	24.15	20
Avg Rain (mm)	7.5	28.8	66.2	153.9	329.6	329.8	415.5	316.0	226.6	141.6	41.6	8.6
Normal Humidity (%)	77	75	77	81	82	86	87	86	86	84	80	79
Normal Wind Speed (m/s)	1.16	1.58	2.81	4.30	4.36	4.64	4.73	4.10	2.69	1.44	0.89	0.88

(Data Source: BMD)

Methodology

Meteorological data was monitored on 28-30 January, 2025 at Six (06) in the project site. Anemometer- AH-4223, and Weather Station shown in figure 1 were used to observe the physical environment including temperature, humidity, wind speed, wind direction respectively. The method of testing was on-site recording. Apart from that, rainfall data were collected from secondary data sources, for instance, Bangladesh Meteorological Department (BMD). Data were analyzed following the descriptive statistical method using MS Excel.

5.2 Biological Environment

The Biological environment are the living organisms, such as animals, plants, microorganisms etc., are often referred as biotic factors and affect human life as in particular period or place. Initially, secondary data sources such as IUCN Report, other ESIA studies in the area were analyzed in order to compile a potential presence/absence list of significant fauna and flora species. Then, field surveys (details in [Appendix-D](#)) were carried out for validation checks against the earlier-compiled species lists in order to establish a comprehensive baseline. The study team comprising Team Leader, Ecological and Fisheries Experts, Environmentalist and field researchers visited the project intervention sites, noted species by direct observation, interviews with local residents, and inspection of fishermen's catches and fish market survey.



Team Leader & Ecologist at Wapda Khal, L.pur



Ecologist at Noler Char, Noakhali



Ecologist at right bank of Little Feni River, near the eastside point of Musapur Closure, Noakhali



Ecologist inspecting fish catch at right bank of Selonia River in Feni



Fish market survey in Noakhali



Fish market, Mogra Bazar, Brahmanbaria

Figure 5.3: Field visit, ecological inspection and consultation for ecological survey

5.2.1 Flora

Both terrestrial and aquatic fauna are found in the study area. The terrestrial flora primarily covers agricultural crops, homestead trees and other vegetation, embankment and roadside trees and grasslands. Various fruit trees are found at the homesteads such as coconut, betel nut (supari), date, various types of plums, banana, jackfruit, guava, mango, lychee etc. Bamboo and cane are found in abundance. Various medicinal trees like Neem, Babla, Mandar, Akashmoni, Koro, Mehogoni are found on roadsides and homesteads. Grasslands, especially uri ghash are found in the newly developed chars. Boro, aman and aus paddy are cultivated whereas corn, wheat, sugarcane, soybean, pulse crop, chili, vegetables etc. are also grown in the area. Water hyacinth is found in waterbodies everywhere. Moreover, other aquatic flora such as water lily, topa pana, binna ghash, hogla etc. are also found.

Trees

The project areas support a diverse assemblage of common tree species that contribute substantially to local biodiversity, ecological stability, and community livelihoods. Fruit-bearing trees such as *Mangifera indica* (Mango), *Syzygium cumini* (Java Plum), *Psidium*

guajava (Guava), *Artocarpus heterophyllus* (Jackfruit), and *Litchi chinensis* (Lychee) are extensively cultivated for their nutritional value and economic importance.

Shade and timber-providing trees like *Ficus benghalensis* (Banyan), *Samanea saman* (Rain Tree), *Swietenia mahagoni* (Mahogany), and *Tectona grandis* (Teak) are commonly observed along homesteads, roadways, and institutional compounds. Several medicinal and culturally significant trees such as *Phyllanthus emblica* (Amlaki), *Aegle marmelos* (Bael), and *Terminalia arjuna* (Arjun) are also prevalent.

Moreover, bamboo species such as *Bambusa balcooa*, *Bambusa tulda*, and *Bambusa longispiculata* serve as vital resources for construction and daily use. The coexistence of both indigenous and exotic species reflects the ecological richness and agroforestry potential of the region. **Table 5-11** presents the tree species recorded in the project area based on primary baseline ecological surveys.

Table 5-11: Tree species recorded in the project area

S/N	Local Name	Common Name	Scientific Name
1	Aam	Mango	<i>Mangifera indica</i>
2	Acacia/Babla	Gum Arabic Tree	<i>Acacia nilotica</i>
3	Amloki	Indian Gooseberry (Amla)	<i>Phyllanthus emblica</i>
4	Arjun	Arjun Tree	<i>Terminalia arjuna</i>
5	Ata fal	Sugar Apple	<i>Annona squamosa</i>
6	Bael	Golden Apple	<i>Aegle marmelos</i>
7	Barak Bansh	Clumping Bamboo	<i>Bambusa balcooa</i>
8	Borta/Dahua	Lakoocha	<i>Artocarpus lacucha</i>
9	Boroi	Indian Jujube	<i>Ziziphus mauritiana</i>
10	Bot	Banyan	<i>Ficus benghalensis</i>
11	Chalta	Elephant Apple	<i>Dillenia indica</i>
12	Deshi Nim	Chinaberry	<i>Melia azedarach</i>
13	Dumur	Opposite Leaf Fig	<i>Ficus hispida</i>
14	Hijal	Indian Putat	<i>Barringtonia acutangula</i>
15	Jalbai	Robust Olive	<i>Elaeocarpus robustus</i>
16	Jam	Java Plum	<i>Syzygium cumini</i>
17	Jambura	Pomelo	<i>Citrus grandis</i>
18	Jamrul	Java Apple	<i>Syzygium samarangense</i>
19	Kad Bel	Wood Apple	<i>Feronia limonia</i>
20	Kadam	Burflower Tree	<i>Anthocephalus chinensis</i>
21	Kalo Karoi	Lebbeck	<i>Albizia lebbeck</i>
22	Kathal	Jackfruit	<i>Artocarpus heterophyllus</i>
23	Khejur	Silver Date Palm	<i>Phoenix sylvestris</i>
24	Krishnachura	Royal Poinciana	<i>Delonix regia</i>
25	Lichu	Lychee	<i>Litchi chinensis</i>
26	Mahogani	American Mahogany	<i>Swietenia mahagoni</i>

S/N	Local Name	Common Name	Scientific Name
27	Mandar	Indian Coral Tree	<i>Erythrina variegata</i>
28	Narikel	Coconut	<i>Cocos nucifera</i>
29	Peara	Common Guava	<i>Psidium guajava</i>
30	Pitali/Medda	False White Teak	<i>Mallotus nudiflorus</i>
31	Raintree/Koroi	Rain Tree	<i>Samanea saman</i>
32	Sajna	Moringa	<i>Moringa oleifera</i>
33	Segun	Teak	<i>Tectona grandis</i>
34	Shal	Sal Tree	<i>Shorea robusta</i>
35	Shawra	Nyireh Batu	<i>Xylocarpus moluccensis</i>
36	Shimul/Simul	Cotton Tree	<i>Bombax ceiba</i>
37	Supari	Areca Palm (Betel Nut)	<i>Areca catechu</i>
38	Tal	Asian Palmyra Palm	<i>Borassus flabellifer</i>
39	Talla Bansh	Tulda Bamboo	<i>Bambusa tulda</i>
40	Tarla Bansh	Mahal Bamboo	<i>Bambusa longispiculata</i>
41	Tetul	Tamarind	<i>Tamarindus indica</i>



Areca palm (Supari)



Mahogany



Bamboo

Figure 5.4: Common trees in the study area

Shrubs

The project areas support a diverse array of common shrub species that play important roles in local ecosystems, homestead gardens, and cultural traditions. Aromatic and flowering shrubs such as *Jasminum sambac* (Beli), *Jasminum auriculatum* (Jui), and *Hibiscus rosa-sinensis* (Jaba) are widely grown for their ornamental appeal and aesthetic appeal.

Medicinal shrubs like *Lawsonia inermis* (Mehedi), traditionally used for body art and cooling treatments, and *Justicia adhatoda* (Bashok), valued for its respiratory benefits, remain

common in household gardens. *Ocimum americanum* (Tulshi) continues to hold religious significance and is widely utilized in herbal remedies. Shrubs such as *Citrus aurantifolia* (Lebu) provide essential culinary and nutritional value, while *Murraya paniculata* (Kamini) is frequently planted as a natural hedge, appreciated for its dense foliage and fragrant blossoms.



Jaba/Hibiscus



Key lime

Figure 5.5: Common shrubs in the study area

The shrubs contribute significantly to the biodiversity, health, and cultural heritage of the communities in the project areas. **Table 5-12** presents the Shrubs species recorded in the project area, based on primary baseline ecological surveys.

Table 5-12: Shrubs species recorded in the project area

S/N	Local Name	Common Name	Scientific Name
1	Bashok	Malabar Nut	<i>Justicia adhatoda / Adhatoda vasica</i>
2	Beli	Jasmine	<i>Jasminum sambac</i>
3	Gondhoraj	Gardenia	<i>Gardenia jasminoides</i>
4	Jaba	Chinese Hibiscus	<i>Hibiscus rosa-sinensis</i>
5	Jui	Juhi	<i>Jasminum auriculatum</i>
6	Kamini	Orange Jessamine	<i>Murraya paniculata</i>
7	Lebu	Key Lime	<i>Citrus aurantifolia</i>
8	Mehedi/Mendi	Henna	<i>Lawsonia inermis</i>
9	Tulshi	Hoary Basil (Holy Basil)	<i>Ocimum tenuiflorum/Ocimum americanum</i>
10	Veranda	Castor Oil Plant	<i>Ricinus communis</i>

Herbs

The project areas are home to a diverse range of common herbaceous plants that serve both ecological and practical functions. Edible herbs like *Oxalis corniculata* (Amrul Shak) and *Eryngium foetidum* (Bon Dhonia) are widely used in local cuisine and traditional medicine. Several banana varieties, including *Musa paradisiaca* (Anaji Kala), *Musa sp.* (Bangla, Sabri, and Sagar Kala), are cultivated for their fruit and leaves.

Medicinal herbs such as *Aloe barbadensis* (Ghrit Kumari) and *Leucas aspera* (Shetdrone) are valued for their healing and therapeutic uses. Wild herbaceous species like *Polygonum hydropiper* (Bish Katali) and *Datura metel* (Dhutura) thrive in moist areas and are often used in folk remedies, albeit with caution due to toxicity. Moreover, ground-covering herbs like *Cynodon dactylon* (Durba) are essential in erosion control and religious rituals.



Banana



Common Fern

Figure 5.6: Common herbs in the study area

The herbs reflect the rich ethnobotanical knowledge and biodiversity of the region. **Table 5-13** presents the Herbs species recorded in the project area, based on primary baseline ecological surveys.

Table 5-13: Herbs species recorded in the project area

S/N	Local Name	Common Name	Scientific Name
1	Ada	Ginger	<i>Zingiber officinale</i>
2	Amrul Shak	Creeping Woodsorrel	<i>Oxalis corniculata</i>
3	Anaji Kala	Musa paradisiacal	<i>Musa × paradisiaca</i>
4	Bangla Kala	Banana Plant	<i>Musa</i> sp.
5	Bish Katali	Water Pepper	<i>Polygonum hydropiper</i>
6	Bon Dhonia	Culantro	<i>Eryngium foetidum</i>
7	Dhona-Pata	Coriander	<i>Coriandrum sativum</i>
8	Dhutura	Devil's Trumpet	<i>Datura metel</i>
9	Durba	Scutch Grass	<i>Cynodon dactylon</i>
10	Gash-full	Goatweed	<i>Ageratum</i> sp.
11	Gandharaj	Cape Jasmine	<i>Gardenia jasminoides</i>
12	Ghrit Kumari	Aloe Vera	<i>Aloe barbadensis</i> / <i>Aloe vera</i>
13	Grito-kumari	Aloe Vera	<i>Aloe vera</i>
14	Holud	Turmeric	<i>Curcuma longa</i>
15	Jangli Kachu	Water Lily Taro	<i>Colocasia nymphaeifolia</i>
16	Kalmegh	Creast or Green Chiretta	<i>Andrographis paniculata</i>
17	Kachu	Taro	<i>Alocasia</i> sp.
18	Lozzaboti	Touch-me-not	<i>Mimosa pudica</i>
19	Mankachu	Indian Taro	<i>Alocasia indica</i>
20	Palong Shak	Spinach	<i>Spinacia oleracea</i>
21	Pudina	Mint	<i>Mentha orvensis</i>
22	Sabri Kala	Banana Plant	<i>Musa</i> sp.

S/N	Local Name	Common Name	Scientific Name
23	Sagar Kala	Banana Plant	<i>Musa sp.</i>
24	Shetdrone	Thumbai	<i>Leucas aspera</i>
25	Thankuni Pata	Centella	<i>Centella asiatica</i>

Creepers

The project areas host a variety of common creeper plants species that contribute significant to local ecosystems, traditional medicine, and household uses. *Quisqualis indica* (Madhabila) is a widely recognized ornamental creeper, often found adorning fences and home gardens. *Cuscuta reflexa* (Swarnalata), although parasitic, continues to be valued for its role in traditional healing practices.

Edible creepers such as *Monordica charantia* (Teet Karela) are cultivated for their nutritional and medicinal value. Medicinal species like *Vitis quadrangularis* (Harjora) are commonly used in folk remedies, particularly for bone-related ailments. Wild varieties including *Piper peepuloides* (Pipul) and *Abrus precatorius* (Kuch) hold cultural and herbal significance, though the latter is highly toxic and must be handled with caution. *Calamus viminalis* (Bet) is also present and is valued for its strong canes, widely used in traditional crafts.

Collectively, these creepers species enhance the botanical diversity of the region and support local livelihoods and traditional knowledge systems. **Table 5-14** presents the creepers species recorded in the project area, based on primary baseline ecological surveys.

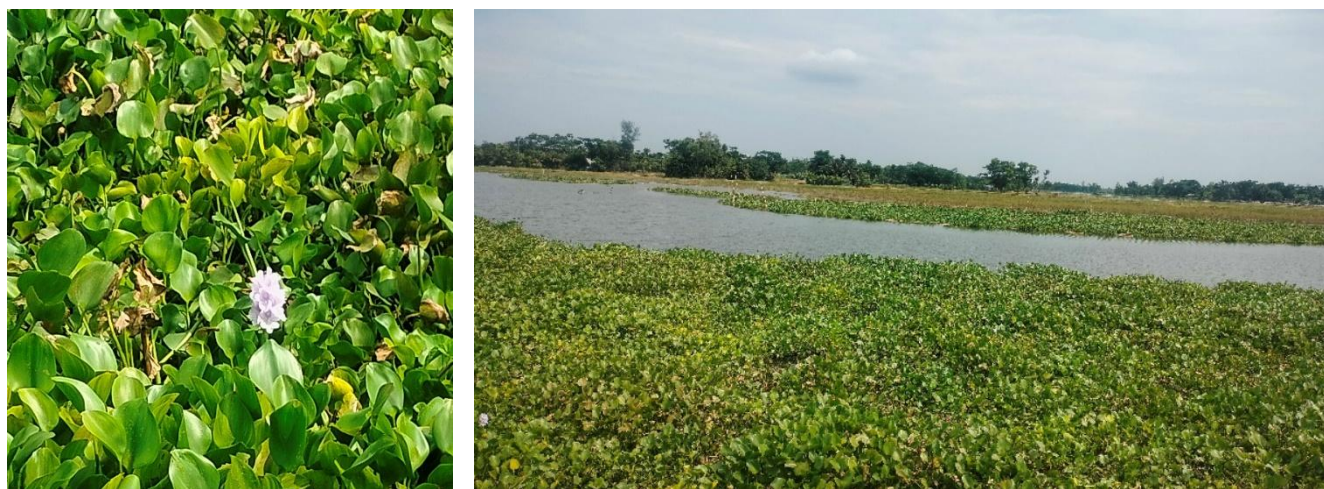
Table 5-14: Creepers species recorded in the project area

S/N	Local Name	Common Name	Scientific Name
1	Assamlata	Jack in the Bush	<i>Eupatorium odoratum</i>
2	Bet	Bitter Rattan palm	<i>Calamus viminalis</i>
3	Harjora	Veld grape	<i>Vitis quadrangularis</i>
4	Kuch	Rosary pea	<i>Abrus precatorius</i>
5	Libuji lota	Perennial creeping climber	<i>Mikania cordata</i>
6	Madhabila	Rangoon creeper or Burma creeper	<i>Quisqualis indica</i> / <i>Combretum indicum</i>
7	Pipul	Wild pepper	<i>Piper peepuloides</i>
8	Swarnalata	Dodder or Amarbel	<i>Cuscuta reflexa</i>
9	Teet Karela	Bitter melon or bitter gourd	<i>Monordica charantia</i>
10	Thankuni	Indian pennywort	<i>Centella asiatica</i>
11	Pui-Sak	Indian Spinach	<i>Basella alba</i>
12	Guloncho	Heart-leaved moonseed	<i>Tinospora cordifolia</i>
13	Lota futki	Balloon vine	<i>Cardiospermum halicacabum</i>

Aquatic Plants

The aquatic ecosystems of the project areas exhibit a rich diversity of aquatic plant species that play a vital role in maintaining fish habitats, enhancing water quality, and supporting

overall ecological balance. Prominent among these is *Eichhornia crassipes* (Water Hyacinth), an invasive species that nonetheless provides temporary shelter for fish during breeding periods. *Ipomoea carnea* and *Ipomoea fistulosa* (Dhol Kolmi), along with *Ipomoea reptans* (Water Spinach), are frequently found along margins of canals and ponds. *Alternanthera philoxeroides* (Alligator Weed) and *Lemna minor* (Duckweed) often form dense mats in stagnant waters, offering critical cover and foraging habitats for aquatic fauna. Additionally, floating and emergent species such as *Trapa bispinosa* (Water Chestnut), *Nymphaea nouchali* (Shalook), and *Nymphaea nucifera* (Shapla/Lotus) contribute to the floral diversity and enhance the ecological and aesthetic value of wetlands and seasonal waterbodies. **Table 5-15** presents the aquatic plant species recorded in the project area, based on primary baseline ecological surveys.



Water Hyacinth (Wapda khal, Lakshmipur)

Figure 5.7: Common aquatic plant in the study area

Table 5-15 presents the aquatic plant species recorded in the project area, based on primary baseline ecological surveys.

Table 5-15: Aquatic plant species recorded in the project area

Sl. No.	Local Name	Common/English Name	Scientific Name
1	Choto pana	Common water hyacinth	<i>Eichhornia crassipes</i>
2	Dhol Kolmi	Pink morning glory	<i>Ipomoea carnea</i>
3	Helencha	Alligator weed	<i>Alternanthera philoxeroides</i>
4	Hogla	Cattail	<i>Typha angustifolia</i>
5	Kachuri pana	Common water hyacinth	<i>Eichhornia crassipes</i>
6	Kalmi	Water spinach	<i>Ipomoea reptans</i>
7	Khudi pana	Common duckweed	<i>Lemna minor</i>
8	Kolmi	Water spinach	<i>Ipomoea aquatica</i>
9	Lal-Shapla	Red water lily	<i>Nymphaea rubra</i>
10	Malancha	Alligator weed	<i>Alternanthera philoxeroides</i>
11	Nol-Khagra	Common Reed	<i>Phragmites karka</i>

Sl. No.	Local Name	Common/English Name	Scientific Name
12	Padma	Water lily / Lotus	<i>Nymphaea nucifera</i>
13	Pani Singara	Water chestnut	<i>Trapa bispinosa</i>
14	Sada-Shapla	Water lily	<i>Nymphaea pubescens</i>
15	Shalook	Water lily	<i>Nymphaea nouchali</i>
16	Shapla/Water Lily	Water lily	<i>Nymphaea nouchali</i>
17	Shawla	Azolla	<i>Azolla sp.</i>

5.2.2 Fauna

The project area is rich in faunal species both aquatic and terrestrial fauna. Aquatic and terrestrial faunal species include fish, reptiles amphibians, birds, and mammals.

Fish and Other Aquatic Fauna

The project sites exhibit a high degree of aquatic biodiversity, encompassing both freshwater and brackish water ecosystems. These regions support diverse fish assemblages that are critical for sustaining local livelihoods, food security, and ecosystem services. Fish market surveys and consultation with local fishermen have been carried out to identify fish species found in the area.

Aquaculture practices in the study area are characterized by the dominance of key indigenous species such as *Labeo rohita* (Rohu), *Catla catla* (Katla), *Cirrhinus mrigala* (Mrigal), and *Pangasius suchi* (Pangas), which are widely cultured in ponds and canals. In the region, there is a noticeable trend toward polyculture systems, as evidenced by the increasing inclusion of introduced species like *Oreochromis niloticus* (Nile Tilapia), *Cyprinus carpio* (Common Carp), and *Barbonymus gonionotus* (Thai Sorputi). This reflects a shared evolution in aquafarming practices, aimed at enhancing productivity and diversification in local aquaculture systems.

Common native species found in these riverine and canal systems include:

- Small indigenous species (SIS) such as *Puntius* spp. (Puti), *Mystus vittatus* (Tengra), *Gudusia chapra* (Chapila), *Parambassis ranga* (Chanda), *Heteropneustes fossilis* (Shing), *Clarias batrachus* (Magur), *Channa punctata* (Shol), *Channa marulius* (Gajar), *Mastacembelus* spp. (Biam), and *Amblypharyngodon mola* (Mola)
- Predatory species like *Channa striata* (Snakehead), *Wallago attu* (Boal), and *Channa marulius* (Gajar).
- Seasonally introduced aquaculture species, such as *Pangasianodon hypophthalmus* (Thai Pangas) and *Barbonymus gonionotus* (Thai Sarputi), along with various native aquaculture species, often escape into natural water systems, contributing to the dynamic interaction between cultured and wild fish populations.

These river and canal fisheries not only support the subsistence and commercial needs of local fishing communities but also demonstrate the ecological productivity and resilience of the aquatic systems in the project area. **Table 5-16** provides a detailed inventory of both

cultured and wild-caught fish species observed in the study rivers and khals. This information serves as an essential baseline for resource management and informs the project's efforts to preserve traditional knowledge and implement sustainable environmental and social management strategies.

Table 5-16: Fish species recorded in the project area

Sl No	Local Name	English Name	Local Name (Bangla)	Scientific Name	Aquaculture/ Natural
1	Ayre/Aor	Longwhiskered Carfish	আইড়	Aorichthys aor	Natural
2	Batashi	Indian Potasi	বাতাসী/পাতাসী	Pseudeutropius atherinoides	Natural
3	Batashi tengra	Tista Batasio	বাতাসি টেংরা	Batasio batasio	Natural
4	Bele/Bailla	Tank Goby	বেলে	Glossogobius giuris	Natural
5	Big head Carp	Big-head Carp	বিগহেড কার্প	Hypophthalmichthys nobilis	Aquaculture
6	Chhep Chela	Silver Hatchet fish	হেটচেট মাছ	Chela cachius	Natural
7	Chela	Large razorbelly minnow	চেলা	Salmophasia bacaila	Natural
8	Chela	Silver Razorbelly Minnow	চেলা	Salmophasia acinaces	Natural
9	Chep chela	Barbs & Minnows	চেপ-চেলা	Chela cachius	Natural
10	Chingri (Large)	Prawn	গলদা চিংড়ি	Macrobrachium rosenbergii	Natural and Aquaculture
11	Chingri (Small)	Prawn	ছোট বা গুড়া চিংড়ি	Macrobrachium sp.	Natural
12	Chital	Humped Featherback	চিতল	Chitala chitala	Natural
13	Chitol	Knifefish	চিতল	Chitala chitala	Natural
14	Commonr Carp	Common Carp	কার্পিও	Cyprinus carpio	Aquaculture
15	Deshi Sarputi	Olive Barb	সরপুটি	Systomus sarana	Natural
16	Gajar/Gajal	Giant Snakehead	গজার মাছ	Channa marulius	Natural
17	Ghaura	Ghaura	গাওড়া	Clupisoma garua	Natural
18	Golda Chingri (Large)	Prawn	গলদা চিংড়ি	Macrobrachium rosenbergii	Natural and Aquaculture
19	Guizza/ Guizza Ayer	Giant Rivercatfish	আইড়	Sperata seenghala	Natural
20	Jatputi	Pool barb	জাতপুটি	Puntius sophore	Natural
21	Kaikla	Freshwatr	কাকিলা	Xenentodon cancila	Natural

Sl No	Local Name	English Name	Local Name (Bangla)	Scientific Name	Aquaculture/ Natural
		Garfish			
22	Kata chanda	Glassy perchlet	কাঁটা চান্দা	Parambassis sp.	Natural
23	Koi	Climbing Perch	কৈ	Anabas testudineus	Natural and Aquaculture
24	Kalibaus	Black Rohu or Orangefin labeo	কালিবউস	Labeo calbasu	Aquaculture and Natural
25	Leijja Poa	Pama croaker	লেইজা পোয়া	Otolithoides pama	Natural
26	Magur	Magur	মাগুর	Clarias batrachus	Natural
27	Magur/Jagur	Walking catfish	মাগুর	Clarias batrachus	Natural
28	Meni	Perches	মেনি	Nandus nandus	Natural
29	Mola	Indian Carplet	মলা	Amblypharyngodon mola	Natural
30	Mrigel	Mrigal	মৃগাল	Cirrhinus mrigala	Aquaculture and Natural
31	Pangus	Pangus catfish	পাঙ্গাস	Pangasius pangasius	Natural
32	Pabda	Pabo Catfish	মধু পাবদা	Ompok pabo	Natural
33	Pholoi	Grey Featherback	কানলা	Notopterus notopterus	Natural
34	Piranha	Piranhas	পিরহানা	Pygocentrus sp.	Aquaculture
35	Punti	Spotfin Barb	পুটি	Puntius sophore	Natural
36	Rita	Rita	রিটা	Rita rita	Natural
37	Rui	Rohu	রুই	Labeo rohita	Aquaculture and Natural
38	Shing	Stinging Catfish	শিং মাছ	Heteropneustes fossilis	Natural and Aquaculture
39	Shol mach	Striped snakehead	শোল মাছ	Channa striata	Natural
40	Shoal	Striped snakehead	শোল মাছ	Channa striata	Natural
41	Swar Punti	Olive Barb	সরপুটি	Puntius sarana	Natural
42	Taki	Spotted Snakehead	টাকি	Channa punctatus	Natural
43	Tel Taki	Asiatic Snakehead	গাছুয়া	Channa orientalis	Natural
44	Teri puti	Onespot barb	টেরি পুটি	Puntius terio	Natural
45	Thai pangas	Thai pangas	থাই পাঙ্গাস	Pangasianodon hypophthalmus	Aquaculture
46	Thai sarputi	Thai sarputi	থাই সরপুটি	Barbonymus gonionotus	Aquaculture
47	Tengara	Striped dwarf	টেংরা	Mystus vittatus	Natural

Sl No	Local Name	English Name	Local Name (Bangla)	Scientific Name	Aquaculture/ Natural
		catfish			
48	Tengara	Tengara catfish	ভোরা টেংরা	Mystus tengara	Natural
49	Tengra/Golsha-tengra	Day's Mystus	টেংরা	Mystus bleekeri	Natural
Other Aquatic Animal Species					
50	Kakra	Crab	কাঁকড়া	Austrotelphusa sp.	Natural
51	Shushuk	River dolphin	শুশুক বা ডলফিন	Platanista gangetica gangetica	Natural

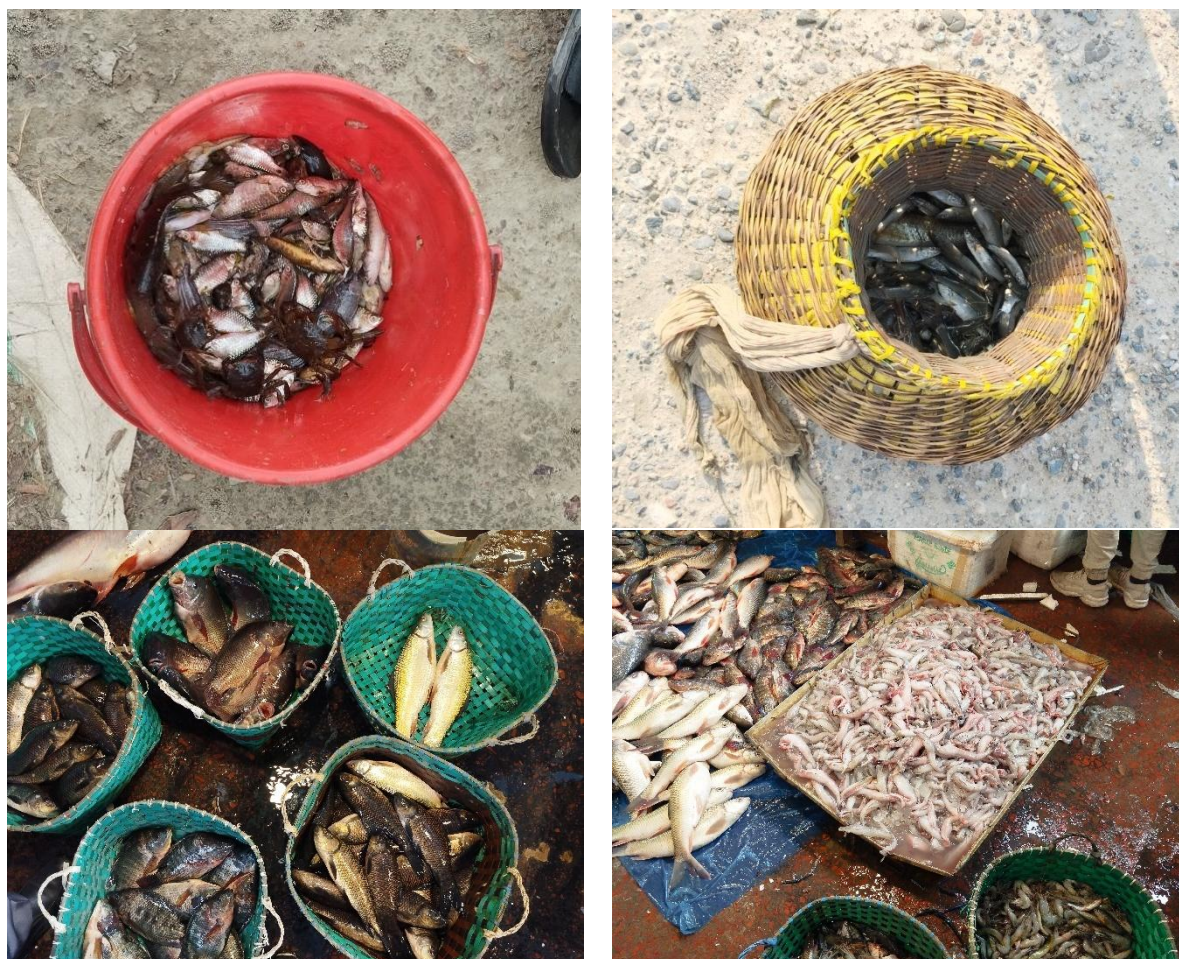


Figure 5.8: Fish species found in the study area (fish catches in Selonia and Little Feni rivers and fish markets in Noakhali)

During monsoon and flood seasons, overflow from aquaculture ponds facilitates the migration of cultured species into adjacent canals and floodplain wetlands, which serve as

critical habitats for both resident and migratory species. These canals support a range of native catfish, including *Ompok pabo* (Pabda), *Mystus vittatus*, *Batasio batasio*, and *Heteropneustes fossilis* (Shing), along with predatory species, such as *Channa straiatus* (Snakehead). Seasonal overflows also introduce additional cultured species like *Pangasianodon hypophthalmus* (Thai Pangas) and *Puntius sophore* (Spotfin Barb) contributing further to the biodiversity. Traditional fishing practices such as the use of *Katha* (fish aggregating devices) remain prevalent across the project areas. These structures attract a wide variety of economically and ecologically important species, including *Wallago attu* (Freshwater Shark), *Notopterus notopterus* (Grey Featherback), and multiple prawn species, both giant and small. These practices not only sustain local fishing communities but also highlight the ecological complexity and productivity of the aquatic systems within the project area. This baseline and preserving traditional knowledge systems as part of the project's environmental and social management planning.

Reptiles

The project areas support a notable diversity of reptilian fauna, indicative of region's varied and ecologically rich habitats. Among the commonly encountered species are lizards such as *Calotes versicolor* (Garden Lizard) and *Hemidactylus brookii* (Spotted House Gecko), which are well-adapted to both natural and human-modified environments. **Table 5-17** provides a list of reptile species recorded within the project areas during baseline assessment. Several snake species, including *Ahaetulla nasuta* (Common Vine Snake) and *Amphiesma stolata* (Buff Striped Keelback), are frequently observed. Monitor lizards such as *Varanus bengalensis* (Bengal Monitor) and *Varanus flavescens* (Yellow Monitor) also inhabit these areas. In addition, the presence of freshwater turtles like *Geoclemys hamiltonii* (Black Pond Turtle) and *Pangshura tecta* (Indian Roofed Turtle) highlights the ecological richness and importance of these habitats for reptilian fauna.

Table 5-17: Reptile species recorded in the project area

S.No	Local Name	Local Name (Bangla)	Scientific Name
1	Bengal monitor, Gui shap	গুইসাপ	<i>Varanus bengalensis</i>
2	Black Pond Turtle	কালো চিত্রা দীঘি কাইট্টা	<i>Geoclemys hamiltonii</i>
3	Brahminy River Turtle	মুকুটি নদ-কাছিম	<i>Hardella thurjii</i>
4	Common vine snake	লাউডগা সাপ/ডারাস	<i>Ahaetulla nasuta</i>
5	Dora shap/ Buff Striped keel back	ডোরা সাপ	<i>Amphiesma stolatum</i>
6	Gui shap/Clouded monitor	গুই সাপ	<i>Varanus nebulosus</i>
7	Holdey Gui Shap/yellow monitor	হলদে গুই সাপ	<i>Varanus flavescens</i>
8	Indian Roofed turtle	দেশি কড়ি কাইট্টা	<i>Pangshura tecta</i>
9	Maitta Shap/Split keelback	মাইট্টা সাপ	<i>Atretium schistosum</i>
10	Original garden lizard	বাগানের গিরগিটি	<i>Calotes versicolor</i>

11	Painna Shap, Common-Smooth-scaled Water Snake	পাইনা সাপ	Enhydris enhydris
12	Red-crowned roofed turtle	কড়ি কাইট্টা	Batagur kachuga
13	Spotted Pond Turtle	কালো কাহিম	Geoclemys hamiltonii
14	Striped grass skink	স্ট্রিপ গ্রাস সাইনক/আচিল	Mabuya dissimilis
15	Tiktiki/spotted house gecko	টিকটিকি	Hemidactylus brookii

Birds

The project areas support a wide array of common bird species, reflecting the presence of vibrant and ecologically diverse avian habitats. Important species include the *Copsychus saularis* (Doel), Bangladesh's national bird, and *Passer domesticus* (House Sparrow), which thrives near human settlements. **Table 5-18** presents the bird species documented within the project area, based on baseline ecological surveys and relevant secondary sources.

Predatory birds like *Milvus migrans* (Black Kite) and *Aviceda jerdoni* (Jerdon's Baza) patrol the skies, while waterbirds such as *Ardea cinerea* (Grey Heron) and *Amaurornis akool* (White-breasted Waterhen) frequent wetlands. The presence of *Psittacula krameri* (Rose-ringed Parakeet), *Oriolus xanthornus* (Black-hooded Oriole), and *Eudynamis scolopacea* (Asian Koel) adds to the acoustic and visual diversity of the region. Additionally, species like *Dinopium benghalense* (Woodpecker), *Halcyon smyrnensis* (White-throated Kingfisher), and various drongos and doves indicate the ecological richness and the importance of preserving these habitats for sustained bird populations.

Table 5-18: Bird species recorded in the project area

S.No	Local Name	Local Name (Bangla)	Scientific Name
1	Babui	বাবুই	Ploceus philippinus
2	Baj	বাজ	Aviceda jerdoni
3	Bhat Shalik/Common myna	ভাত শালিক	Acridotheres tristis
4	Bhutum Pencha	ভুতুম পেচা	B. bengalensis
5	Bulbuli/Red-vented Bulbul	বুলবুলি	Pycnonotus cafer
6	Charui/House sparrow	চড়ুই	Passer domesticus
7	Chil	চিল	Milvus migrans
8	Choto Fingey	ছোট ফিংগে	D. aeneus
9	Dahuk	ডাউক	Amaurornis akool
10	Dar Kak/Jungle crow	দাড়কাক	Corvus macrorhynchos
11	Dhushor Bok	ধূসর বক	Ardea cinerea
12	Doel/Robin	দোয়েল	Copsychus saularis
13	Fingey/Black drongo	ফিংগে	Dicrurus macrocercus
14	Gangchil	গাংচিল	Gelochelidon nilotica
15	Ghughu (grey)	বাদামী ঘুঘু	Streptopelia senegalensis
16	Ghughu/Dove (Spotted)	তিলা ঘুঘু	Spilopelia chinensis

S.No	Local Name	Local Name (Bangla)	Scientific Name
17	Gobrey Shalik	গোবরে শালিখ	<i>Sturnus contra</i>
18	Holdey Pakhi (Black hooded oriolus)	হলদে পাখি, ইস্টিকুটুম	<i>Oriolus xanthornus</i>
19	Jalali Kobutar	জালালি কবুতর	<i>Columba livia</i>
20	Kalo Shalik	কালো শালিক	<i>Aplonis panayensis</i>
21	Kana Bok/Pond heron	কানা বক	<i>Ardeola grayii</i>
22	Kaththokra	কাঠঠোকরা	<i>Dinopium benghalense</i>
23	Kokil	কোকিল	<i>Eudynamys scolopacea</i>
24	Kura	কূড়া	<i>Gallicrex cinerea</i>
25	Kutum bird	কুটুম পাখি	<i>Oriolus sp.</i>
26	Maachranga/Kingfisher	মাছরাঙ্গা	<i>Halcyon smyrnensis</i>
27	Pan Kauri	পান কৈরী	<i>Rynchops albicollis</i>
28	Pati Kak/House crow	পাতি কাক	<i>Carvus splendens</i>
29	Pencha/Owl	পেচা	<i>Bubo nipalensis</i>
30	Sada Bok	সাদা বক	<i>Ardea insignis</i>
31	Shankho Chil	শঙ্খ চিল	<i>Haliastur Indus</i>
32	Tia	টিয়া	<i>Psittacula krameri</i>
33	Tuntuni/Common tailorbird	টুনটুনি	<i>Orthotomus sutorius</i>

Mammals

The project areas host a variety of common mammalian species, reflecting the ecological richness of both natural and semi-urban landscapes. Notable small mammals include *Callosciurus pygerythrus* (Irrawaddy Squirrel) and *Mus musculus* (House Mouse), frequently observed in homestead zones and along forest-edges. Several bat species, such as *Pipistrellus* spp. (Small Bats) and *Pteropus* spp. (Flying Foxes), are abundant and play essential ecological roles in pollination and seed dispersal.

Predatory mammals, including *Felis chaus* (Jungle Cat) and *Herpestes auropunctatus* (Small Indian Mongoose) are occasionally encountered in forest patches and wetland areas. The presence of both *Vulpes bengalensis* (Bengal Fox) and *Canis aureus* (Golden Jackal) suggests a relatively intact trophic structure, while insectivores such as *Suncus etruscus* (Pygmy Shrew) highlight the diversity of ground-dwelling fauna. **Table 5-19** presents the mammalian species recorded in the project area, based on primary baseline ecological surveys.

Table 5-19: Mammalian species recorded in the project area

S/N	Local Name	Local Name (Bangla)	Scientific Name
1	Badami Kathbirali	বাদামি কাঠবিড়ালি	<i>Callosciurus pygerythrus</i>
2	Ban Biral/Jungle Cat	বন বিড়াল	<i>Felis chaus</i>
3	Beji/Mongoose	বেজি	<i>Herpestes sp.</i>
4	Bara Indur	বড় ইদুর	<i>Bandicota bengalensis</i>

5	Chamchika	চামচিকা	<i>Megaderma lyra</i>
6	Chika	চিকা	<i>Suncus etruscus</i>
7	Khek Shial	খেক শিয়াল	<i>Vulpes bengalensis</i>
8	Pati Shial	পাতি শিয়াল	<i>Caris aureus</i>
9	House Rat	ঘরের ইদুর	<i>Rattus rattus</i>
10	Nengti Indur	নেংটি ইদুর	<i>Mus musculus</i>
11	Rangchita Badur	রংচিত্রা বাদুর	<i>Pipistrellus sp.</i>
12	Mecho Biral	মেছো বিড়াল	<i>Prionailurus viverrinus</i>

5.2.3 Habitats

The project area encompasses various terrestrial habitat types, including forests, grasslands, and wetlands. Within these broad categories, more specific habitats exist, each characterized by distinct climate conditions, temperature ranges, soil types, and vegetation. The terrestrial habitats can be classified into two categories: (1) natural habitats such as wooded areas, grassland and other natural habitats and (2) human influenced habitats including homestead gardens, plantation, cropland and cultivated land. Homestead is one of the major types of terrestrial ecosystems in terms of biodiversity and wildlife habitats. Homesteads of the project area are vital sources of livelihood for many farmers and serve as the safety net during the time of hardship and natural disasters. The major plant species found in the homestead are coconut, betel nut, neem, date, bamboo, tamarind, koroi, toddy plum, hog plum, jackfruit, mango etc. The main crop is rice in the area during monsoon and rice, corn, wheat, sugarcane, soybean, pulse crop, chili, vegetables etc. are grown during dry season. There are grasslands and are used for grazing of animals and serve as habitats for several plant and wildlife species.

The study area lies within the Meghna Floodplain and the Coastal Meghna Floodplain regions, predominantly shaped by fluvial sediments deposited by upstream river systems (IUCN, 2002). The landscape is characterized by low-lying char lands, meandering rivers, and interconnected khals which constitute habitats for grasslands and aquatic species.

5.2.4 Biodiversity

The study region supports rich biodiversity due to its dynamic hydrological processes, diverse aquatic-terrestrial interfaces, and fertile alluvial soils. Key characteristics of biodiversity in this region include:

Aquatic Biodiversity: The floodplain hosts a wide range of freshwater fish species, such as puti, tengra, rui, mrigel, katla, baula etc. which is ecologically and economically significant. Moreover, various aquatic invertebrates, amphibians, and reptiles, such as turtles and water snakes, are common. Seasonal wetlands and khals serve as breeding and nursery grounds for many fish and amphibian species and fish species enter the river/khals from the sea when the water control structures at downstream are open for flushing irrigation water.

Avifauna: The region is home to numerous resident and migratory bird species, particularly gray nightjar, river lapwing, black-shallered kite, cattle egret and black kite (IUCN, 2002). Flooded fields and wetland patches support diverse bird habitats during both dry and monsoon seasons.

Terrestrial and Riparian Flora: The alluvial landscape supports seasonal vegetation shifts, influencing habitat availability and food chains.

Mammals and Herpetofauna: Mammals such as jackels, rhesus macaque, bats, common mongoose, small Indian civet etc. are found in the region (IUCN, 2002). Moreover, amphibians and reptiles adapted to wetland ecosystems, including frogs, toads, and monitor lizards, are prevalent.

5.2.5 Ecological Assessment

The Area of Influence (AoI) spanning Noakhali, Brahmanbaria, Feni, Lakshmipur and Cumilla contains a mosaic of coastal/estuarine, riverine, floodplain/haor, agricultural, semi-urban and remnant semi-natural habitats that support fisheries, migratory birds, riparian vegetation and locally important flora/fauna. Planned or existing development (infrastructure, land-use change, industrial expansion, transport corridors and urbanisation) can cause habitat loss/fragmentation, water and soil pollution, hydrological change, disturbance to fisheries and birds, invasive species spread, and reduced ecosystem services (flood attenuation, fisheries, carbon sequestration). Hilsa fish breeding has been disrupted in Meghna, Gomti, Titas and Feni river due to a combination of hydrological, ecological, and anthropogenic pressures. However, as the project works are mostly rehabilitation of existing infrastructures, the impact area is expected to be limited to the close proximity of the work sites, with area of within about 1 km radius is considered to be of having risks of direct impact from construction and associated activities.

5.2.6 IUCN Status

Table 5-20: Species listings status according to the IUCN Red List in the Project Area

Common Name	Habitat / Occurrence in AoI	Global IUCN Red List Status / Bangladesh Note
Hilsa shad	Estuarine & tidal rivers (Meghna/Noakhali region)	<i>Least Concern (LC)</i> globally.
Nandi Labeo	Freshwater rivers/streams in Bangladesh	<i>Critically Endangered (CR)</i> among freshwater fishes of Bangladesh.
Barca snakehead	Rare freshwater fish (Bangladesh)	<i>Data Deficient (DD)</i> globally; CR in Bangladesh.
Baghair (giant catfish)	Big river channels (possible in Bangladesh for freshwater	

Common Name	Habitat / Occurrence in AoI	Global IUCN Red List Status / Bangladesh Note
	AoI rivers)	fishes.
Khorka (loach)	Hill-stream/stream species, some tributaries in region	CR in Bangladesh.
Pipla Shol	Freshwater fish species of Bangladesh	CR in Bangladesh.
White-breasted waterhen	Wetlands, marshes & floodplains across the region	<i>Least Concern (LC)</i> globally (general bird)
Common Moorhen	Wetland/pond edges in region	<i>Least Concern (LC)</i> globally
Thick-billed Green Pigeon	Forested patches / riparian vegetation	<i>Least Concern (LC)</i> globally.
Bengal Fox (<i>Vulpes bengalensis</i>)	Forest edges, grasslands; likely in Feni, Cumilla	<i>Least Concern</i> globally / <i>Vulnerable</i> in Bangladesh
Fishing Cat (<i>Prionailurus viverrinus</i>)	Wetlands, rivers, coastal areas; Noakhali, Lakshmipur	<i>Vulnerable</i> globally / <i>Endangered</i> in Bangladesh
Marsh Crocodile (<i>Crocodylus palustris</i>)	Coastal wetlands, estuaries; Noakhali, Lakshmipur	<i>Vulnerable</i> globally / <i>Vulnerable</i> in Bangladesh
Bengal Monitor (<i>Varanus bengalensis</i>)	Forests, agricultural lands; widespread	<i>Least Concern</i> globally / <i>Near Threatened</i> in Bangladesh
Indian Bullfrog (<i>Hoplobatrachus tigerinus</i>)	Wetlands, paddy fields; districts	<i>Least Concern</i> globally / <i>Least Concern</i> in Bangladesh
Hilsa (<i>Tenualosa ilisha</i>)	Major rivers, estuaries; Noakhali, Lakshmipur, Feni	<i>Near Threatened</i> globally / <i>Vulnerable</i> in Bangladesh
Walking Catfish (<i>Clarias batrachus</i>)	Rivers, ponds, wetlands; widespread	<i>Least Concern</i> globally / <i>Least Concern</i> in Bangladesh
Magnolia griffithii	Forested areas; historically in Cumilla	<i>Critically Endangered</i> globally / <i>Extinct</i> in Bangladesh

Common Name	Habitat / Occurrence in AoI	Global IUCN Red List Status / Bangladesh Note
Memecylon ovatum	Forested areas; likely southeast Bangladesh	in Critically Endangered globally / Extinct in Bangladesh

5.3 Socio-economic Environment

The socio-economic environment refers to the social and economic conditions that influence the lives and livelihoods of people in the study area. It includes factors such as income levels, employment patterns, education, health services, housing conditions, and access to basic infrastructure. Most of the socio-economic information are collected for the proposed interventions and influence area from the population census of 2022 and field investigations.

Understanding the socio-economic environment is crucial for assessing community needs, identifying vulnerable groups, and designing effective development interventions. A well-informed analysis ensures that projects are responsive to local realities and contribute to sustainable improvements in quality of life. The information has been mostly gathered from secondary sources and the rest from social consultations.

According to socioeconomic survey conducted in January 2025, a total of 4058 project affected entities including residential households, commercial enterprises, only land losing households, community properties, trees owners, etc. were identified in Cumilla, Brahmanbaria and Feni districts. A total of 3951 households were affected in these three districts. People have been affected by the project interventions in these districts due to bank protection and embankment re-sectioning works by losing structure, trees, business, wages, etc. Among the identified affected household through survey, 94.43% are male headed household, 5.57% are female headed households.

5.3.1 Demography

Demographic variables refer to the characteristics of a population that help in understanding its structure and composition. Key demographic variables include age, gender, household size, education level, occupation, and income. These factors are essential for planning and implementing development interventions, as they influence social behavior, economic activity, and the needs and vulnerabilities of different population groups. Analyzing demographic variables helps ensure that project benefits are equitably distributed and tailored to the specific context of the target community.

The demographic information of the study unions (the project interventions and influence area) is presented in following tables. The demographic data on population, gender distribution, dependency and literacy rates, population density and annual population growth rate and so on are collected from the population census of 2022 conducted by Bangladesh Bureau of Statistics (BBS). The study area house a population of about 2.1 million. Literacy rates average 84.73%, and average household size is 4.27. Population density is about 1,974 per square kilometer ranging from about 279.6 per square kilometer at Karerhat on bank of Feni River to 7,300 per square kilometer at Uttar Durgapur in Cumilla on bank of Gomati River.

Affected Household Based on Family Head	Cumilla	B- Baria	Feni
Number of male headed HHs affected	3283	30	497
Number of female headed HHs affected	116	0	25

Table 5-21: Demographic information in project implementation area

Sl No	Khal/ River	Influence Area			Total Popn.	Sex Ratio	Dependency ratio	Literacy Rate	General HHs	Avg. HH size	Ethnic popn.	Avg. Growth Rate	Pop. Density (Sq km)
		Union	Upazila	District									
1	C.Khal	Uttor Hamchari	Lakshmipur Sadar	Laxmipur	34,034	81.2	63.38	88%	8,494	3.91	0	0.54	1473
2		Bamni	Raipur		28,822	76.2	62.76	85%	7,251	3.95	0	1.3	2056
3		Keroa	Raipur		33,974	81.7	62.94	91%	8,450	3.92	0	0.91	2028
4		Raipur Paurashava	Raipur		39,809	95.8	59.43	89%	9,339	4.00	1	2.3	3939
5		Shakchar	Lakshmipur Sadar		18,312	94.3	62.18	76%	4,390	4.11	0	1.6	2067
6		Laharkandi	Lakshmipur Sadar		32,682	85.0	62.08	80%	7,627	4.26	0	1.1	2368
7		Mandari	Lakshmipur Sadar		42,313	90.1	63.95	80%	9,682	4.21	0	1.8	2065
8	Gomoti	Chhalia-kandi	Muradnagar	Cumilla	18,745	88.9	61.11	76%	4,349	4.27	5	0.95	1595
9		Sholanal	Burichang		41,325	90.5	62.59	86%	9,460	4.27	0	0.99	1719
10		Uttar Durgapur	Adarsha Sadar		78,166	100.3	57.03	86%	16,896	4.38	12	3.2	7300
11		Maynamati	Burichang		56,911	90.1	64.33	86%	12,441	4.38	27	1.9	2684
12		Bharella Dakshin	Burichang		29,737	87.3	62.19	83%	6,494	4.48	0	-	2631
13		Bharella Uttar	Burichang		22,026	92.8	63.96	83%	4,692	4.60	0	-	2437
14		Jafarganj	Debidwar		31,427	88.2	66.78	83%	6,890	4.40	5	1.8	2461
15		Bhitikandi	Titas		27,596	85.2	67.79	77%	6,237	4.31	0	0.38	1817
16		Narayandia	Titas		20,015	85.4	66.63	75%	4,376	4.46	0	1.7	2538
17		Gouripur	Daudkandi		53,254	101.4	72.45	87%	10,533	4.25	5	4.4	6037
18		Fatehabad	Debidwar		41,683	83.5	67.54	85%	9,022	4.57	0	0.36	1833

SI No	Khal/ River	Influence Area			Total Popn.	Sex Ratio	Dependency ratio	Literacy Rate	General HHs	Avg. HH size	Ethnic popn.	Avg. Growth Rate	Pop. Density (Sq km)
		Union	Upazila	District									
19		Malapara	Brahmanpara		18,963	84.8	67.67	82%	4,202	4.50	0	0.61	2050
20		Jagannathpur	Adarsha Sadar		69,064	94.6	52.23	84%	15,306	4.31	40	2.3	3490
21		City Corpn. Area	Adarsha Sadar		283,438		47.12	90%	63,856	4.13	186	-	-
22		City Corpn. Area	Sadar Dakhin		156,795		50.37	89%	33,801	4.15	519	-	-
23		Amratali	Adarsha Sadar		48,250	88.5	58.57	84%	10,569	4.52	0	1.8	2241
24		Muradnagar	Muradnagar		40,256	89.7	62.67	79%	8,976	4.30	7	0.55	2029
25		Panchthubi	Adarsha Sadar		58,248	92.3	55.76	85%	13,155	4.30	11	1.6	2762
26	Hawra River	Mogra	Akhaura	Brahmanbaria	31,636	85.2	68.35	78%	6,948	4.47	5	1.2	1721
27	Muhuri/ Selonia	Fulgazi	Fulgazi	Feni	34,203	88.7	62.90	86%	7,726	4.29	93	0.58	1282
28		Darbarpur	Fulgazi		17,238	88.5	63.22	87%	3,805	4.37	0	-0.11	1531
29		Amjadhat	Fulgazi		24,622	84.0	67.78	86%	5,547	4.30	8	1.2	1110
30		Gm Hat	Fulgazi		13,365	88.5	60.10	89%	2,961	4.35	0	0.48	1071
31		Mahamaya	Chhagalnaiya		27,884	85.4	64.10	82%	6,671	4.08	3	0.4	1172
32		Box Mahmud	Parshuram		25,376	84.3	64.88	81%	5,800	4.29	6	0.7	884.6
33		Munsirhat	Fulgazi		22,067	86.2	64.03	85%	5,030	4.25	2	-0.09	1199
34		Parashuram Paurashava	Parshuram		36,112	92.9	61.66	85%	8,029	4.33	9	1.8	1653
35		Mirzanagar	Parshuram		24,750	80.1	64.84	83%	5,677	4.30	4	0.8	973.9
36		Chithalia	Parshuram		27,079	82.8	66.01	85%	6,116	4.30	5	0.61	1059

SI No	Khal/ River	Influence Area			Total Popn.	Sex Ratio	Dependency ratio	Literacy Rate	General HHs	Avg. HH size	Ethnic popn.	Avg. Growth Rate	Pop. Density (Sq km)
		Union	Upazila	District									
37	Little Feni	Sindurpur	Daganbhuiyan	Feni	34,239	82.0	60.87	82%	7,805	4.31	6	-0.07	1489
38	Little Feni	Daganbhuiyan	Daganbhuiyan		19,664	83.6	61.67	88%	4,408	4.42	1	0.5	2022
39	Matubhuiyan Khal	Matubh-uiyan	Daganbhuiyan		21,197	85.9	58.89	86%	4,644	4.46	6	0.7	2003
40	Matubhuiyan Khal	Char Majlishpur	Sonagazi		21,197	82.9	58.89	83%	6,865	4.32	0	0.93	1875
41	Feni	Farhadnagar	Feni Sadar		24,919	81.7	59.82	84%	5,671	4.35	5	0.58	1579
42	Little Feni	Baligaon	Feni Sadar		38,837	90.3	60.18	84%	8,673	4.39	2	1	2316
43	Selonia	Chhanua	Feni Sadar		25,413	89.1	60.03	87%	5,629	4.37	10	0.75	1937
44	Selonia	Lemua	Feni Sadar		24,038	87.9	60.29	85%	5,325	4.37	12	0.78	1730
45	Selonia	Nababpur	Sonagazi		19,754	82.7	62.14	84%	4,578	4.27	13	0.7	1805
46	Selonia	Anandapur	Fulgazi		13,949	85.1	61.84	88%	3,109	4.40	1	0.23	1164
47	Selonia	Munsirhat	Fulgazi		22,067	86.2	64.03	85%	5,030	4.25	2	-0.09	1199
48	Feni	Karerhat	Mirsharai	Chatto-gram	43,477	93.1	58.46	82%	10,523	4.08	1573	1.8	279.6
49	Feni	Osmanpur	Mirsharai		17,803	90.8	59.60	81%	4,051	4.35	1	1.8	1137
50	Feni	Icchakhali	Mirsharai		35,476	118.4	48.42	84%	7,026	4.33	61	2.1	558.5
51	Little Feni	Char Darbesh	Sonagazi	Feni	37,899	86.8	62.01	82%	8,875	4.24	4	1.5	963.1
52	Little Feni	Bagadana	Sonagazi	Feni	25,964	80.7	63.10	82%	5,955	4.31	7	0.69	2108
53	Meghna	Chanandi	Hatiya	Noakhali	52,331	102.1	81.79	72%	11,586	4.48	1	-	677.1
54	Little Feni	Musapur	Companiganj	Noakhali	28,408	87.6	64.93	79%	5,912	4.73	0	2.3	863.1
Project area and surroundings					2,116,809	89.62	59.54	84.73%	476,463	4.27	2,658	1.37	1,974.29

Table 5-20: Marital Status of Population Aged 10 Years and above by Sex

Khal/ River	Influence Area			Percentage of Male					Percentage of Female				
	Union	Upazila	District	Never Married	Currently Married	Widower	Divorced	Separated	Never Married	Currently Married	Widow	Divorced	Separated
C.Khal	Uttor Hamchari	Lakshmipur Sadar	Lakshmipur	40.77	57.79	1.08	0.16	0.2	21.04	67.98	10.16	0.55	0.27
	Bamni	Raipur		38.85	59.14	1.49	0.21	0.3	19.61	68.44	11.12	0.47	0.36
	Keroa	Raipur		39.7	58.74	1.19	0.16	0.2	21.07	67.11	11.05	0.46	0.32
	Raipur Paurashava	Raipur		41.54	57.34	0.79	0.22	0.12	22.51	67.04	9.48	0.69	0.28
	Shakchar	Lakshmipur Sadar		36.85	61.53	1.23	0.15	0.23	20.08	69	9.74	0.64	0.54
	Laharkandi	Lakshmipur Sadar		37.49	60.85	1.3	0.11	0.26	21.78	67.57	9.89	0.47	0.29
	Mandari	Lakshmipur Sadar		42.02	56.9	0.78	0.1	0.2	22.5	68.83	7.98	0.47	0.22
Gomoti	Chhaliakandi	Muradnagar	Cumilla	37.09	61.48	1.3	0.03	0.1	21.72	69.77	8.32	0.1	0.09
	Sholanal	Burichang		40.39	58.17	1.16	0.13	0.14	23.54	66.35	9.24	0.42	0.46
	Uttar Durgapur	Adarsha Sadar		41.53	57.29	0.9	0.14	0.14	25.01	65.69	8.12	0.56	0.61
	Maynamati	Burichang		41.28	57.68	0.82	0.11	0.12	24.29	66.71	8.15	0.51	0.34
	Bharella Dakshin	Burichang		38.58	60.05	1.03	0.16	0.17	22.35	69.06	7.78	0.45	0.35
	Bharella Uttar	Burichang		40.03	58.95	0.77	0.09	0.16	22.23	69	7.94	0.34	0.49
	Jafarganj	Debidwar		40.11	58.31	1.31	0.17	0.1	23.22	65.92	9.95	0.44	0.48
	Bhitikandi	Titas		40.13	58.79	0.77	0.11	0.2	21.61	69.81	7.8	0.48	0.31
	Narayandia	Titas		41.08	57.8	0.84	0.16	0.13	22.59	67.94	8.45	0.66	0.37
	Gouripur	Daudkandi		48.64	50.39	0.63	0.17	0.16	29.55	61.95	7.76	0.43	0.3
	Fatehabad	Debidwar		39.99	59.08	0.71	0.08	0.13	23.97	67.85	7.86	0.17	0.15
	Malapara	Brahmanpara		39.8	58.72	1.16	0.12	0.2	23.1	66.64	9.81	0.31	0.14
	Jagannathpur	Adarsha Sadar		39.4	59.23	0.91	0.22	0.24	24.8	64.7	9.19	0.73	0.58
	City Corpn. Area	Adarsha Sadar		41.6	57.28	0.82	0.16	0.15	28.92	61.6	8.58	0.45	0.45
	City Corporation Area	Sadar Dakhin		43.24	55.99	0.54	0.11	0.12	26.96	64.89	6.97	0.64	0.55

Khal/ River	Influence Area			Percentage of Male					Percentage of Female				
	Union	Upazila	District	Never Married	Currently Married	Widower	Divorced	Separated	Never Married	Currently Married	Widow	Divorced	Separated
	Amratali	Adarsha Sadar		38.97	59.41	1.21	0.21	0.21	22.65	66.22	10.23	0.51	0.4
	Muradnagar	Muradnagar		41.85	57.02	0.84	0.11	0.19	24.92	66.13	8.35	0.29	0.31
	Panchthubi	Adarsha Sadar		39	59.65	0.99	0.17	0.19	24.69	65.27	8.95	0.59	0.5
Hawra River	Mogra	Akhaura	Brahmanbaria	42.47	55.88	1.23	0.24	0.18	24.74	65.1	9.45	0.36	0.36
Muhuri/ Selonia	Fulgazi	Fulgazi	Feni	41.58	57.14	1.06	0.11	0.11	23.52	65.96	9.85	0.35	0.31
	Darbarpur	Fulgazi		44.75	54.04	0.88	0.17	0.16	22.59	65.4	11.21	0.47	0.32
	Amjadhat	Fulgazi		42.73	56.05	0.92	0.11	0.2	22.98	66.9	9.38	0.4	0.34
	Gm Hat	Fulgazi		46.03	52.82	0.97	0.08	0.1	23.07	65.12	11.38	0.28	0.16
	Mahamaya	Chhagalnaiya		44.59	54.07	1.09	0.12	0.12	22.2	66.04	10.72	0.52	0.52
	Box Mahmud	Parshuram		40.94	58.07	0.74	0.07	0.17	21.46	67.99	9.49	0.57	0.49
	Munsirhat	Fulgazi		43.34	55.63	0.87	0.13	0.04	23.21	66.32	9.77	0.44	0.27
	Parashuram Paurashava	Parshuram		41.73	57.11	0.91	0.1	0.15	23.36	65.89	9.88	0.54	0.33
	Mirzanagar	Parshuram		39.18	59.39	1.08	0.16	0.19	20.53	67.37	10.66	0.85	0.59
	Chithalia	Parshuram		44.13	54.58	1.2	0.05	0.03	21.79	66.37	10.72	0.85	0.26
Little Feni	Sindurpur	Daganbhuiyan	Feni	42.57	56.11	1.11	0.1	0.12	23.51	65.72	10	0.44	0.32
Little Feni	Daganbhuiyan	Daganbhuiyan		42.43	56.55	0.78	0.07	0.17	22.56	66.71	10.34	0.29	0.1
Matubhuiyan Khal	Matubhuiyan	Daganbhuiyan		43.89	54.76	1.04	0.09	0.22	23.3	66.38	9.62	0.34	0.36
Matubhuiyan Khal	Char Majlishpur	Sonagazi		41.82	57.1	0.81	0.05	0.22	21.65	67.22	10.47	0.24	0.42
Feni	Farhadnagar	Feni Sadar		41.99	56.84	1.03	0.06	0.08	22.68	66.82	9.85	0.41	0.24
Little Feni	Baligaon	Feni Sadar		44.42	54.61	0.83	0.03	0.1	23.27	66.84	9.29	0.34	0.26
Selonia	Chhanua	Feni Sadar		42.94	55.85	0.92	0.11	0.18	21.6	66.99	10.85	0.35	0.21

Khal/ River	Influence Area			Percentage of Male					Percentage of Female				
	Union	Upazila	District	Never Married	Currently Married	Widower	Divorced	Separated	Never Married	Currently Married	Widow	Divorced	Separated
Selonia	Lemua	Feni Sadar		42.71	56.16	0.94	0.07	0.13	22.42	67.05	10	0.32	0.21
Selonia	Nababpur	Sonagazi		41.45	57.52	0.81	0.06	0.16	21.58	68.69	9.16	0.34	0.24
Selonia	Anandapur	Fulgazi		43.71	55.18	0.88	0.04	0.2	24.07	63.81	11.35	0.4	0.37
Selonia	Munsirhat	Fulgazi		43.34	55.63	0.87	0.13	0.04	23.21	66.32	9.77	0.44	0.27
Feni	Karerhat	Mirsharai	Chattogram	40.1	58.69	0.92	0.1	0.2	22.69	65.66	10.42	0.59	0.65
Feni	Osmanpur	Mirsharai		41.46	57.44	0.91	0.11	0.09	21.41	65.69	11.98	0.52	0.4
Feni	Icchakhali	Mirsharai		42.11	57.05	0.66	0.09	0.1	22.52	65.75	11.02	0.39	0.31
Little Feni	Char Darbesh	Sonagazi	Feni	41.87	57.04	0.85	0.06	0.18	21.9	68.21	8.82	0.57	0.5
Little Feni	Bagadana	Sonagazi	Feni	40.72	58.35	0.77	0.03	0.14	21.9	67.94	9.57	0.36	0.24
Meghna	Chanandi	Hatiya	Noakhali	34.62	64.58	0.64	0.03	0.13	22.54	71.02	5.63	0.35	0.46
Little Feni	Musapur	Companiganj	Noakhali	42.73	56.09	0.93	0.16	0.09	23.6	66.14	9.39	0.5	0.37

Table 5-21: Literacy Rate of Population Aged 5 Years and above

Khal/ River	Influence Area			5 Years and above		
	Union	Upazia	District	Total	Male	Female
C.Khal	Uttor Hamchari	Lakshmipur Sadar	Lakshmipur	82.69	83.35	82.18
	Bamni	Raipur		80.58	80.67	80.52
	Keroa	Raipur		84.18	85.08	83.47
	Raipur Paurashava	Raipur		84.69	85.2	84.21
	Shakchar Union	Lakshmipur Sadar		65.75	66.67	64.91
	Laharkandi Union	Lakshmipur Sadar		71.6	71.63	71.58
	Mandari Union	Lakshmipur Sadar		74.31	73.83	74.73
Gomoti	Chhaliakandi Union	Muradnagar	Cumilla	69.56	70.79	68.48
	Sholanal Union	Burichang		79.02	80.27	77.92
	Uttar Durgapur Union	Adarsha Sadar		82.41	82.87	81.96
	Maynamati Union	Burichang		82.29	83.36	81.33
	Bharella Dakshin Union	Burichang		76.52	77.27	75.87
	Bharella Uttar Union	Burichang		76.69	77.5	75.94
	Jafarganj Union	Debidwar		74.28	75.92	72.85
	Bhitikandi Union	Titas		67.02	67.25	66.84
	Narayandia Union	Titas		65.87	65.92	65.84
	Gouripur Union	Daudkandi		83.68	85.01	82.33
	Fatehabad Union	Debidwar		76.39	78	75.07
	Malapara Union	Brahmanpara		75.2	76.57	74.07
	Jagannathpur Union	Adarsha Sadar		77.21	77.57	76.87
	City Corporation Area	Adarsha Sadar		87.36	87.43	87.29
	City Corporation Area	Sadar Dakhin		85.01	85.81	84.19
	Amratali Union	Adarsha Sadar		79.82	80.4	79.31
	Muradnagar Union	Muradnagar		72.26	73.37	71.29
	Panchthubi Union	Adarsha Sadar		81.28	82.1	80.54
Hawra River	Mogra Union	Akhaura	Brahmanbaria	74	73.38	74.5
Muhuri/ Selonia	Fulgazi Union	Fulgazi	Feni	78.16	79.74	76.78
	Darbarpur Union	Fulgazi		81.3	82.29	80.43
	Amjadhat Union	Fulgazi		80.17	82.46	78.31

Khal/ River	Influence Area			5 Years and above		
	Union	Upazia	District	Total	Male	Female
	Gm Hat Union	Fulgazi		82.07	83.43	80.88
	Mahamaya Union	Chhagalnaiya		77.63	78.89	76.57
	Box Mahmud Union	Parshuram		75.43	76.75	74.35
	Munsirhat Union	Fulgazi		82.3	83.13	81.61
	Parashuram Paurashava	Parshuram		80.28	81.15	79.48
	Mirzanagar Union	Parshuram		78.39	79.99	77.15
	Chithalia Union	Parshuram		77	79.2	75.22
Little Feni	Sindurpur Union	Daganbhuiyan		73.85	74.04	73.7
Little Feni	Daganbhuiyan Union	Daganbhuiyan		82.87	83.84	82.09
Matubhuiyan Khal	Matubhuiyan Union	Daganbhuiyan		80.2	81.97	78.71
Matubhuiyan Khal	Char Majlishpur Union	Sonagazi		74.87	76.43	73.62
Feni	Farhadnagar Union	Feni Sadar		75.72	78.62	73.4
Little Feni	Baligaon Union	Feni Sadar		74.83	76.93	72.97
Selonia	Chhanua Union	Feni Sadar		81.94	84.83	79.38
Selonia	Lemua Union	Feni Sadar		79.22	81.88	76.94
Selonia	Nababpur	Sonagazi		76.98	78.49	75.76
Selonia	Anandapur Union	Fulgazi		81.09	82.85	79.62
Selonia	Munsirhat Union	Fulgazi		82.3	83.13	81.61
Feni	Karerhat	Mirsharai	Chattogram	78.52	80.75	76.46
Feni	Osmanpur	Mirsharai		76.53	78.6	74.69
Feni	Icchakhali	Mirsharai		77.03	80.73	72.55
Little Feni	Char Darbesh Union	Sonagazi	Feni	72.42	74.28	70.84
Little Feni	Bagadana	Sonagazi	Feni	74.34	76.83	72.37
Meghna	Chanandi Union	Hatiya	Noakhali	62.71	62.81	62.61
Little Feni	Musapur	Companiganj	Noakhali	70.16	70.18	70.14

5.3.2 Land Use

The project interventions are primarily located within river and khal areas, as well as along the riverbanks. There are some destitute people now residing on the embankments but those areas are excluded from any redesign of the embankments due to safety concerns. The land within the project's area of influence comprises rivers, khals, agricultural fields, residential settlements with homestead vegetation, grasslands, general vegetation cover, roads, ponds, and urban built-up areas.

The major rivers where the interventions are planned are the Feni River, Little Feni River, Selonia River, Muhuri River, Kahua River, Matubhuiyan River, Gumti River, Hawra River, Rahmatkhali Khal and Wapda Khal. Agricultural land use is largely influenced by the area's agro-climatic conditions of the area. It represents the predominant land use category in the study influence area, since agriculture is the primary source of livelihood for the local population.

5.3.3 Livelihoods

The livelihood information is taken from the census 2022 data and presented in **Table 5-22**. Out of the total population aged 5 years and above, approximately 28.44% are employed, 27.71% are engaged in household work, 1.35% are actively seeking employment, and the remaining 42.51% are not working (including students, elderly, etc.).

From the compiled employment data across various unions, the total employed population stands at 544,016. Among them, the largest share (56.05%) is engaged in the service sector, followed by 27.89% in agriculture and 16.06% in industry. However, discussions with local communities revealed that many individuals categorized under agriculture are also involved in fishing, petty trading, and other small-scale economic activities, indicating diverse income sources that blur strict sectoral classifications. Moreover, the livelihoods of the people are largely dependent on agriculture as the service provided by the people in the area is often to the agricultural fields.

Impacts/Types of losses	Cumilla	B-Baria	Feni	Total
Total Number of Business Owner	843	0	36	879
Own Business	741	0	33	774
Rental Business	102	0	3	105
Total Number of Wage Labour	48	0	5	53
Skill Wage Labour	35	0	4	39
Un-Skill Sage Labour	13	0	1	14

Table 5-22: Employment status of Population Aged 5 Years and above (BBS, 2022)

Khal/ River	Influence Area			Population	Working Status			Working Sector		
	Union	Upazila	District		Employed Population	HH Work	Looking for Work	Agriculture	Industry	Service
C.Khal	Uttor Hamchari	Lakshmipur Sadar	Lakshmi- pur	30,417	7,097	11,100	537	3337	1057	2703
	Bamni	Raipur		25,608	5,977	9,567	206	2445	665	2867
	Keroa	Raipur		30,521	7,516	9,955	537	2659	1018	3839
	Raipur Paurashava	Raipur		35,871	9,442	10,690	425	781	1033	7628
	Shakchar	Lakshmipur Sadar		16,218	4,914	5,065	180	1768	213	2933
	Laharkandi	Lakshmipur Sadar		29,028	7,948	9,577	396	2473	654	4821
	Mandari	Lakshmipur Sadar		37,816	9,932	11,995	376	3895	951	5086
Gomoti	Chhaliakandi	Muradnagar	Cumilla	16,791	4,848	5,522	121	2293	942	1613
	Sholanal	Burichang		37,066	9,298	11,172	785	3787	1316	4195
	Uttar Durgapur	Adarsha Sadar		70,499	23,042	16,451	521	3345	3002	16695
	Maynamati	Burichang		51,112	16,501	451	482	7507	1882	7112
	Bharella Dakshin	Burichang		26,369	7,228	7,844	165	2664	1444	3120
	Bharella Uttar	Burichang		19,484	5,425	5,706	223	1982	1063	2380
	Jafarganj	Debidwar		27,810	7,651	8,182	268	3050	1038	3563
	Bhitikandi	Titas		24,615	6,059	8,250	581	3232	1052	1775
	Narayandia	Titas		17,875	4,305	5,254	725	2376	549	1380
	Gouripur	Daudkandi		48,402	13,450	10,924	369	2516	1317	9617
	Fatehabad	Debidwar		36,910	8,880	12,188	424	4131	1408	3341
	Malapara	Brahman-para		16,681	3,918	4,949	141	1653	356	1909
	Jagannathpur	Adarsha Sadar		62,192	21,093	16,213	548	4141	4543	12409
	City Corporation	Adarsha Sadar		261,931	83,361	52,098	4,427	1284	16210	65867

Khal/ River	Influence Area			Population	Working Status			Working Sector		
	Union	Upazila	District		Employed Population	HH Work	Looking for Work	Agriculture	Industry	Service
	Area									
	City Corporation Area	Sadar Dakhin		142,351	47,650	32,377	1,738	3126	14326	30198
	Amratali	Adarsha Sadar		43,284	12,472	12,293	464	3218	1197	8057
	Muradnagar	Muradnagar		36,187	9,626	9,648	466	3919	625	5082
	Panchthubi	Adarsha Sadar		52,674	17,414	13,449	414	4053	3527	9834
Hawra River	Mogra	Akhaura	Brahman- baria	27,941	7,126	8,207	369	3028	644	3454
Muhuri/ Selonia	Fulgazi	Fulgazi	Feni	30,883	7,972	9,430	550	2668	970	4334
	Darbarpur	Fulgazi		15,487	4,001	5,011	118	1258	119	2624
	Amjadhat	Fulgazi		21,998	5,234	7,499	322	2143	256	2835
	Gm Hat	Fulgazi		12,060	3,077	3,673	77	1054	111	1912
	Mahamaya	Chhagal-naiya		24,999	6,176	7,530	347	2916	838	2422
	Box Mahmud	Parshuram		22,664	5,567	7,872	417	2165	399	3003
	Munsirhat	Fulgazi		19,785	4,896	6,250	367	1782	401	2713
	Parashuram Paurashava	Parshuram		32,357	8,050	10,244	460	1516	1062	5472
	Mirzanagar	Parshuram		21,842	5,458	7,973	294	2644	424	2390
	Chithalia	Parshuram		24,136	5,483	7,856	250	2583	473	2427
Little Feni	Sindurpur	Dagan-bhuiyan		30,930	7,383	10,650	387	3244	1109	3030
Little Feni	Daganbhuiyan	Dagan-bhuiyan		17,763	4,012	5,922	364	1443	673	1896
Matu- bhuiyan Khal	Matubhuiyan	Dagan-bhuiyan		19,169	4,695	6,302	194	1583	1121	1991
Matubh uiyan Khal	Char Majlishpur	Sonagazi		26,953	6,477	8,788	479	2395	859	3223

Khal/ River	Influence Area			Population	Working Status			Working Sector		
	Union	Upazila	District		Employed Population	HH Work	Looking for Work	Agriculture	Industry	Service
Feni	Farhadnagar	Feni Sadar		22,369	5,540	7,443	312	1666	982	2892
Little Feni	Baligaon	Feni Sadar		35,079	9,199	10,979	378	2504	1431	5264
Selonia	Chhanua	Feni Sadar		22,934	5,799	7,837	269	1912	868	3019
Selonia	Lemua	Feni Sadar		21,638	5,340	7,239	364	1907	1299	2134
Selonia	Nababpur	Sonagazi		17,661	4,326	6,414	242	1519	476	2331
Selonia	Anandapur	Fulgazi		12,606	3,238	3,848	138	986	130	2122
Selonia	Munsirhat	Fulgazi		19,785	4,896	6,250	367	1782	401	2713
Feni	Karerhat	Mirsharai	Chatto-gram	38,893	12,327	12,498	484	5973	1748	4606
Feni	Osmanpur	Mirsharai		15,965	4,516	4,796	325	2248	359	1909
Feni	Icchakhali	Mirsharai		32,380	11,891	8,503	996	3810	5536	2545
Little Feni	Char Darbesh	Sonagazi	Feni	33,589	9,046	10,783	496	4381	1058	3607
Little Feni	Bagadana	Sonagazi	Feni	23,297	5,706	7,748	302	2007	630	3069
Meghna	Chanandi	Hatiya	Noakhali	44,566	15,030	13,351	441	10205	1075	3750
Little Feni	Musapur	Compani-ganj	Noakhali	25,275	6,508	8,113	129	2766	509	3233
Project influence area				1,912,716	544,016	529,929	25,757	151,723	87,349	304,944

5.3.4 Vulnerable Groups and Gender Issues

Gender-related issues among riverside communities along the project area is a key focus in the Social Impact Assessment, aimed at ensuring the socio-economic protection of affected populations. As in many parts of this lower-middle-income country, the vital contributions of women to socio-economic development and the well-being of their families and communities often go unrecognized. The male and female ratio in the project districts is 88.9% but the society and like other areas of Bangladesh, both decision-making powers and economic control are vested to the hands of men in the project communities. Women are primarily responsible for cooking, childcare etc. Common social practices include child marriage, dowry, polygamy, and abandonment. Domestic violence is widespread, and women have limited decision-making power. Social norms also limit women's mobility, access to paid work, health services, and property rights. Following vulnerable groups are present in the project area:

- People with disabilities
- Women
- Children
- Female-headed households
- Elderly (especially those of 60 years and above) people
- Low-income people from Small Ethnic Communities living in the project area
- Community laborers
- Transgender and LGBTQ groups/people

There are a total of 2,658 ethnic population in the study area, majority of them are 1,670 Chakmas, 485 Bedia, 189 Marma and 314 other ethnic communities.

Table 5-23: Ethnic Population by Major Ethnic Group and Location (Census 2022)

Khal/ River	Influence Area			Ethnic Popn. Total	Ethnic Population in Major Groups			
	Union	Upazila	District		Chakma	Bedia	Marma	Others
C.Khal	Uttor Hamchari	Lakshmi-pur Sadar	Lakshmi-pur	0	0	0	0	0
	Bamni	Raipur		0	0	0	0	0
	Keroa	Raipur		0	0	0	0	0
	Raipur Paura-shava	Raipur		1	1	0	0	0
	Shakchar	Lakshmi-pur Sadar		0	0	0	0	0
	Lahar-kandi	Lakshmi-pur Sadar		0	0	0	0	0
	Mandari	Lakshmi-pur Sadar		0	0	0	0	0
Gomoti	Chhalia-kandi	Murad-nagar	Cumilla	5	0	0	0	5
	Sholanal	Burichang		0	0	0	0	0
	Uttar Durgapur	Adarsha Sadar		12	1	7	2	2
	Mayna-mati	Burichang		27	0	0	4	23
	Bharella Dakshin	Burichang		0	0	0	0	0
	Bharella	Burichang		0	0	0	0	0

Khal/ River	Influence Area			Ethnic Popn. Total	Ethnic Population in Major Groups			
	Union	Upazila	District		Chakma	Bedia	Marma	Others
	Uttar							
	Jafarganj	Debidwar		5	0	3	0	2
	Bhitikandi	Titas		0	0	0	0	0
	Narayan-dia	Titas		0	0	0	0	0
	Gouripur	Daud-kandi		5	0	0	2	3
	Fatehabad	Debidwar		0	0	0	0	0
	Malapara	Brahman-para		0	0	0	0	0
	Jagannath-pur	Adarsha Sadar		40	0	34	1	5
	City Corp. Area	Adarsha Sadar		186	15	100	37	34
	City Corp. Area	Sadar Dakhin		519	179	210	90	40
	Amratali	Adarsha Sadar		0	0	0	0	0
	Muradnagar	Murad-nagar		7	0	2	0	5
	Panchthubi	Adarsha Sadar		11	8	2	0	1
Hawra River	Mogra	Akhaura	Brahman-barua	5	1	0	0	4
Muhuri/ Selonia	Fulgazi	Fulgazi	Feni	93	1	0	1	91
	Darbarpur	Fulgazi		0	0	0	0	0
	Amjadhat	Fulgazi		8	0	0	8	0
	Gm Hat	Fulgazi		0	0	0	0	0
	Maha-maya	Chhagal-naiya		3	2	0	0	1
	Box Mahmud	Parshuram		6	2	1	0	3
	Munsirhat	Fulgazi		2	1	0	0	1
	Parashu-ram Paura-shava	Parshuram		9	7	0	2	0
	Mirzanagar	Parshuram		4	2	0	2	0
	Chithalia	Parshuram		5	1	1	3	0
Little Feni	Sindurpur	Dagan-bhuiyan	Feni	6	0	0	0	6
Little Feni	Dagan-bhuiyan	Dagan-bhuiyan		1	0	0	1	0
Matubh uiyan Khal	Matu-bhuiyan	Dagan-bhuiyan		6	0	0	0	6
Matubh uiyan Khal	Char Majlishpur	Sonagazi		0	0	0	0	0
Feni	Farhad-nagar	Feni Sadar		5	3	2	0	0
Little Feni	Baligaon	Feni Sadar		2	0	0	1	1
Selonia	Chhanua	Feni Sadar		10	1	0	7	2
Selonia	Lemua	Feni Sadar		12	0	3	2	7

Khal/ River	Influence Area			Ethnic Popn. Total	Ethnic Population in Major Groups			
	Union	Upazila	District		Chakma	Bedia	Marma	Others
Selonia	Nababpur	Sonagazi	Chatto- gram	13	0	5	5	3
Selonia	Ananda-pur	Fulgazi		1	0	0	0	1
Selonia	Munsirhat	Fulgazi		2	1	0	0	1
Feni	Karerhat	Mirsharai		1573	1439	98	17	19
Feni	Osmanpur	Mirsharai		1	0	0	1	0
Feni	Ichchakhali	Mirsharai		61	4	17	3	37
Little Feni	Char Darbesh	Sonagazi	Feni	4	1	0	0	3
Little Feni	Bagadana	Sonagazi	Feni	7	0	0	0	7
Meghna	Chanandi	Hatiya	Noakhali	1	0	0	0	1
Little Feni	Musapur	Companiganj	Noakhali	0	0	0	0	0
Total				2,658	1,670	485	189	314

5.4 Cultural Heritage

The social team visited the study area and listed the cultural sites in the project influence area. There is an archaeological site of Lalmai-Mainamati inside Cumilla district near Gomati River which is included in the indicative list of world heritage sites. The historical/cultural assets in the broader study areas are Shalbon Boudha Bihar, Bangladesh Rural Development Academy, Moynamati War Cemetery, Ananda Bihar, Cumilla Zoo and Botanical Garden, Shah Shuja Masque, Dharmasagar Dighi, Rajeshpur Eco-park, Itakhola Mura, and Itakhola Bihar etc. The slope protection work at 15+800 – 16+200 km chainage is the nearest to the major cultural properties. The major historical places at the impacted area of Muhua, Feni, Silonia, Little Feni and Kahua River are Rajazir dighi, Bijoyshingh dighi, Grand Trank Road, Shomsher Gazir Dighi, Jongli Shah Mazar, Malipathor Bhoddhvumi, Dagonbhuyan dighi, Bhom Rajar dighi, Jiner Masque, Sreerampur Rajbari, Shomsher Gazir Killa etc.

It is found that most of the people in the area is muslims (94.63%), followed by hindus (5.27%), Christians (0.02%) and Buddhists (0.07%). The people follow their religious cultures as well as Bangali culture. presents the religious beliefs of the people.

Table 5-24: Population by Religion (Census 2022)

Khal/ River	Influence Area			Muslim	Hindu	Christian	Buddhist	Other
	Union	Upazila	District					
C.Khal	Uttor Hamchari	Lakshmi-pur Sadar	Lakshmi-pur	32648	1386	0	0	0
	Bamni	Raipur		28101	721	0	0	0
	Keroa	Raipur		33190	781	3	0	0
	Raipur Paurashava	Raipur		37426	2378	0	4	1
	Shakchar	Lakshmi-pur Sadar		18093	219	0	0	0
	Laharkandi	Lakshmi-pur Sadar		32355	324	1	2	0

Khal/ River	Influence Area			Muslim	Hindu	Christian	Buddhist	Other
	Union	Upazila	District					
	Mandari	Lakshmi- pur Sadar		41260	1049	1	3	0
Gomoti	Chhalia- kandi	Murad- nagar	Cumilla	15680	3064	0	1	0
	Sholanal	Burichang		39657	1664	4	0	0
	Uttar Durgapur	Adarsha Sadar		74221	3928	2	12	3
	Maynamati	Burichang		53456	3435	1	19	0
	Bharella Dakshin	Burichang		28996	739	1	1	0
	Bharella Uttar	Burichang		21910	115	0	1	0
	Jafarganj	Debidwar		29369	2054	1	3	0
	Bhitikandi	Titas		27028	567	0	1	0
	Narayandia	Titas		19494	520	0	1	0
	Gouripur	Daudkandi		50973	2264	3	12	2
	Fatehabad	Debidwar		40991	690	1	1	0
	Malapara	Brahman- para		18017	943	0	3	0
	Jagannath- pur	Adarsha Sadar		66755	2270	13	24	2
	City Corpn. Area	Adarsha Sadar		254675	28192	167	362	42
	City Corpn. Area	Sadar Dakhin		150174	5915	85	598	23
	Amratali	Adarsha Sadar		47068	1180	0	2	0
	Murad- nagar	Murad- nagar		38408	1840	4	4	0
	Panchthubi	Adarsha Sadar		56863	1352	3	26	4
Hawra River	Mogra	Akhaura	Brahman -baria	30008	1622	1	4	1
Muhuri / Selonia	Fulgazi	Fulgazi	Feni	30990	3199	4	10	0
	Darbarpur	Fulgazi		15311	1921	3	1	2
	Amjadhat	Fulgazi		23855	763	0	4	0
	Gm Hat	Fulgazi		12040	1322	2	0	1
	Mahamaya	Chhagal- naiya		27834	47	1	1	1
	Box Mahmud	Parshuram		24598	771	1	6	0
	Munsirhat	Fulgazi		21080	979	2	6	0
	Parashuram Paurashava	Parshuram		33020	3080	0	10	2
	Mirzanagar	Parshuram		24552	189	0	9	0
	Chithalia	Parshuram		26733	340	3	3	0
Little Feni	Sindurpur	Dagan- bhuiyan	Feni	32835	1400	2	2	0
Little Feni	Dagan- bhuiyan	Dagan- bhuiyan		18970	693	0	1	0
Matu- bhuiya	Matu- bhuiyan	Dagan- bhuiyan		20166	1028	1	2	0

Khal/ River	Influence Area			Muslim	Hindu	Christian	Buddhist	Other
	Union	Upazila	District					
n Khal								
Matu- bhuiya n Khal	Char Majlishpur	Sonagazi		28232	1922	2	109	0
Feni	Farhad- nagar	Feni Sadar		24805	109	1	3	1
Little Feni	Baligaon	Feni Sadar		37857	976	1	2	1
Selonias	Chhanua	Feni Sadar		24071	1333	0	8	1
Selonias	Lemua	Feni Sadar		21605	2425	1	3	4
Selonias	Nababpur	Sonagazi		18920	826	1	5	2
Selonias	Anandapur	Fulgazi		13750	196	1	1	1
Selonias	Munsirhat	Fulgazi		21080	979	2	6	0
Feni	Karerhat	Mirsharai	Chatto- gram	38051	5092	125	203	6
Feni	Osmanpur	Mirsharai		15011	2790	1	1	0
Feni	Ichchakhali	Mirsharai		31420	3832	8	106	110
Little Feni	Char Darbesh	Sonagazi	Feni	35192	2706	0	1	0
Little Feni	Bagadana	Sonagazi	Feni	24370	1593	0	0	1
Meghn a	Chanandi	Hatiya	Noakhali	51324	1002	0	3	2
Little Feni	Musapur	Compani- ganj	Noakhali	27184	1224	0	0	0
Total				2,011,672	111,949	453	1,590	213
Percentage				94.63%	5.27%	0.02%	0.07%	0.01%

5.5 Summary of Data Sources and Methods Used

Data for baseline is collected from various primary and secondary sources. Data on various physical environmental parameters have been collected from both primary and secondary sources. Secondary data have been collected from various sources such as Bangladesh Meteorological Department (BMD), Soil Resource Development Institute (SRDI) and so on. Air and noise qualities have been measured at five representative locations near the proposed interventions in the five study districts. The measurements have been done by EnviroCare and their report is in Appendix-C.

Surface and ground water samples have been collected from study rivers and khals at or near proposed intervention sites and then tested at IWM Water Quality Laboratory. Soil samples have been collected from the proposed dredging locations of Ruhita Khal in Cumilla district and C-khal in Lakshmipur district. These samples are tested at Institute of National Analytical Research and Service (INARS) laboratory of Bangladesh Council of Scientific and Industrial Research (BCSIR). Moreover, the benthic species present in the soil samples are identified at the laboratory of the Department of Zoology, University of Dhaka. The sampling locations are presented in the following map.

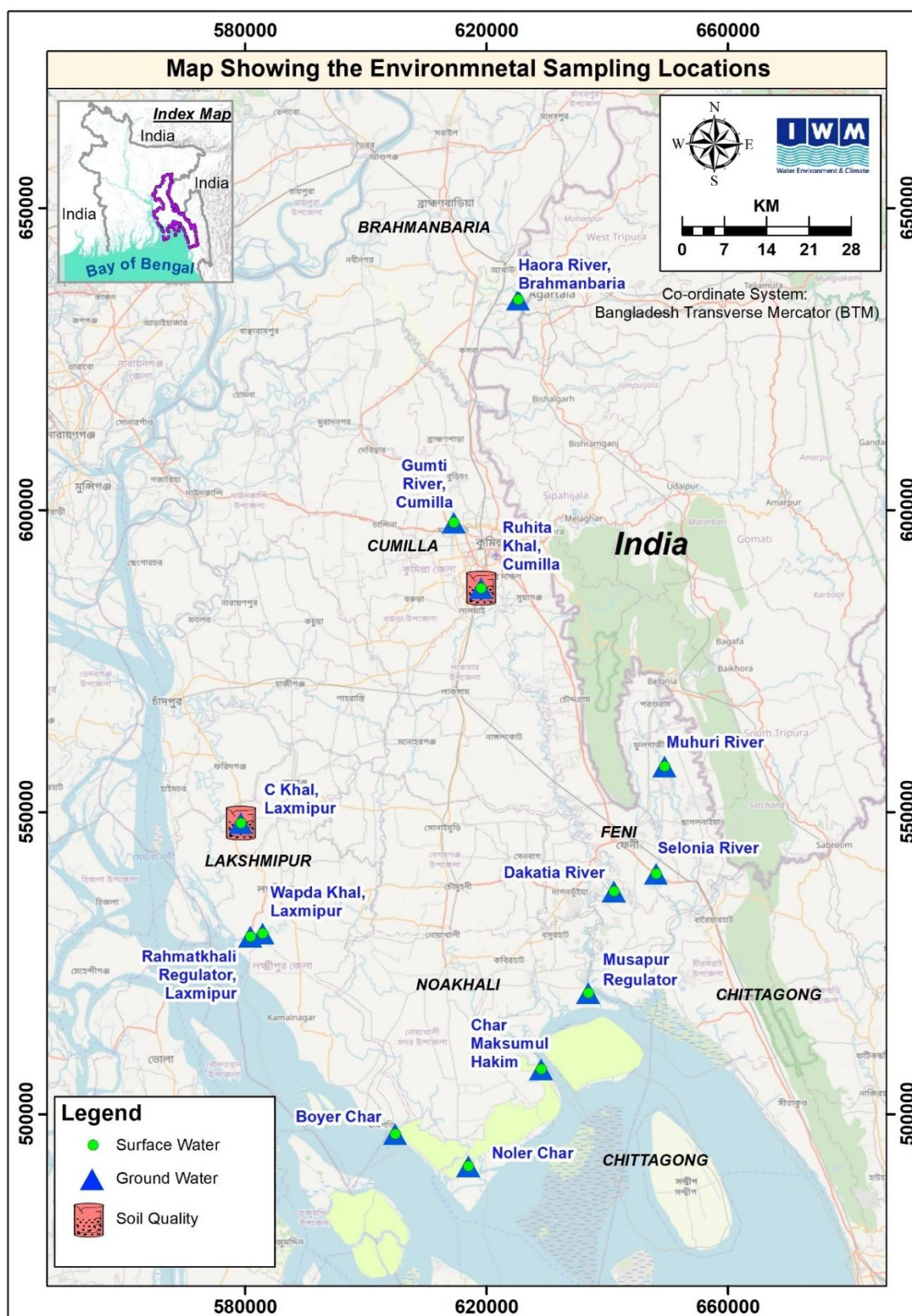


Figure 5.9: Sampling locations in the study area

The study area comprises both terrestrial and aquatic ecosystems, encompassing regions subject to both direct and indirect project impacts. Ecological surveys and field investigations

were conducted to characterize the vegetation types and ecosystem diversity within the project impact zone. During the visits, consultations and discussions were also made with the local informants to determine the status of both terrestrial and aquatic flora of the study area. Moreover, Fish market surveys and consultations with local fishermen were conducted to identify and document the diversity of fish species present in the study area. These activities provided valuable insights into commonly caught species, seasonal availability, and local ecological knowledge, helping to establish a baseline for understanding fish population dynamics and guiding conservation and management efforts. Various secondary data sources for biodiversity resources have been used such as IUCN data and other ESIA project data in or near the study area. These data were verified through ecological survey near the proposed intervention locations.

Social consultation and surveys have been also carried out in the study area. Various secondary data sources such as BBS Census 2022 data for social and demographic information and so on are also used for establishing the baseline social conditions.

CHAPTER-6: ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS

6.1 Valued Environmental and Social Components (VESC)s

Valued Environmental and Social Components (VESC)s refer to key elements of the physical, biological, or socio-economic environment that could be affected by the proposed project interventions. The selection of VESC)s varies depending on the project's type, location, and the surrounding environmental, socio-economic and health-related context. In this project, the following VESC)s are likely to be affected by the project activities:

- Water Quality
- Air and Noise Quality
- Lives and livelihood of people
- Fisheries resources: fish habitats and fish migration
- Terrestrial Biodiversity
- Flood protection and drainage facilities
- Crop production
-

Fisheries resources: fish habitats and fish migration

Back ground and Trend

The rivers and khals in the project area exhibit a high degree of aquatic biodiversity, encompassing both freshwater and brackish water ecosystems. In addition to cultured fishes, a wide range of wild capture species is also present. Seasonal monsoon floods and pond overflows facilitate the migration of cultured species into nearby canals and floodplain wetlands, which serve as important habitats for resident and migratory fish species. Fish market surveys and consultations identified a rich assemblage of indigenous (e.g., mola, shing, tengra, puti) and exotic aquaculture species (e.g., Thai pangas, tilapia). Seasonal floods allow exchanges between wild and cultured fish stocks.



Fisheries resources

Key Risks and Impacts

Construction, excavation works are likely increasing turbidity of water. Moreover, the construction of new water control structures as well as roads/railways and other development

works, without proper drainage and fish migration facilities will hamper fish migration and fisheries habitats.

Terrestrial Biodiversity

Back ground and Trend

The region supports diverse terrestrial flora and fauna. Homesteads are rich in fruit-bearing trees like mango, guava, jackfruit, and coconut, along with bamboo, supari and medicinal plants. Grasslands, floodplains, and seasonal char lands support a mosaic of natural and human-modified ecosystems. A variety of creepers, herbs, shrubs and so on contribute to biodiversity and ecosystem services. The grass covers on the banks and embankments are notable VECs.



Terrestrial fauna

Terrestrial faunal species include reptiles, birds and mammals. Among the commonly encountered species are lizards such as *Calotes versicolor* (Garden Lizard) and *Hemidactylus brookii* (Spotted House Gecko), which are well-adapted to both natural and human-modified environments. Important bird species include the *Copsychus saularis* (Doel), Bangladesh's national bird, and *Passer domesticus* (House Sparrow), *Milvus migrans* (Black Kite), *Aviceda jerdoni* (Jerdon's Baza), *Psittacula krameri* (Rose-ringed Parakeet), *Oriolus xanthornus* (Black-hooded Oriole), and *Eudynamis scolopacea* (Asian Koel) etc. *Callosciurus pygerythrus* (Irrawaddy Squirrel), *Mus musculus* (House Mouse), *Pipistrellus* spp. (Small Bats), *Pteropus* spp. (Flying Foxes), *Felis chaus* (Jungle Cat), *Herpestes auropunctatus* (Small Indian Mongoose), *Vulpes bengalensis* (Bengal Fox), *Caris aureus* (Golden Jackal), *Suncus etruscus* (Pygmy Shrew) highlight the diversity of ground-dwelling mammals.

Key Risks and Impacts

Site clearing, fencing the project area, building labor sheds, construction material stockpiling, mobilization of construction equipment, vehicles, excavators etc. and some construction works are likely to affect the terrestrial flora which in turn will hamper the habitats of the terrestrial fauna.

Flood and erosion protection and drainage facilities

Back ground and Trend

The embankment often gets breached due to floods, surges surge and tidal effects; it inundates the study area. In August 2024, a flood devastated the study area which was caused by upstream rainfall event and



delayed drainage. Erosion is also found along the banks of Lower Meghna, Little Feni, Selonia, Gomati rivers and Matubhuiyan Khal.

Key Risks and Impacts

The proposed project interventions are likely to improve the risk and vulnerability to future floods when implemented. However, the flood conditions will not improve in future if proper drainage is not provisioned in the transport and infrastructure development projects. Rehabilitation and construction of shelters will also increase flood and surge protection. The bank protection and slope protection works will improve bank erosion in the study area.

Water Quality

Back ground and Trend

The water quality in the study area is good at most of the locations except the Ruhita Khal and C-khal where dredging is proposed. The rivers in the area are generally not polluted.

Key Risks and Impacts

The project activities may impact on surface and ground water quality if the suggested mitigations are not implemented. Construction, excavation works are likely increasing turbidity of water.

Air and Noise Quality

Back ground and Trend

The air and noise quality in the rural area is often calm, quiet and pollution-free. However, air and noise pollution are often observed in the growth centers and crowded places and also at construction sites.

Key Risks and Impacts

The air and noise pollution are more likely in future due to various development works. Moreover, better transport facilities are likely to attract more vehicles and business to the area which in turn will induce air and noise pollution

Crop production

Back ground and Trend

The embankment often gets breached due to floods, surges surge and tidal effects; it inundates the study area and damages crops. Crop production is impacted by embankment erosion and flood hazards.

Key Risks and Impacts



Riverbank Erosion

After construction/rehabilitation of embankment in conjunction with river bank protection works per proper design to withstand the flood and storm surge effect; crops will be protected from flooding distress. Therefore, the the risk and vulnerability of crops due to floods are likely to improve in the future. Improvement of transport infrastructure will facilitate market access to the produced crops.

Lives and livelihood of people

Back ground and Trend

The embankment often gets breached due to floods, surges surge and tidal effects; it inundates the study area, damages crops and other properties and causes severe distress to the inhabitants of the area. Lives and livelihoods of the people in the area are impacted by embankment erosion and flood hazards.

Key Risks and Impacts

Agricultural and commercial activities may increase in the area consequent to land stability after erosion and flood protection, which may create new opportunities for income generation and livelihood improvement. Moreover, communication infrastructure and other development works in the area are likely to improve lives and livelihoods of the community increasing more business opportunities.

6.2 Identification of Key Risks and Impacts

The likely impacts of the project activities are assessed from analysis of the baseline conditions, future predictions and social impact assessment study. As part of the environmental and social impact assessment (ESIA) process, a customized screening matrix was applied to the proposed Project, specifically designed to evaluate potential environmental impacts due to the project activities.

The ‘effect pathway’ must be understood before starting the project activities. It describes the cause-and-effect chain linking a project action to a VESC. This impact can be direct or indirect—where the project influences other natural or human systems that the VESC relies on. For instance, a project might degrade water quality, which affects fish populations, ultimately impacting local economic activity dependent on fishing. In this case, water quality and fish serve as intermediate steps along the pathway to the final affected VESC—economic activity. VESCs are at the heart of impact prediction, knowing more about how and why they are chosen and if they adequately represent the risks and impacts of the project, it may fulfill the purpose of Environmental & Social Impact Assessment (ESIA).

An outline of the impacts of project activities (in accordance with the design footprints) at different locations during different phases of the project on VESCs and the sensitive receptors are presented in **Table 6-1**.

Table 6-1: Key Environmental risks and impacts of the project interventions on the identified VESCs

Major Project Activities	Location	VESC	Sensitive Receptors	Potential Impacts
Pre-Construction Phase				
• Site clearing • Fencing the project area • Building labor sheds • Construction material stockpiling • Mobilization of construction equipment, vehicles, excavators etc. • Fire fighting arrangements • Water supply • Drainage facilities	Along banks of: • Feni, Little Feni, Muhuri, Kahua, Selonia rivers and Matubhuiyan Khal in Feni • Little Feni and Meghna River in Noakhali • WAPDA, Rahmatkhali and C khals in Lakshmipur • Gomati River and Ruhita Khal in Cumilla • Hawra River in Brahmanbaria	Terrestrial vegetation	Terrestrial vegetation	Herbs and shrubs are likely to be temporarily damaged in the footprint area of labor shed construction material stockyard. Some amphibian and reptile Species may be temporarily affected.
		Employment opportunities, livelihood improvement & poverty reduction	Local community/ day labourers	The pre-construction activities will create employment opportunities and have positive impact on livelihood improvement & poverty reduction.
		Water Quality	Fish habitat, quality and fish production	Oil and grease release for transportation of construction equipment and materials may cause degradation of river water. Besides, increasing the water turbidity and decreasing the DO may cause death of sensitive fishes.
		Land dispute	Local inhabitants/ land owners	Dispute may arise between BWDB and private landowners during land demarcation for construction/ rehabilitation of embankment since both khals and private land, and some settlements, shops, etc. fall within the embankment alignment.
Construction Phase				
Operation of construction equipment	Along banks of: • Feni, Little Feni,	Noise quality	Inhabitants near the proposed bank	• Noise level may increase due to operation of construction and

Major Project Activities	Location	VESC	Sensitive Receptors	Potential Impacts
	Muhuri, Kahua, Selonia rivers and Matubhuiyan Khal in Feni • Little Feni and Meghna River in Noakhali • WAPDA, Rahmatkhali khals in Lakshmipur • Gomati River in Cumilla • Hawra River in Brahmanbaria		protection, construction and repair sites Terrestrial fauna	excavation equipment, i.e. from a mixture machine, vibrator, excavator etc. • Emissions from mechanical equipment • Increased vibration
Operation of excavation equipment	• C khal in Lakshmipur; • Ruhita Khal in Cumilla;		Aquatic and terrestrial fauna	
Construction activities such as production of CC blocks, sand filling of geo-bags, construction of embankment	Along banks of: • Feni, Little Feni, Muhuri, Kahua, Selonia rivers and Matubhuiyan Khal in Feni • Little Feni and Meghna River in Noakhali • WAPDA, Rahmatkhali khals in	Air Quality	Terrestrial flora and fauna, Nearby communities	Deterioration of air quality due to operation of construction and excavation equipment (i.e. exhaust emissions from construction equipment); dust generation from the vehicle movement, making concrete for construction of regulator and production of CC blocks, sand filling of geo-bags, construction of embankment.

Major Project Activities	Location	VESC	Sensitive Receptors	Potential Impacts
	Lakshmipur - Gomati River in Cumilla - Hawra River in Brahmanbaria			
Construction/ repair activities and river bank protection works, if construction waste is thrown into the river or stacked on riverbanks during monsoon/rainfall events	- Feni, Little Feni, Muhuri, Kahua, Selonia rivers and Matubhuiyan Khal in Feni - Little Feni and Meghna River in Noakhali - WAPDA, Rahmatkhali khals in Lakshmipur - Gomati River in Cumilla - Hawra River in Brahmanbaria	Surface Water Quality	Aquatic flora and fauna Fisheries resources Domestic/drinking water for local people	Deterioration of water quality is likely due to throwing construction waste into the river, river bank protection works.
Excavation activities including of Canals/Khals	- C khal in Lakshmipur - Ruhita Khal in Cumilla			- Excavation of borrow earth from agricultural land(s) may affect soil fertility, reducing productivity - May increase turbidity and suspended solids during dredging and spoil disposal - Disturbance of aquatic habitats; temporary displacement of fish and aquatic organisms

Major Project Activities	Location	VESC	Sensitive Receptors	Potential Impacts
Construction/ repair of embankments and regulators	Along banks of: - Feni, Little Feni, Muhuri, Kahua, Selonia rivers and Matubhuiyan Khal in Feni - Little Feni and Meghna River in Noakhali - WAPDA, Rahmatkhali khals in Lakshmipur - Gomati River in Cumilla - Hawra River in Brahmanbaria	Soil Erosion	Communities on riverbanks Terrestrial flora and fauna Aquatic flora and fauna	Soil erosion might occur from base and surface of embankment and regulator approach and backfilled area.
Construction/ repair activities if construction wastes are disposed in the surrounding lands or CC blocks are constructed and stockpiled on agriculture land	Along banks of: - Feni, Little Feni, Muhuri, Kahua, Selonia rivers and Matubhuiyan Khal in Feni - Little Feni and Meghna River in Noakhali - WAPDA, Rahmatkhali khals in Lakshmipur	Changes in Land Quality and Environmental Pollution	Flora and fauna Local community	Changes in land quality and environmental pollution due to disposal of construction wastes in the surrounding lands or CC blocks are constructed and stockpiled on agriculture land.

Major Project Activities	Location	VESC	Sensitive Receptors	Potential Impacts
	- Gomati River in Cumilla - Hawra River in Brahmanbaria			
Excavation activities, if excavated materials are dumped on the agriculture land	- C khal in Lakshmipur - Ruhita Khal in Cumilla	Crop Production loss	Local community	Loss of crop production will occur if excavated materials are dumped on the agriculture land due to potential soil contamination or reduced fertility due to disposal of unsuitable or saline spoil, alteration of landform or drainage patterns
Construction activities such as production of CC blocks, sand filling of geo-bags, construction of embankment	- Feni, Little Feni, Muhuri, Kahua, Selonia rivers and Matubhuiyan Khal in Feni - Little Feni and Meghna River in Noakhali - WAPDA, Rahmatkhali khals in Lakshmipur - Gomati River in Cumilla - Hawra River in Brahmanbaria	Fish habitat, quality and fish Production	Fisheries resources Local communities and their livelihoods	- Decline of water quality due to construction debris and excavation of River and lubricant, oil from the machineries. Moreover, increased turbidity in the water due to excavation and slope preparation would decline the DO and pH in the water for construction and excavation period. - Movement of the excavator and other equipment would also enhance the water turbidity.
- Khal excavation - Spoil management	- C khal in Lakshmipur - Ruhita Khal in Cumilla	Fish migration and movement	Fisheries resources	Fish migration and movement may be disturbed temporarily during re-excavation and construction period.

Major Project Activities	Location	VESC	Sensitive Receptors	Potential Impacts
		Fish Diversity and species richness	Fisheries resources Livelihoods	Fish diversity and composition may decrease partially during re-excavation period.
		Benthic environment	Benthos Aquatic fauna Fisheries resources	The benthic environment will be lost temporarily which acts as source of food for fishes and other aquatic species.
Construction activities such as production of CC blocks, sand filling of geo-bags, construction of embankment, Canal/Khal excavation	- Feni, Little Feni, Muhuri, Kahua, Selonia rivers and Matubhuiyan Khal in Feni - Little Feni and Meghna River in Noakhali - WAPDA, Rahmatkhali khals in Lakshmipur - Gomati River in Cumilla - Hawra River in Brahmanbaria - C khal in Lakshmipur - Ruhita Khal in Cumilla	Fish mortality	Fisheries resources Local communities and their livelihoods	The release of toxic substances from CC block preparation, along with oil and lubricants from machinery, can lead to the mortality of juvenile fish and a reduction in phytoplankton and zooplankton populations in construction and excavation area
		Terrestrial biodiversity	Terrestrial flora and fauna	Terrestrial flora and fauna may be adversely affected due to vegetation loss in areas designated for CC block production, stockpiling, and embankment construction
		Aquatic biodiversity	Aquatic flora and fauna	Aquatic resources may be adversely impacted during bank protection work, and re-excavation works
		Social Forestation	Terrestrial flora and fauna	Damage of social forestation on the slope of the embankment and river side may be cut at construction points
Construction activities such as production of CC	Along banks of Little Feni River in Noakhali;	Mangrove vegetation	Mangrove vegetation	Mangrove vegetation is likely to be damaged in a few interventions area such as Little Feni River.

Major Project Activities	Location	VESC	Sensitive Receptors	Potential Impacts
blocks, sand filling of geo-bags, construction of embankment				
All project activities	Along banks of: • Feni, Little Feni, Muhuri, Kahua, Selonia rivers and Matubhuiyan Khal in Feni • Little Feni and Meghna River in Noakhali • WAPDA, Rahmatkhali khals in Lakshmipur • Gomati River in Cumilla • Hawra River in Brahmanbaria • C khal in Lakshmipur • Ruhita Khal in Cumilla	Employment opportunities, Livelihood improvement and Poverty reduction	Local community	Employment opportunities for the local semi-skilled and unskilled labours will be created in the construction related activities.
All project activities	Project locations	Occupational Health and Safety	Project workers	The workers may be injured during riverbank protection work, repair of water control structures and embankment, excavation of khals. Some of these injuries may turn into casualty, if not properly treated.
Post-Construction Phase				
Riverbank protection and	Along banks of:	Riverbank Stability	Local community	Riverbank protection works will save land,

Major Project Activities	Location	VESC	Sensitive Receptors	Potential Impacts
embankment construction/repair	- Feni, Little Feni, Muhuri, Kahua, Selonia rivers and Matubhuiyan Khal in Feni - Little Feni and Meghna River in Noakhali - WAPDA, Rahmatkhali khals in Lakshmipur - Gomati River in Cumilla - Hawra River in Brahmanbaria		Terrestrial and aquatic flora and fauna	settlements and infrastructures at different vulnerable locations
		Flood protection	Local community Terrestrial flora and fauna	Flood control embankment will save crops and infrastructures from flood and storm surge
- Khal excavation - Construction/repair of regulators	Along banks of: - C khal in Lakshmipur - Ruhita Khal in Cumilla	Drainage Improvement	Local community Terrestrial flora and fauna	Drainage conditions will improve after completion of the project/ khals excavation.
		Changes in Land Use & Drainage Patterns		Land use and drainage patterns may be changed due to commercial and industrial growth, development of settlements etc. consequent to protection of land from erosion and flooding.
		Crop Production	Terrestrial flora and fauna	Crop cultivation is likely to increase due to erosion and flood protection and drainage improvement.
		Fish habitat, quality and fish Production		Habitat quality and fish production may increase concurrently.
		Fish migration and movement		Fish movement may be increased and smooth due to sufficient water round the year because of

Major Project Activities	Location	VESC	Sensitive Receptors	Potential Impacts
				incremental depth of khals.
Riverbank protection and embankment construction/repair	Along banks of: - Feni, Little Feni, Muhuri, Kahua, Selonia rivers and Matubhuiyan Khal in Feni - Little Feni and Meghna River in Noakhali - WAPDA, Rahmatkhali khals in Lakshmipur - Gomati River in Cumilla - Hawra River in Brahmanbaria	Terrestrial biodiversity		Terrestrial flora and fauna is likely to be enriched due to protection of riverbank and stabilization of land and flood protection works, and maintenance excavation.
		Employment opportunities, Livelihood improvement and Poverty reduction	Local community	Agricultural and commercial activities may increase in the area consequent to land stability after erosion and flood protection, which may create new opportunities for income generation and livelihood improvement.
		Communication facility	Local community	The embankment-cum road might be paved resulting improved network in the study area.
- Khal excavation - Construction/ repair of regulators	- Along banks of: - C khal in Lakshmipur - Ruhita Khal in Cumilla	Domestic water facilities	Local community	The khals will retain fresh water after re-excavation and construction/rehabilitation of water control structures. The local people may use this water for domestic purposes
All project activities	Project locations	Occupational Health and Safety	Project workers	Labors may encounter accidents during O&M of construction activities and excavation.

Table 6-2: Key Social risks and impacts of the project interventions on the identified VESCs

Major Project Activities	Location	Social Issue / VESC	Sensitive Receptors	Potential Impacts
<i>Pre-Construction Phase</i>				

Major Project Activities	Location	Social Issue / VESC	Sensitive Receptors	Potential Impacts
Site clearance, fencing, mobilization of equipment	Along project banks and khal excavation sites in Feni, Noakhali, Lakshmipur, Cumilla, Brahmanbaria	Resettlement	Squatters, non-titled affected people, shop owners, structure owners	Temporary displacement or permanent loss of shelter/business; possible conflicts over compensation and relocation.
Demarcation of embankment land	All project sites	Land ownership dispute	Local inhabitants, landowners, BWDB	Disputes may arise between BWDB and private landowners regarding land acquisition, boundary alignment, or compensation.
Establishment of labor sheds and material stockyards	Within project sites and adjacent community areas	Community safety and social interaction	Nearby community, women and children	Risks of community disturbance, women's safety concerns, and social tension due to presence of non-local laborers.
Construction Phase				
Riverbank protection, excavation, construction of CC blocks and regulators	All project sites	Livelihood disruption	Local traders, boatmen, fishermen, day laborers	Temporary disruption of income due to restricted access to rivers, khals, or roads; loss of workdays for fishermen during excavation.
Transportation of construction materials	Access roads and project vicinity	Traffic congestion and communication disruption	Local commuters, school children, road users	Increased traffic, road damage, and restricted movement causing delay to school and work; increased accident risk.
Construction activities (noise, dust, vibration)	Near residential areas, schools, markets	Noise and air pollution	Students, teachers, local residents	Noise and dust pollution from heavy machinery and mixing plants may disturb academic activities and daily life.
Labor influx during construction period	Worker camps, nearby markets and settlements	Labor influx and social conflict	Local community, women and vulnerable groups	Potential social conflicts, gender-based violence risks, disease transmission, and increased demand on local resources.
Construction activities and restricted access during works	Riverbanks, khal excavation sites	Education and communication disruption	School-going children, teachers, local transport operators	Access to schools and markets may be temporarily disrupted due to machinery movement or blocked roads.
Movement of heavy equipment and vehicles	Project approach roads	Risk of accidents	Pedestrians, children, community members	Accidental injuries due to poor traffic management and high-speed movement of heavy vehicles.

Major Project Activities	Location	Social Issue / VESC	Sensitive Receptors	Potential Impacts
All construction activities	All sites	Occupational health and safety	Construction workers	Workers exposed to accidents, machinery injuries, heat stress, unsafe working conditions without PPE.
Post-Construction Phase				
Completion of riverbank protection and embankment	All project sites	Improved communication and accessibility	Local community	Embankment-road improves connectivity; travel and trade become easier.
Drainage and flood control improvement	Re-excavated khals and regulators	Improved livelihood and living conditions	Farmers, traders, households	Reduced flood risks enhance crop productivity, housing security, and income opportunities.
Project completion and handover	All project locations	Employment and livelihood enhancement	Local community, women, youth	Operation and maintenance activities create new employment; improved local economy.
Improved land stability and flood protection	Project influence areas	Resettlement rehabilitation outcomes	Resettled households	Livelihood restoration and improved security for displaced households due to protected land and increased access to resources.

6.3 Impact Assessment Methodology

The ESIA is an integrated assessment of the potential impacts of the projects interventions on the surrounding physical, biological and social environment which aims to develop and describe mitigation measures that will be taken to prevent or minimize any potential negative effects and maximize the potential benefits; and communicate the severity of residual impacts that will remain once the applied mitigation. A main output of the environmental investigations and ESIA process is a strategy for managing risks and mitigating impacts which is known as Environmental and Social Management Plan (ESMP) which includes the impacts on Valued Environmental and Social Components (VESC)s identified in the project area and surroundings; the mitigation measures for minimizing the adverse impacts; an Environmental Enhancement Plan for compensating the environment for the residual impacts; and an Environmental Monitoring Plan for implementation of the EMP during its pre-implementation, implementation and post-implementation phases.

A comprehensive Environmental and Social Impact Assessment (ESIA) study has been carried out for river bank protection works, structure repair and khal re-excavation in Brahmanbaria, Cumilla, Feni, Noakhali and Lakshmipur districts affected during the August 2024 flood. This ESIA Report clearly mentions the justification of the proposed interventions, mitigation measures for minimizing the adverse effects on the environment, and plan for surveillance and monitoring.

This ESIA includes examining all the activities during planning, design, construction and post construction stages, which may result in impacts on the natural environment and social environment. Based on the analysis of impacts, the ESIA identifies the potential mitigation measures to reduce and offset the negative impacts. The study also suggests the outline of the Environmental and Social Management Plan (ESMP) in compliance with the national regulatory requirements. During the course of preparation of the ESIA, extensive public consultation has been undertaken and baseline environmental, social and biological information have been collected. This ESIA has been carried out by a multidisciplinary team of environmental and social experts. A standard ESIA procedure has been followed as shown in **Figure 6.1**.

Cumulative impacts including other planned projects in project area in addition of the proposed project interventions are also be analysed. Stakeholder consultations have been carried out throughout the study in order to incorporate their views and prepare a comprehensive ESIA report.

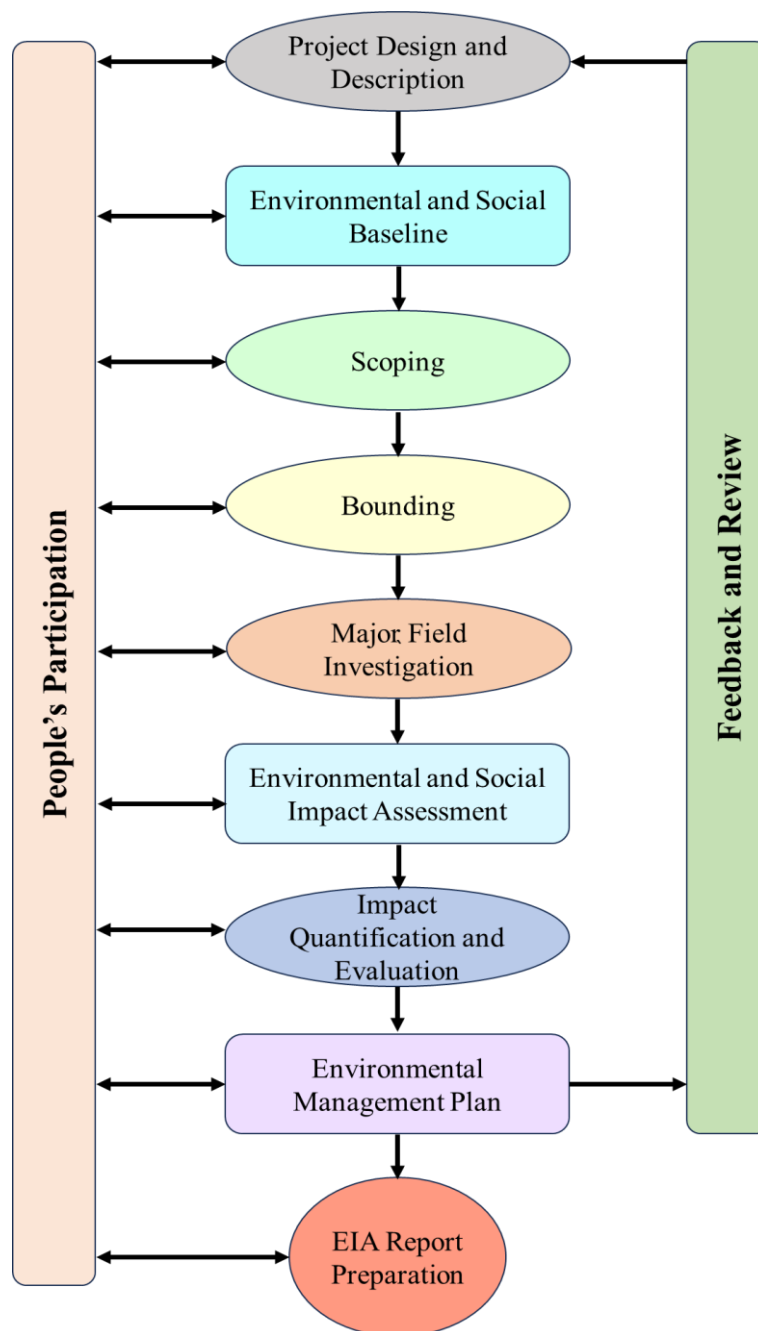


Figure 6.1: Flowchart showing methodology for Environmental and Social Impact Assessment

6.4 Significance of Impacts

As part of the environmental impact assessment process, an impact matrix was tailored specifically to the proposed Project, focusing on the potential environmental impacts during the pre-construction, construction and post-construction phases. The matrix examined the interaction of project activities with various Valued Environmental and Social Components (VESC) of the environment as well as the significance of the impacts. The anticipated impacts and their significance before adopting mitigation measures are subsequently characterized as presented in **Table 6.3**.

Table 6.3: Significance of likely environmental and social impacts of project activities

VESC	Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Before mitigation)
Pre-Construction Phase							
Terrestrial vegetation	Herbs and shrubs are likely to be temporarily damaged in the footprint area of labor shed construction material stockyard. Some amphibian and reptile species may be temporarily affected.	Short term	Local	Reversible	Likely	Low	Negligible
Employment opportunity, Livelihood improvement & Poverty reduction	The pre-construction activities will create employment opportunities.	Short term	Within the study area				Positive
Fish habitat, quality and fish production	Oil and grease release for transportation of construction equipment and materials may cause degradation of river water. Besides, increasing the water turbidity and decreasing the DO may cause death of sensitive fishes.	Short term	Local	Reversible	Likely	Minor Negative	Minor Negative
Land dispute	Dispute may arise between BWDB and private landowners during land	Short term	Footprint area of embankment	Reversible	Likely	Medium	Moderate

VESC	Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Before mitigation)
	demarcation for construction/ rehabilitation of embankment since both khals and private land, and some settlements, shops, etc. fall within the embankment alignment.						
Ethnic Communities	Some minor works may affect ethnic people If ethnic community people are within project area and/or affected then an Indigenous People Plan may need to be prepared. Provision or Requirements for this may be indicated.	Short term	Local	Reversibly	Less likely	Low	Low
Resettlement (Presence of squatters, non-titled affected people)	Temporary or permanent displacement, loss of shelter or livelihood sources for non-titled occupants, grievances over compensation	Short to medium-term	Site-specific (within embankment/canal alignment)	Irreversible without compensation	Medium	Medium	Medium
Construction Phase							
Noise	Noise level may increase due to operation of construction and excavation equipment, i.e. from a	Short term	Local	Reversibly	Likely	Medium	Moderate

VESC	Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Before mitigation)
	mixture machine, vibrator, excavator etc.						
Air Quality	Deterioration of air quality due to operation of construction and excavation equipment (i.e. exhaust emissions from construction equipment); dust generation from the vehicle movement, making concrete for construction of regulator and production of CC blocks, sand filling of geo-bags, construction of embankment.	Short term	Local	Reversibly	Likely	Medium	Moderate
Surface Water Quality	Deterioration of water quality is likely due to throwing construction waste into the river, river bank protection works and excavation of khals.	Short term	Local	Reversibly	Likely	Medium	Moderate
Soil Erosion	Soil erosion might occur from base and surface of embankment and regulator approach and backfilled area.	Short term	Local	Reversible	Likely	Medium	Moderate
Changes in Land Quality and	Changes in land quality and environmental pollution due to	Short term	Local	Reversible	Likely	Medium	Moderate

VESC	Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Before mitigation)
Environmental pollution	disposal of construction wastes in the surrounding lands.						
Crop Production loss	Loss of crop production will occur if re-excavated material is dumped on the agriculture land and CC blocks are constructed and stockpiled on agriculture land.	Short term	Local	Reversible	Less likely	Medium	Moderate
Fish habitat, quality and fish Production	Decline of water quality due to construction debris and excavation of River and lubricant, oil from the machineries. Moreover, increased turbidity in the water due to excavation and slope preparation would decline the DO and pH in the water for construction and excavation period. Movement of the excavator and other equipment would also enhance the water turbidity.	Short term	Localized	Reversible	Likely	Moderate Negative	Moderate Negative
Fish migration and movement	Fish migration and movement may be disturbed temporarily during re-excavation and construction period.	Short term	Localized	Reversible	Likely	Minor Negative	Minor Negative

VESC	Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Before mitigation)
Fish Diversity and species richness	Fish diversity and composition may decrease partially during re-excavation period.	Short term	Localized	Reversible	Likely	Minor Negative	Minor Negative
Fish mortality	The release of toxic substances from CC block preparation, along with oil and lubricants from machinery, can lead to the mortality of juvenile fish and a reduction in phytoplankton and zooplankton populations in construction and excavation area	Short term	Localized	Reversible	Likely	Minor Negative	Minor Negative
Terrestrial biodiversity	Terrestrial flora and fauna may be adversely affected due to vegetation loss in areas designated for CC block production, stockpiling, and embankment construction	Short term	Local	Reversible	Likely	Medium	Moderate
Aquatic biodiversity	Aquatic resources may be adversely impacted during bank protection work, and re-excavation works	Short term	Local	Reversible	Likely	Medium	Moderate
Social Forestation	Damage of social forestation on the slope of the embankment and river side may be cut at construction points	Short term	Local	Reversible	Likely	Low	Negligible

VESC	Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Before mitigation)
Mangrove vegetation	Mangrove vegetation is likely to be damaged in a few interventions area such as Little Feni River.	Short term	Local	Reversible	Likely	Low	Negligible
Employment opportunities, Livelihood improvement and Poverty reduction	Employment opportunities for the local semi-skilled and unskilled labours will be created in the construction related activities.	Short term	Study area				Moderately positive
Occupational Health and Safety	The workers may be injured during riverbank protection work, repair of water control structures and embankment, excavation of khals. Some of these injuries may turn into casualty, if not properly treated.	Short term	Within the entire project area	Irreversible	Likely	Medium	Moderate
Labour Influx	Increased pressure on local services (water, sanitation, health), social tension, risk of SEA/SH incidents, spread of communicable diseases	Medium	Concentrated around workers' camps and nearby communities	Partially reversible with management	Likely	Medium	Moderate to high
Education and Livelihood	Restricted access to schools, markets, or workplaces due to road blockages or machinery movement	Medium	Localized along construction corridors	Reversible post-construction	Likely	Medium	Medium

VESC	Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Before mitigation)
Communication Disruption / Road Closures	Temporary closure or restricted access to roads and footpaths near embankments or canals	Short	Local	Reversible	Likely	Medium	Medium
Construction Works (Noise, Pollution, Traffic, Accidents)	Noise and dust pollution, vibration, traffic congestion, risk of accidents for workers and community	Medium	Within project area	Reversible with controls	Likely	Medium	Medium
Post-Construction Phase							
Riverbank Stability	Riverbank protection works will save land, settlements and infrastructures at different vulnerable locations.	Long term	Project area	-	-	-	Highly positive
Flood protection	Flood control embankment will save crops and infrastructures from flood and storm surge.	Long term	Study area	-	-	-	Highly positive
Drainage Improvement	Drainage conditions will improve after completion of the project/ khals excavation.	Long term	Project area	-	-	-	Moderately positive
Changes in Land Use & Drainage Patterns	Land use and drainage patterns may be changed due to commercial and industrial growth, development of	Long term	Local	Reversible	Likely	Medium	Moderate

VESC	Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Before mitigation)
	settlements etc. consequent to protection of land from erosion and flooding.						
Crop Production	Crop cultivation is likely to increase due to erosion and flood protection and drainage improvement.	Long term	Study area				Highly positive
Fish habitat, quality and fish Production.	Habitat quality and fish production may increase concurrently.	Short term	Localized	Reversible	Likely	Minor Positive	Moderate Positive
Fish migration and movement	Fish movement may be increased and smooth due to sufficient water round the year because of incremental depth of khals.	Short term	Localized	Reversible	Likely	Minor Positive	Minor Positive
Terrestrial biodiversity	Terrestrial flora and fauna is likely to be enriched due to protection of riverbank and stabilization of land and flood protection works, and maintenance excavation.	Long term	Within the footprint area	-	-	-	Positive
Employment opportunities, Livelihood improvement and	Agricultural and commercial activities may increase in the area consequent to land stability after erosion and flood protection, which may create new opportunities for	Long term	Study area	-	-	-	Moderately positive

VESC	Potential Impacts	Temporal Aspects	Spatial Aspects	Reversibility	Likelihood	Sensitivity	Significance (Before mitigation)
Poverty reduction	income generation and livelihood improvement.						
Communication facility	The embankment-cum road might be paved resulting improved network in the study area.	Long term	Study area	-	-	-	Moderately positive
Domestic water facilities	The khals will retain fresh water after re-excavation and construction/rehabilitation of water control structures. The local people may use this water for domestic purposes	Long term	Study area	-	-	-	Moderately positive
Occupational Health and Safety	Labors may encounter accidents during O&M of construction activities and excavation.	Short term	Within the Project area	Irreversible	Likely	Medium	Moderate
Restoration of Livelihood and Access	Delay in restoring temporary livelihood sites; need for reinstatement of community facilities	Short term	Localized	Reversible	Likely	Medium	Moderate

6.5 Alternative Analysis

Primarily, the project scope includes repair and rehabilitation of damaged infrastructure such as bank protection structures, embankment, drainage khals etc. Hence, there are not much alternative options to the project works except “Without Project” alternative. Evaluation of the “Without Project” and “With Project” alternatives are presented in **Table 6-**.

Table 6-4: Alternative Analysis and Evaluation

VESC	Without Project	With Project	Potential Risks and Impacts
Riverbank Stability	-	+	Erosion is a major problem in the study area. Every year, many settlements and valuable lands get eroded, causing severe distress to the inhabitants of the area. River bank protection, slope protection, embankment improvement works along the vulnerable banks of Gumati, Muhuri, Kahua, Little Feni, Feni, Haora River and WAPDA khal, Rahmatkhali khal, Matubhuiyan khal and Ruhita khal will protect the valuable lands, lives, crops, other properties and livelihood of the people of a number of bankside unions of Cumilla, Brahmanbaria, Feni, Laxmipur, and Noakhali District from river erosion and flash flood damages. It is very likely that the project interventions will improve riverbank stability by implementing bank protection works.
Flood Protection	-	+	The embankment often gets breached due to floods, surges surge and tidal effects; it inundates the study area, damages crops and other properties and causes severe distress to the inhabitants of the area. After construction/rehabilitation of embankment in conjunction with riverbank protection works per proper design to withstand the flood and storm surge effect; lives, crops and other properties as well as livelihood of the people will be protected from flooding distress. Therefore, the project is likely to improve the risk and vulnerability to future floods when implemented.
Drainage & waterlogging	-	+	At present, most of the khals lack connectivity for which monsoon logged water can't be drained out in time. The water control structure's size is not enough for proper drainage. Besides, many water control structures are inactive for many years for which rain runoff can't be drained out and causes drainage congestion. After restoration of connectivity by re-excavation of khals and rehabilitation of water control structures, drainage condition and monsoon flooding will be improved. Hence, the project is likely to have positive impact on drainage and flood hydrology of the area and reduce water logging.

VESC	Without Project	With Project	Potential Risks and Impacts
Noise level	0	-	The noise level in the study area may rise due to the operation of construction equipment (such as mixture machines and vibrators) for making concrete, as well as during the construction or rehabilitation of water control structures, vehicle movement, and excavation of khals activities. It is likely that the noise level will increase in the project area during the construction phase of the project and may affect the environment if proper mitigation measures are not undertaken. However, it is unlikely to increase during the project operation phase.
Air quality	0	-	Fugitive dust would be generated during filling of the geo-bags, manufacturing of CC block; construction and rehabilitation of the water control structures; and vehicle movement. In addition, the emission of gases from construction equipment, excavator and vehicles may deteriorate the ambient air quality around the excavation/construction site and nearby areas. Fugitive dust emissions from the material stockyards may also deteriorate the ambient air quality of the locality. Hence, it is likely that the air quality will deteriorate in the project area during the construction phase of the project and may affect the environment if proper mitigation measures are not undertaken. However, air quality will not be significantly impacted during the project operation phase.
Surface Water Quality	-	-/+	The main interventions of the project are riverbank protection works, construction and rehabilitation of water control structures, and re-excavation of khals. Water quality might deteriorate, if empty cement bags, litter, residuals of coarse aggregates, waste concrete generated for construction/rehabilitation of water control structures, and CC blocks production for bank protection works, Kitchen wastes, WC wastes from labor sheds, etc. are directly released to the surrounding rivers and other water bodies. Water quality may also deteriorate during re-excavation of khals activities. However, water quality is likely to be better during the project operation phase if the riverbank erosion, flooding and water logging are reduced.
Soil quality	0	-	Placing the excavated materials may affect the soil quality of the disposal/storage ground if the excavated materials are contaminated. Moreover, the construction activities of revetment along the river bank (production of CC block, filling of geo-bags, preparation of slope, dumping of geo-bags, and CC Block below WWL, placing of geotextile, filter

VESC	Without Project	With Project	Potential Risks and Impacts
			material, and CC Block above WWL) may lead to an increase the soil contamination in the project development site. During this period, rainfall is likely to accelerate soil contamination.
Land use and drainage pattern	0	0/+	The construction of embankment improvement, slope protection and river bank protection works is not likely to change the drainage pattern in the study area. There are some irrigations set up e.g. pump house, irrigation drain which may be shifted from interventions areas during construction period. After completion of construction works, the those can be shifted to their previous places. Re-excavation of Ruhita khal will improve the drainage system of the drainage area under the khal and it will give available water for irrigation on the cropping land. Re-excavation of C-khal, Rahmatkhali Khal and WAPDA khal is likely to improve the drainage of the area.
Enhancement of crop production	0	-/+	During the construction phase of the project, Bank protection works and the rehabilitation or construction of embankments may damage crops in nearby agricultural land. Additionally, disposing of excavated earth materials from rivers and khals on farmland may result in crop loss. The movement of vehicles and equipment may also hinder crop production in the area. Therefore, crop production may be hampered if proper measures are not taken. During the operation phase, rehabilitation/construction of embankment and regulators may reduce the crop damage from tidal effect of the low-lying areas and re-excavation of khal is likely to remove the drainage congestion enhancing transplanted of rice crops in proper time in the study area. Crop production may increase which leads to a change in cropping patterns, increased yield level with more use of HYV/Hybrid varieties, and increased cropping intensity in the study area.
Habitat condition, quality, and fish production	-	-	During the construction phase, mobilization of equipment, excavators, and machinery may change the fish habitat condition and quality and production. Besides, the proposed interventions like re-excavation and bank protection work will impact on the fish habitat due to the changing of nature and function during the operation phase.
Fish movement and migration	0	-/+	Fish migration may be hampered due to excavation/construction works in the selected location in the river and khals. Moreover, creating noise under the water during excavation and placement of CC blocks may change

VESC	Without Project	With Project	Potential Risks and Impacts
			fish movement and migration in re-excavation and riverbank protection locations. Construction activities may disturb the fish migration in the project area. However, fish migration may benefit from khal re-excavation works.
Fish diversity and species richness	-	-/+	Fish diversity and species richness would change due to changing fish migration to alter riverine habitat and khals due to re-excavation. Therefore, species richness and abundance of fish may change.
Fish Mortality	0	-	Small fishes in the river and irrigation and drainage canals, especially for the slow movement of fish and fish fries, might be disrupted/die because of re-excavation, bank protection work, and movement of other equipment in the selected location.
Terrestrial biodiversity	0	-	In an ecosystem terrestrial biodiversity plays a significant role by holding different types of flora and fauna. In the study area terrestrial flora and fauna are important biological components growing around the riverside. Some vegetation might be damaged in the footprint area of labor shade, construction yard, material stockyard, CC block construction and stockyard, and excavated material disposal site, which might impact the terrestrial flora and fauna. On the other hand, the terrestrial habitat in the riparian area will be protected in post post-project/operation phase due to erosion and flood protection, which would in turn enrich the terrestrial flora and fauna.
Aquatic biodiversity	0	-	The aquatic species are likely be impacted in the footprint area of river bank protection work due to placing and dumping of Geo-bags and CC blocks, as well as during re-excavation of khals.
Benthic environment	0	-	The benthic environment will be lost temporarily due to khal re-excavation works. However, it is very likely that the benthic environment will be replenished within 6-12 month after the re-excavation works. Moreover, it is likely that the benthic environment will enrich during the poset-construction phase as the garbage deposited on khal beds will be removed by re-excavation.
Resettlement	0	-	Resettlement associated with embankment protection, slope protection, re-sectioning, and canal re-excavation works may lead to both physical and economic displacement, particularly for squatters and non-titled affected persons residing or operating businesses along the project corridors. The primary risks include loss of shelter, residential or productive land,

VESC	Without Project	With Project	Potential Risks and Impacts
			and livelihood opportunities for informal vendors, fishermen, and agricultural laborers. Displacement can also disrupt social networks, education, mobility, and access to community facilities, while creating psychological stress and uncertainty among affected households. Women, elderly, and vulnerable groups may experience disproportionate impacts, including increased risk of gender-based violence and SEA/SH from labor influx. Inadequate consultation or delayed compensation can further aggravate grievances, while exclusion of non-titled occupants may result in social conflict and inequity. Poorly planned relocation may expose people to health and environmental hazards, and loss of cultural or religious structures can cause long-term social distress

6.6 Cumulative and Induced Impacts

Cumulative and induced impacts refer to the broader environmental and social effects that arise from a project's activities when considered alongside other past, present, or foreseeable future actions. Cumulative impacts encompass the combined effects of multiple activities over time and space, which may be minor individually but significant collectively. These can include degradation of air, noise and water quality, loss of plants/benthic environment, or erosion and flood protection. Induced impacts are secondary effects triggered by the project, such as changes in crop production, change in lives and livelihoods etc. Assessing these impacts is crucial for sustainable development, as it enables the identification of potential long-term consequences and the implementation of appropriate mitigation strategies.

The study area covers various parts of the five flood-affected districts, namely Bramanbaria, Cumilla, Noakhali, Feni and Lakshmipur. The approved projects in this area and also the projects which are in the Greenbook of the government, are considered for Cumulative and Induced Impacts Assessment (CIIA). The current and future development projects in context of cumulative and induced impacts are as follows:

- Feasibility study for the rehabilitation of the Muhuri-Kahua Flood Control, Drainage, and Irrigation Project under Feni District
- Feasibility study (1st Revised) for introduction of electric traction (including overhead catenary and sub-station construction) on the Narayanganj–Dhaka–Chattogram route of Bangladesh Railway
- Multipurpose Cyclone Shelter Construction Project in Coastal and Cyclone-Prone Areas (Phase 3)
- Integrated Project for Increasing Crop Production and Intensity through Management of Water and Soil Salinity in Coastal Areas (SRDI Component)
- 4-Lane Development of Regional Highways: Cumilla–Lalmai–Chandpur–Lakshmipur–Begumganj (R-140) (from Lakshmipur Inter-District Bus Terminal to Begumganj Intersection) and Begumganj–Sonaiaimuri–Ramganj (R-142) (from Sonaiaimuri to Ramganj)
- Upgradation of Cumilla–Salda–Kasba (Sayedabad) Road (N-114) to National Highway Standard
- Feasibility Study and Detailed Design for Construction of a Parallel Dual Gauge Railway Line along the Proposed Dual Gauge Section of Akhaura–Sylhet
- Dhaka–Chattogram Highway Development Project
- Master Plan Formulation Project for 5 Upazilas of Brahmanbaria District (Brahmanbaria Sadar, Bijoy Nagar, Nabinagar, Sarail, and Nasirnagar)

Table 6-5: Cumulative and induced impacts

VESC	Background and Trend	Cumulative Impact
Fish habitats, fish migration	The rivers and khals in the project area exhibit a high degree of aquatic biodiversity, encompassing both freshwater and brackish water ecosystems. In addition to cultured fishes, a wide range of wild capture species is also present. Seasonal monsoon floods and pond overflows facilitate the migration of cultured species into nearby canals and floodplain wetlands, which serve as important habitats for resident and migratory fish species.	Construction, excavation works are likely increase turbidity of water. Moreover, the construction of new water control structures as well as roads/railways and other development works, without proper drainage and fish migration facilities will hamper fish migration and fisheries habitats.
Flood protection and drainage facilities	The embankment often gets breached due to floods, surges surge and tidal effects; it inundates the study area. In August 2024, a flood devastated the study area which was caused by upstream rainfall event and delayed drainage.	The proposed project and other projects related to drainage improvement and flood protection are likely to improve the risk and vulnerability to future floods when implemented. However, the flood conditions will not improve in future if proper drainage is not provisioned in the transport and infrastructure development projects. Rehabilitation and construction of shelters will also increase flood and surge protection.
Crop production	The embankment often gets breached due to floods, surges surge and tidal effects; it inundates the study area and damages crops. Crop production is impacted by embankment erosion and flood hazards.	After construction/rehabilitation of embankment in conjunction with river bank protection works per proper design to withstand the flood and storm surge effect; crops will be protected from flooding distress. Therefore, the the risk and vulnerability of crops due to floods are likely to improve in the future. Improvement of transport infrastructure will facilitate market access to the produced crops.
Lives and livelihood of people	The embankment often gets breached due to floods, surges surge and tidal effects; it inundates the study area, damages crops and other properties and causes severe distress to the inhabitants of the area. Lives and livelihoods of the people in the area are impacted by embankment erosion and flood hazards.	Agricultural and commercial activities may increase in the area consequent to land stability after erosion and flood protection, which may create new opportunities for income generation and livelihood improvement. Moreover, communication infrastructure and other development works in the area are likely to improve lives and livelihoods of the community

VESC	Background and Trend	Cumulative Impact
		increasing more business opportunities.
Air and Noise Quality	The air and noise quality in the rural area is often calm, quiet and pollution-free. However, air and noise pollution are often observed in the growth centers and crowded places and also at construction sites.	The air and noise pollution are more likely in future due to various development works. Moreover, better transport facilities are likely to attract more vehicles and business to the area which in turn will induce air and noise pollution
Communication facility	The project area has national and regional highways as well as local and rural roads. The towns and growth centers have good transport facilities though the remote places have moderate transport infrastructure.	The embankment–cum road might be paved resulting improved network in the study area. Improvement of railway and road network in the area will further improve the condition.
Labour Influx	The project area, encompassing embankment, slope protection, and canal re-excavation works, is predominantly rural with a mix of semi-urban growth centers where local labor availability is moderate. Large-scale civil works in such areas typically attract external laborers from other districts, especially for specialized construction activities. Historically, similar infrastructure and flood protection projects in the region have experienced moderate labor influx during peak construction seasons. The arrival of outside workers can temporarily increase demand for accommodation, water, sanitation, food, and healthcare facilities within local communities. Social interactions between workers and host populations may also give rise to tension, cultural misunderstandings, or risks of gender-based violence and SEA/SH incidents if unmanaged. Furthermore, influx-related issues such as waste generation, pressure on local resources, and the spread of communicable diseases are recurring concerns in comparable projects across coastal and floodplain regions of Bangladesh.	With multiple infrastructure and flood protection initiatives being implemented concurrently in the region, the combined effect of labor influx from various projects may amplify social and environmental pressures. The cumulative impacts could include heightened demand for housing and public services, degradation of sanitation and hygiene conditions, and increased risk of conflict or exploitation, particularly affecting vulnerable groups such as women and children. However, effective enforcement of Labor Management Procedures (LMP), worker code of conduct, and community awareness measures can substantially reduce these risks. In the long term, the influx may also yield positive outcomes—such as temporary income generation for local vendors, increased demand for goods and services, and skill transfer—if properly coordinated and managed across all ongoing projects.

VESC	Background and Trend	Cumulative Impact
Resettlement	Settlements and small businesses are commonly established along embankments, canal banks, and low-lying areas within the project footprint. Many of these are informal or non-titled households that rely on nearby agricultural land, fishing, or trading for their livelihoods. In past embankment and river protection projects, displacement of such communities was observed during site clearance and construction activities, often leading to temporary loss of shelter, income, and access to basic services. Although government and donor-supported projects follow resettlement planning and compensation procedures, implementation delays and gaps in addressing the needs of non-titled or vulnerable persons have been persistent challenges. As a result, resettlement remains a socially sensitive issue that requires extensive stakeholder consultation, transparent compensation, and livelihood restoration planning.	Cumulatively, resettlement pressures may increase in the region due to multiple, overlapping development projects—such as embankment rehabilitation, drainage improvement, and transport infrastructure expansion—targeting similar areas. Repeated displacement of the same vulnerable households could lead to social fatigue, impoverishment risks, and erosion of community cohesion if not properly synchronized. Conversely, coordinated resettlement planning across projects can create opportunities for improved housing, enhanced land tenure security, and better access to services in planned relocation sites. In the long term, successful resettlement implementation will contribute to social stability, livelihood enhancement, and community resilience against future flood and erosion hazards.

6.7 Project Impact Assessment Against WB ESS

Table 6-6: Cumulative and induced impacts

WB ESS	Impacts	Relevance to the Project
ESS1: Assessment and Management of Environmental and Social Risks and Impacts	• Drainage congestion and waterlogging during construction • Temporary surface and groundwater pollution • Construction-related dust, air, and noise pollution • Water quality degradation from sediment disturbance during excavation • Temporary disruption of water flow, navigation, and community access • Increased turbidity impacting aquatic life • Community health and safety risks near construction sites, especially schools • GHG emissions from equipment and machinery • Waste generation from construction • Exclusion of vulnerable and disadvantaged groups from consultation and benefits • Traffic disruption during rehabilitation works • Worker OHS and accident risks • Interruption of local access, especially for emergency service	E&S risks and impacts are identified based on consultations with stakeholders, including communities, civil society, local government, NGOs, and implementing agencies. Appropriate mitigation measures are suggested for avoiding or mitigating the environmental and social impacts. Moreover, the environmental and social parameters will be monitored during the project implementation. Detailed ESIA is prepared.
ESS2: Labor and	• Risk of child labor and forced labor	This is a large project, and that's why the project will

WB ESS	Impacts	Relevance to the Project
Working Conditions	• Gender-based violence (GBV) issues • Occupational health and safety (OHS) risks • Labor influx (expected to be minimal) • Inadequate working conditions • Discrimination against vulnerable workers	need many labourers in construction and repair works of the embankments, slope protection, canal re-excavation, works. During the works, accidents, health issues, gender-based violence, conflict among workers etc. may occur. The project needs to be careful and a LMP and a SEA/SH Plan will be prepared to tackle these issues effectively. Preparation of Occupational Health and Safety Plans (OHSP) following World Bank Group EHS Guidelines
ESS3: Resource Efficiency and Pollution Prevention and Management	• Air emissions from vehicles and machinery • Fugitive dust during construction • Water pollution from construction waste and agricultural runoff • GHG emissions from transportation and operations • Solid waste generation • Chemical contamination from pesticides and fertilizers • Fumigation and pest control chemical exposure in storage facilities • Spills/leaks, soil contamination	<i>Resource Efficiency:</i> The project and the ESIA process will identify feasible measures for efficient (a) energy use; (b) minimization and management water usage and maintain balance for the demand of water resources; (c) raw materials use by exploring local materials, recycled aggregates, and innovative technology. <i>Pollution Management:</i> The project will develop prevention and mitigation measures to offset risks and impacts of pollution from potential sources such as dust and emission during project activities, effluents and wastewater from labour/construction camps; spillage or leakage during handling of chemical admixtures, hazardous materials during the project construction/implementation period.

WB ESS	Impacts	Relevance to the Project
ESS4: Community Health and Safety	- Community health and safety risks from construction - Fire safety risks, particularly in disaster shelters - Increased traffic and accident risks - Disease transmission risks - Chemical exposure from agricultural inputs - Safety risks during emergency training and operation - Waste and wastewater management hazard - Public nuisance from dust, noise, vibration	The project will implement measures to protect public health and safety. The project will construct water supply and sanitation facilities in the project areas to mitigate health and safety risks. Gender and SEA/SH Action Plan development and implementation. Traffic management measures with adequate warning signs during construction. Emergency response mechanisms for accidents with immediate Bank/PIU reporting. Maintain World Bank EHS Guidelines compliance in all ESIA's and ESMPs
ESS5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement	- Risk of affecting private lands - Physical displacement of communities - Temporary displacement during construction - Impacts on existing land use and access - Construction impacts on informal land users - Disruption of local economic/livelihood activities	The project does not have provision for land acquisition. There may be some squatters/non-titled affected people.. The project will adhere to prevailing requirements for compensation to resolve any social issues and Impacts. Further details will be addressed in the RPF and RAP
ESS6: Biodiversity Conservation and Sustainable management of Living Natural Resources	- Modification of natural habitats - Impacts on wildlife habitats and ecologically sensitive areas - Aquatic ecosystem disturbance from canal works - Biodiversity loss from agricultural intensification	The coastal zone of Bangladesh has various natural resources, including coastal fisheries, shrimp, forests, salt and minerals. Moreover, there are several ecosystems such as estuaries and brackish ecosystems etc. with important conservation values. Proper mitigation measures will be adopted in order to avoid or minimizing adverse impacts on these ecosystems. If

WB ESS	Impacts	Relevance to the Project
	• Introduction of invasive species through agricultural inputs • Fish migration disruption • Impacts on pollinator species from pesticide use	triggered in any intervention site during project implementation, the project will prepare a site-specific plantation plan, Biodiversity Management, and Conservation Plan. Environmental screening with priority exclusion of sensitive biodiversity areas. Timing restrictions during fish breeding seasons for canal works. Fish rescue and relocation protocols and wet land restoration during excavation
ESS7: Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities	• The project is unlikely to adversely impact Small Ethnic Communities (SECs) • Potential exclusion of SECs from project benefits • Cultural appropriateness of interventions for ethnic minorities • Loss of traditional land uses/resources	BWDB project interventions are unlikely to impact ethnic community. The project assesses the nature and degree of the expected direct and indirect economic, social, cultural (including cultural heritage), impacts on Ethnic Communities present in, or have a collective attachment to, the project area. The project will prepare a consultation strategy and identify how Ethnic Peoples will participate in project design and implementation. Adopt and implement a Small Ethnic Communities Planning Framework (SECPF). Full access to project-level Grievance Redress Mechanism for SECs.
ESS8: Cultural Heritage	• Not relevant	Not relevant.
ESS9: Financial Intermediaries (Fis)	Not relevant	Not relevant.
ESS10: Stakeholder	• The project will engage in meaningful	Preparation and implementation of a Stakeholder

WB ESS	Impacts	Relevance to the Project
Engagement and Information Disclosure	consultations with all stakeholders and ensure their spontaneous participation in project implementation. • The project will disclose timely, relevant, and accessible information about the project activities that may have significant impacts	Engagement Plan (SEP) ensuring meaningful consultation with the stakeholders and inclusion of their views in project design; ensuring appropriate and timely disclosure of the project information on environmental and social risks and impacts and redressing the issues and grievances of the stakeholders. PIU will operate its own GRM with GRCs formed as and where grievances originate.

CHAPTER-7: MITIGATION MEASURES AND IMPACT MANAGEMENT

This chapter aims to provide the environmental management plan (EMP) for the Project to mitigate potential negative environmental and social impacts, which may occur as a result of Project activities. This chapter also specifies the Contractor's environmental obligations in performing the works to be carried out under the project. The methodology followed for preparing the EMP consists of the following steps:

- Deriving mitigation/protection measures for identified impacts for each of the project activity and environmental component;
- Recommend mitigation, compensation and enhancement measures for each identified impacts and risks;
- Developing a mechanism (institutional arrangement) for monitoring the proposed mitigation measures;
- Estimating budget requirements for implementation mitigation and monitoring measures;
- Identifying responsibilities of various agencies involved in the Project for implementation, and
- Monitoring of mitigation measures.

7.1 Environmental and Social Mitigation Hierarchy

One of the key outputs of the ESIA process is the development of a strategy to manage risks and mitigate impacts. Mitigation measures are identified through consultations with affected groups and are guided by the mitigation hierarchy. This hierarchy prioritises the avoidance of negative social or environmental impacts wherever feasible. When avoidance is not possible without compromising the project's conservation objectives, efforts must be made to minimise the impacts to acceptable levels. Any remaining residual impacts will then need to be addressed through fair and appropriate compensation measures.

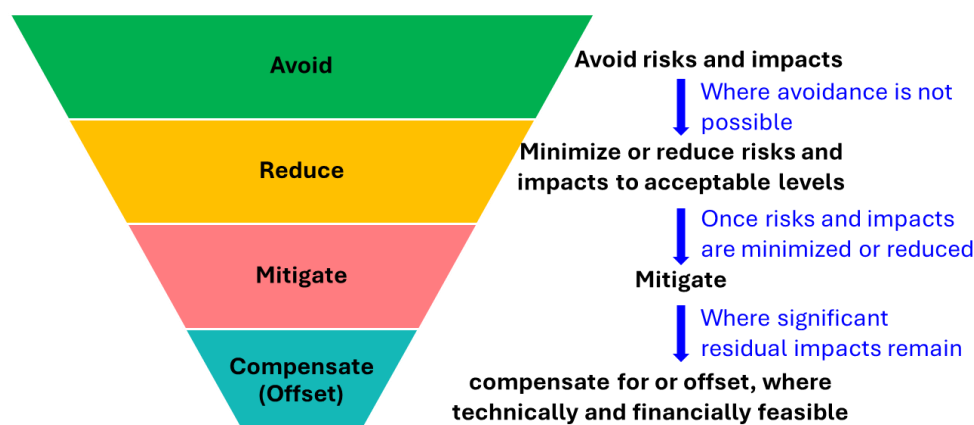


Figure 7.1: Impact mitigation hierarchy

The risks and impacts of the project activities were avoided as much as possible in planning and design of the interventions during the feasibility study for the proposed project. For example, some bank protection and re-excavation of khals were avoided due to ES issues. The environmental and social mitigation hierarchy includes mitigation and enhancement measures to be taken during pre-construction, construction and post-construction phases **Table 8-**. The table also presents the likely residual impacts after implementation of the proposed mitigation and enhancement measures.

Table 7-1: Mitigation and enhancement measures

VESC	Impact	Proposed Mitigation & Enhancement Measures
Pre-Construction Phase		
Site Clearance & Restoration	There may be some loss of land cover/trees/habitats	Loss will be replenished after construction (repair) activities
	There is no scope for land acquisition or dislocation of physical assets	(Avoidance) Planning and design team of project interventions tried their best not to create any resettlement or ES issues
	Clearing the sites and dismantling the damaged infrastructure is likely to generate some debris, spoils, scraps etc. and create hindrance and encumbrance for the local communities	The debris/ spoils/ scrapes etc. shall be disposed of timely and properly without creating hindrance and encumbrance for the local communities
Loss of livelihood	Temporary unemployment of people (who temporarily use the embankment/other structure for selling something/other livelihoods) due to rehabilitation of infrastructure	Preferably employment with the contractor for the affected unskilled workers
Fish habitat, quality and fish production	Clearing the sites and dismantling the damaged infrastructure may generate some debris, spoils, scraps etc. and create hindrance and encumbrance for the local communities.	The driver/crew of construction machinery shall be aware to fisheries, and the excavator and related equipment shall be driven properly and avoid accidents. So that oil or lubricant does not spill into the river water.
Resettlement	Temporary or permanent	Conduct detailed socio-economic census and asset

VESC	Impact	Proposed Mitigation & Enhancement Measures
(Presence of squatters, non-titled affected people)	displacement, loss of shelter or livelihood sources for non-titled occupants, grievances over compensation	verification of all affected persons, including non-titled occupants, prior to site clearance. • Prepare and implement a site-specific Resettlement Action Plan (RAP) in accordance with World Bank ESS5 and national resettlement policy. • Ensure compensation at replacement cost for lost assets, transitional allowances, and livelihood restoration support for both titled and non-titled affected persons. • Provide relocation assistance (transport, shifting grants, temporary housing if needed) before displacement. • Establish a Grievance Redress Mechanism (GRM) to receive and resolve complaints in a timely and transparent manner. • Conduct continuous stakeholder consultations and information disclosure to maintain trust and participation. • Prioritize affected households for employment opportunities during project construction.
Construction Phase		
Noise level	May hamper lives of people, especially in residential areas and educational institutions. It may also disturb fauna, including endangered species.	Reduce equipment noise at source by isolation of exhaust systems. Limit the noisy work to daylight hours, where possible. Inspect and maintain equipment in good working conditions. levels of engines or other noise producing sources will be ramped up, so that the noise will slowly increases.
Air Quality	The air quality may deteriorate due to construction activities, i.e., exhaust emissions from construction machinery, dust generated by the movement of vehicles, dredger, excavator, production of CC block at the construction yards, sand filling of geo-bags, disposal of excavated materials etc.	• Water shall be sprayed at the construction yard and connected road twice a day in order to suppress fugitive dust; • Loading of the construction materials for concrete mixing shall be done carefully to avoid the emission of dust to the extent possible; • Construction materials shall be kept covered to avoid dispersion in air; • Construction equipment, namely batching plant/mixer machine, washing plant and grader, etc. shall be properly maintained; vehicles and equipment shall have proper fitness; • Vehicles, construction equipment, dredger and excavator shall use clean air technology. • Avoid earthen roads for carrying the construction materials to the extent possible; • Switch off / throttle down all site vehicles,

VESC	Impact	Proposed Mitigation & Enhancement Measures
		construction equipment, and excavator, generators, and machinery when not in use; • Vehicle speed restriction must be enforced to control dust generation; • Plant different kinds of trees (Timber, Fruit bearing, medicinal) in the project area.
Surface Water Quality	Degradation of surface water quality	• A land fill/ dumping place shall be selected by BWDB and contractor in consultation with the Local Government Institute and Local Administration, before starting of the project activities, if there is no existing land. • The construction wastes shall be segregated into biodegradable & non-biodegradable waste, in separate bins. • The contractor shall arrange to transport the bins to the designated land fill site • Biodegradable waste or organic waste shall be disposed of at the land fill site or gathered for composting • The non-biodegradable waste shall be segregated into recyclable and rejected waste. • Recyclable waste like small pieces of rod, steel wire, rubber, plastic bottles, plastic bags, etc. to be collected and shall be sent to licensed traders for recycling • Rejected waste shall be dumped in landfill sites. • Dredger/excavator shall be properly maintained to minimize release of oil and grease, mobiles, and diesel into water bodies.
Soil Erosion	Soil Erosion might occur from the base and surface of embankment regulator approach and backfilled area.	• The construction of embankment shall be completed immediately in the segment where vegetation will be cleared. • The embankment surface, and regulator approach and backfilled area shall be covered with turf immediately after completion of construction.
Changes in Land Quality and environmental pollution	Haphazardly throwing of construction wastes (waste concrete, washed off aggregates, empty cement bags, litters etc.), WC wastes from labor shed, litters etc. will pollute surrounding environment and change land quality.	• The onsite wastes shall be properly contained and prevented from escaping into surrounding lands; • The process of disposing of the wastes mentioned under IEC-surface water quality shall be followed.

VESC	Impact	Proposed Mitigation & Enhancement Measures
Crop Production Loss	Crop production loss may occur, if CC blocks are constructed and stockpiled on the agriculture land.	- The farmers shall be informed well ahead (before the start of cropping season) about the excavation and other activities so that they may not take any initiative in the cultivation of any crops in the study area & vulnerable locations. - The bank revetment work shall be done as per the design level. - The contractor shall prepare site-specific excavated materials management and disposal plans for each site to be followed upon approval by the PIU of BWDB and the Consultant. - The contractor shall ensure that no vehicular and equipment movements take place through agricultural fields. - The contractor shall maintain liaison with the communities. Compensation: Compensation shall be made for any standing crop damage. The compensation amount will be calculated after consultation with the local Department of Agriculture Extension (DAE) officials.
Fish habitat, quality and fish production	Decline the water and fish habitat quality due to release oil and grease from the dredger. Furthermore, increased turbidity and decline of DO and PH temporarily both in the river and the internal khals. That increases the fish mortality and decreases fish production.	Bamboo barrier shall be installed to retain suspended sediment within excavation perimeter. This will reduce the occurrence of turbidity.
Fish movement and migration	Fish migration may be disturbed during excavation and bank protection works.	Avoid the month of May – July for excavation to consider the fish spawning period. If not, then excavation shall be carefully during the spawning period of fish through using barrier.
Terrestrial biodiversity	Impact on terrestrial flora and fauna due to damage of vegetation at the CC block production and stockyard, and embankment construction area.	- Use barren land, if possible, for production and stockpiling of CC blocks, - Carryout tree plantation with native species at the vegetation damaged sites after completion of construction works and other suitable areas. - The embankment shall be covered with grass

VESC	Impact	Proposed Mitigation & Enhancement Measures
		turf immediately after construction. Awareness shall be raised among the local people about wildlife and habitat conservation, so that the relocated wildlife may escape easily and take secured shelter in nearer habitat.
Spoil Management	Improper spoil (dredged material) management during khal re-excavation can cause water pollution from increased turbidity and sediment runoff, soil degradation and drainage blockage from unsuitable disposal, and dust and noise pollution affecting nearby communities. It may damage aquatic habitats, vegetation, and agricultural land, while also posing health and safety risks to workers and residents due to dust, accidents, and mosquito breeding. Spoil transport can disrupt local access, damage roads, and affect livelihoods, and unrehabilitated spoil heaps can lead to visual and environmental degradation.	- Some soil samples of canal bed has been tested and it has been found to be not contaminated with pollutants - If dredging material is suitable for embankment protection works, then it can be used which is subjective to testing. If suitable to use for embankment, then borrow pit will not be necessary - If not suitable to use for embankment purpose, then can be utilized in nearby filling purposes - Rehabilitate spoil disposal sites after completion through leveling, turfing, or tree plantation - Select designated and environmentally approved spoil disposal sites, avoiding agricultural land, wetlands, and residential areas. - Prepare Dredging material management plan if necessary
Navigation	No potential navigability impacts as the project interventions will be carried out in existing structure (regulator repair, embankment protection,	- Conduct all works within the defined alignment and footprint of existing structures to avoid obstruction of navigation routes. - Schedule construction activities during low navigation periods, where applicable, to minimize disturbance. - Prohibit disposal of construction materials, debris, or waste into the khal or river.

VESC	Impact	Proposed Mitigation & Enhancement Measures
	slope protection)	Regularly remove any temporary blockages
Employment opportunity, livelihood improvement and Poverty reduction	People who live in the Employment opportunities will be created for different construction related activities.	- Local labor shall be given priority in recruitment for the construction activity. - Project authorities shall consider this issue and include a clause in the contract document for local labor recruitment based on their potential and availability for employment in the different project activities.
Occupational Health and Safety	The labours might be injured during various construction activities, some of these injuries may turn into the casualty, if not timely and properly treated.	- Labors shall be trained before engaging in the construction activity; - PPEs shall be provided to the labors with proper training for using them during the working period; - First Aid medical facilities shall be ensured on the construction site; - Contact number of emergency ambulance services shall be hanged at the construction site.
Ethnic Communities	Some minor works may affect ethnic people	If ethnic community are within project area and/or affected then an Indigenous People Plan may need to be prepared. Provision or Requirements for this may be indicated.
Labour Influx	Increased pressure on local services (water, sanitation, health), social tension, risk of SEA/SH incidents, spread of communicable diseases	- Prepare and implement a Labor Influx Management Plan and Labor Management Procedures (LMP). - Ensure that all contractors' workers sign a Code of Conduct addressing SEA/SH, child labor, and respectful community relations. - Establish properly managed workers' camps with adequate water, sanitation, waste disposal, and medical facilities. - Conduct community awareness programs on communicable diseases, SEA/SH prevention, and safety measures. - Promote local hiring to minimize external influx and maximize local benefits
Impact on Education and Livelihood	Restricted access to schools, markets, or workplaces due to road blockages or machinery movement	- Avoid or minimize disturbance to schools, markets, and workplaces during construction by careful scheduling and site planning. - Provide alternative access routes and temporary walkways for students and workers where required. - Compensate affected vendors, farmers, and wage earners for temporary loss of income in accordance with the RAP. - Support livelihood restoration through training, micro-enterprise development, and

VESC	Impact	Proposed Mitigation & Enhancement Measures
		employment in project activities. Conduct awareness sessions among construction workers to avoid unsafe interactions near schools and public places.
Communication Disruption / Road Closures	Temporary closure or restricted access to roads and footpaths near embankments or canals	- Schedule construction activities to minimize access disruption, especially during school and market hours. - Place visible signboards, traffic diversions, and safety barriers in coordination with local authorities. - Inform communities in advance about road closures, construction timing, and alternative routes. - Ensure that emergency access for ambulances, police, and fire services is maintained at all times. - Rehabilitate damaged roads, pathways, and access points immediately after construction completion.
Impacts from Construction Works (Noise, Pollution, Traffic, Accidents)	Noise and dust pollution, vibration, traffic congestion, risk of accidents for workers and community	- Use well-maintained machinery and install silencers to reduce noise. - Water sprinkling and dust suppression should be practiced regularly along access roads and construction sites. - Transport construction materials during off-peak hours to reduce traffic congestion. - Provide proper signage, lighting, and speed control near work zones to prevent accidents. - Conduct regular health and safety training for workers and awareness programs for nearby communities. - Monitor air, noise, and vibration levels and take corrective action if limits are exceeded.
Occupational Health and Safety	Construction activities for embankment and slope protection, re-sectioning, bank stabilization, and canal excavation pose occupational health and safety risks. Workers may be exposed to injuries from machinery and equipment, falls from embankments or excavations, collapses of temporary structures, dust, noise, vibration, heat stress,	- Contractor shall implement a Project-specific Occupational Health and Safety (OHS) Management Plan in line with World Bank EHS Guidelines and national labor regulations. - Key measures include mandatory use of personal protective equipment (PPE), safe operation of machinery, demarcation of hazardous areas with barriers and signage, dust and noise control, provision of hygienic worker camps, health awareness and disease prevention training, traffic and community safety management, emergency preparedness plans, first aid facilities, and periodic safety

VESC	Impact	Proposed Mitigation & Enhancement Measures
	waterborne contaminants, and vector-borne diseases. Local communities are also at risk from traffic accidents, uncontrolled access to worksites, and exposure to construction hazards. Emergency and fire hazards at machinery storage and fuel handling sites further increase vulnerability if proper safety measures are not enforced.	inspections and drills. The PIU shall ensure compliance through contractual obligations, routine monitoring, reporting, and corrective actions.
Post-Construction/Operation & Maintenance Phase		
Noise Level	Noise from maintenance dredging/excavation, O&M of river bank protection works, regulators etc.	Mitigation measures similar to construction phase shall be taken.
Air quality	The air quality will deteriorate through some post-construction activities as mentioned above.	Mitigation measures similar to construction phase shall be taken.
Surface water quality	Degradation of water quality	Mitigation measures similar to the construction phase
River bank stability	Riverbank will be stable at Gumati, Muhuri, Kahua, Little Feni, Feni, Haora River and WAPDA khal, Rahmatkhali khal, Matubhuiyan khal and Ruhita khal	- Bank protection works shall be closely monitored and emergency protection work shall be carried out. if failure of bank protection is observed. - O&M for protection works shall be done properly to combat the failure of the bank. - There shall be stockpile of geo-bag and CC block for tackling emergency situation. - Adequate budget shall be provided for operation and maintenance of river bank protection work.
Surface water availability	Surface water availability will increase after implementation of proposed interventions.	- Maintenance shall be done as and when required. - Maintenance re-excavation of khals shall be carried out as and when required. - Operation of water control structures shall be properly done.

VESC	Impact	Proposed Mitigation & Enhancement Measures
Drainage Improvement	Drainage conditions will improve.	- Siltation of khals shall be monitored and maintenance excavation shall be done when needed. - Drainage structures shall be properly operated to ensure smooth drainage. - Regular inspections, particularly following rainfall shall be conducted to ascertain the operation of outlet structures and also ensure smooth flow of runoff through the drainage system. - Adequate budget shall be provided for operation and maintenance of drainage system.
Flood protection	Embankment will protect crops and infrastructures from floods and storm surge.	- Embankment shall be properly monitored and maintained to avoid sudden breach. - Adequate budget shall be provided for operation and maintenance of embankment.
Changes in Land Use and Drainage Patterns	Land use and drainage patterns may be changed/improved	Materials accumulated from excavation works shall not be dumped on agricultural lands. Such materials shall be spread over the agricultural lands and leveled over properly. Enhancement: Intensive farming practices shall be continued on the residual agricultural lands of the study areas until further development by providing essential inputs to the farmers.
Increase Crop Production	Crop production may be increased.	- Crop land will be saved from river bank erosion. Farmers of the study area and vulnerable locations is likely to be encouraged to apply more irrigation, as they can grow HYV/ Hybrid crop. In this case, the farmers need good support from the Govt. for timely supply of inputs e.g fertilizers, pesticides, seeds, credits, etc. - Capacity building and awareness-raising of the farmers shall be carried out regarding the use of Integrated Crop Management (ICM) and Good Agricultural Practices (GAP) to minimize the usage of chemical inputs. - The farmers shall be encouraged to use organic and green manure to increase soil fertility as well as avoid water contamination of water sources. - The farmers shall be encouraged to cultivate leguminous crops (N₂ fixing) to enhance the soil quality as well as soil productivity.
Fish Habitat,	Habitat quality may	Protect the newly excavated area about 500

VESC	Impact	Proposed Mitigation & Enhancement Measures
quality and fish production	improve, and incremental fish production is expected after one monsoon of completion.	m of two khals for sheltering place, and keep this area as non-fishing zone. Use some device, red flag and signboard round the year for awareness raising to the local community. Incremental species diversity and fish production is expected. • Management committee shall be formed by (9-11) members by the adjacent village peoples based on selected area including the related Union Chairman / members. Activities shall be monitored by management committee. • Protected area shall selected by the local community and finalized through discussion with the Upazila DoF official. • The related DoF officials through observation of the Fish week, World water day, World Environment Day. Provide training to the management committee by the DoF Officials and awareness raising to the local community by the management committee.
Fish migration and movement	Fish migration and movement may be smooth in the River round the year.	Awareness activities shall be conducted for the local community of the area to make aware them for protection of wetland and the importance of fish and water bodies in our daily life.
Terrestrial biodiversity	Terrestrial flora and fauna may be enriched due to protection of lands from erosion and flooding.	• A smart plantation plan shall be prepared which shall include the species composition, location of plantation area, number of saplings to be planted. Indigenous plant species shall be given priority in the plan. Native and ornamental plant species shall receive preference for plantation, which will enhance vegetation coverage. • Ensure regular maintenance of green areas and implement plantation in each season of each year to enhance the green cover and complement the vegetation loss. • Avoid single species selection or clone monoculture as plantation
Employment opportunity, livelihood improvement and poverty reduction	Agricultural and commercial activities will increase in the study area consequent to land stability after erosion and flood protection, which will create new opportunities for income	Enhancement: • Motivate and train the local people to develop skills to avail the possible scope of employment in industries to be established in the study area. • There shall be a provision in industries/ commercial organizations for ensuring

VESC	Impact	Proposed Mitigation & Enhancement Measures
	generation and livelihood improvement.	employment opportunities for local people as per their skill. - Local destitute people shall be given priority in recruitment of unskilled laboring activities in the newly developed commercial and industrial activities. - Farmers and labors shall be trained to works in modernized agricultural activities.
Restoration of Livelihood and Access	Delay in restoring temporary livelihood sites; need for reinstatement of community facilities	- Provide transitional allowances, cash compensation, or income support for temporarily affected households and businesses during construction. - Facilitate employment opportunities for affected persons within project construction and maintenance activities based on skill levels and interest. - Support skill development and vocational training programs (e.g., small enterprise development, tailoring, fishing equipment maintenance, agro-processing) to promote sustainable income generation.

7.2 Residual Impacts After Mitigation

Residual impacts refer to the environmental and social effects that remain even after the implementation of all feasible mitigation measures. For example, the benthic environment will be damaged by the khal excavation works proposed in the project. Some of the benthos will recur after a certain time (within 6 months or less) but complete recurrence of the benthos is not possible if there is maintenance dredging requirement.

These impacts may include long-term or cumulative changes to ecosystems, biodiversity, land use, livelihoods, or social dynamics that cannot be fully avoided or reversed. While often reduced in magnitude through mitigation, residual impacts can still pose significant risks to vulnerable communities and natural resources if not carefully monitored. Therefore, they require ongoing assessment, stakeholder engagement, and adaptive management strategies to ensure that any negative consequences are identified early and addressed effectively over the project lifecycle.

Accidental events can occur due to extreme climatic event, causing damage to the biophysical environment, as well as to effects on human health and safety. The severity of effects from accidental events is dependent upon the magnitude of the event, location of the event, and the time of year. For the prediction of residual adverse environmental effects, it is acknowledged that, while the likelihood is low, the result can be significant.

Mitigation measures for each area of environmental and social impact are discussed in full in the **Chapter 8** of the report. The predicted residual effects are considered for each Project phase. There is residual impact on several indicator criteria representing each VESC and the identified avoidance or mitigation measures, which could eliminate or reduce the predicted effect to minimal level as in **Table 8-1**.

7.3 Climate Change Considerations and Adaptation Measures

The climate change in Bangladesh creates more frequent and intense hazards such as floods, cyclonic storm surges, late drainage due to sea level rise, droughts etc. According to the Climate Change Scenarios: Meteorology Report of the project titled “*Long Term Monitoring, Research and Analysis of Bangladesh Coastal Zone (Sustainable Polders Adapted to Coastal Dynamics)*” the meteorological hazards will aggravate with climate change in the coastal areas of Bangladesh including Brahmanbaria, Cumilla, Noakhali, Lakshmipur and Feni districts (DHI et al 2021). According to the report, Bangladesh is likely to experience increased monsoon and annual precipitation, while winters are expected to become drier in future conditions with climate change. The report also predicts that mean sea level rise values by 2100 for Bangladesh is likely to be equal to 0.473 m (95% = 0.661m) in a moderate climate change scenario (RCP4.5), and 0.756 m (95% = 1.049m) in a extreme climate change scenario (RCP8.5). The frequency and intensity of cyclones in the North Indian Ocean and Bay of Bengal have increased since 1972 and is likely to increase more in future (DHI et al 2021).

The proposed project will repair and reconstruct damaged embankments, riverbank protection works and water control structures as well as re-excavate drainage khals. These measures will assist in flood and erosion protection as well as climate-proofing of the infrastructures in the area. The project interventions are aimed at enabling the study area in adapting floods and future climate hazards. However, majority of the works under the project are rehabilitation of existing infrastructures, leaving little room to include additional adaptive features. New or replacement designs will include potentially possible improvement(s).

7.4 Resource Efficiency and Pollution Prevention

Resource efficiency and pollution protection are essential in the project to promote sustainable and environmentally responsible development works. Efficient use of materials—such as optimizing earthworks, using durable, low-impact construction inputs, and incorporating locally sourced resources—helps reduce waste and project costs while minimizing ecological disruption. Pollution protection measures focus on preventing contaminants, including oil, chemicals, and construction debris, from entering water bodies during all project phases. These practices not only protect river ecosystems and water quality but also enhance the long-term resilience and effectiveness of the proposed flood and erosion control infrastructures. Detail measures for resource efficiency and pollution control are presented in the Environmental Management Plan (EMP) presented in the following chapter.

CHAPTER-8: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

This chapter outlines the Environmental and Social Management Plan (ESMP) developed for the Project, aimed at mitigating potential environmental and social impacts arising from project activities. It also presents the roles and responsibilities of different parties in executing the project works; the implementation schedule; capacity building needs; and budget estimates for implementing the EMP.

8.1 Mitigation and Monitoring Measures

A detailed summary of the mitigation measures is provided in Table 9.1, which the contractor needs to follow. Complying the measures presented in this table, the contractor is required to prepare excavation and construction plans and obtain approval from the Project Director (PD) of BWDB to ensure that no critical habitats are impacted. Construction and excavation methods should be chosen to minimize harm to aquatic, benthic, and terrestrial habitats, reduce air and noise pollution, and enhance operational precision. Regular inspection and monitoring will be carried out to assess the effectiveness of impact mitigation measures and re-adjusted where necessary.

The project's Environmental Management and Mitigation Plan requires a multidisciplinary approach, involving coordinated efforts from multiple agencies. Several institutions are likely to participate in the project's implementation. The contractor is responsible for carrying out the ESMP during construction, while the Design and Supervision Consultant (D&S Consultant) is mainly tasked with overseeing and monitoring its implementation.

Table 8-1: Environmental Mitigation and enhancement measures

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
Pre-Construction Phase: Bank and slope protection works and embankment repair/re-sectioning					
Engagement of Environmental and other technical staff	Without adequate technical staff, it would be difficult to implement EMP as prescribed.	Contractors and BWDB shall hire all technical staff as described in institutional arrangement Section for effective implementation of the EMP. Contractor's staff: Occupational Health and Safety Specialists, and Community Liaison Officers, BWDB staff: Environment Specialist, DSC, Resettlement specialist, GRM officer	–	Included in Contractor's Budget	Contractors supervised by PIU/ BWDB
Inclusion of environmental Clauses in Construction Contracts	Compliance by the Contractor to requirements defined in the ESIA, EMP and BMP.	Specific environmental and biodiversity conservation clauses are added to contract specifications and a separate environmental bill-of-quantities section is to be prepared.	–	Included in Contractor's Budget	BWDB / PIU Contractors
Site Clearance & Restoration	There may be some loss of land cover/trees/habitats	Loss will be replenished after construction/repair activities	Negligible	Included in Contractor's Budget	Contractors supervised by PIU and Environmental and Specialist Social Specialist and Gender and GVB Specialist of PIU and E&S specialist of M&E firm
	There is no scope for land acquisition or dislocation of physical assets	(Avoidance) Planning and design team of project interventions tried their best not to create any resettlement or ES issues. However, if any ES issue arises the RPF shall be fully implemented prior to initiation of project activities.			
	Clearing the sites and dismantling the damaged infrastructure is likely to generate some debris, spoils, scraps etc. and create hindrance and encumbrance	The debris/ spoils/ scrapes etc. shall be disposed of timely and properly without creating hindrance and encumbrance for the local communities.			

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
	for the local communities				
Loss of livelihood	Temporary unemployment of people due to the rehabilitation of infrastructure	Preferably employment with the contractor for the affected unskilled workers	Negligible	-	The contractor, supervised by BWDB officials.
Fish habitat, quality and fish production	Clearing the sites and dismantling the damaged infrastructure may generate some debris, spoils, scraps etc. and create hindrance and encumbrance for the local communities.	The driver/crew of construction machinery shall be aware of the driver and crew, and the excavator and related equipment shall be driven properly and avoid accidents. So that oil or lubricant does not spill into the river water.	Negligible	Included in Contractor's Budget	The contractor, supervised by BWDB officials
Pre-Construction Phase: Regulator Repair					
Engagement of Environmental, social and other technical staff	Without adequate technical staff, it would be difficult to implement ESMP as prescribed.	Contractors and BWDB shall hire all technical staff as described in institutional arrangement Section for effective implementation of the EMP. Contractor's staff: Occupational Health and Safety Specialists, and Community Liaison Officers, BWDB staff: Environment Specialist, DSC, Resettlement specialist, GRM officer	-	Included in Contractor's Budget	Contractors PIU/ BWDB
Inclusion of environmental Clauses in Construction Contracts	Compliance by the Contractor to requirements defined in the ESIA, EMP and BMP.	Specific environmental and biodiversity conservation clauses will be added to contract specifications and a separate environmental bill-of-quantities section will be prepared.	-	Included in Contractor's Budget	BWDB / PIU
Site Clearance &	There may be some loss of	Loss will be replenished after construction/repair activities	Negligible	Included in	PIU and

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
Restoration	land cover/trees/habitats			Contractor’s Budget	Environmental and Specialist Social Specialist and Gender and GVB Specialist of PIU and E&S specialist of M&E firm
	Clearing the sites is likely to generate some debris, spoils, scraps etc. and create hindrance and encumbrance for the local communities	The debris/spoils/scrapes etc. shall be disposed of timely and properly without creating hindrance and encumbrance for the local communities.			
Pre-Excavation Phase: Re-excavation of khals					
Engagement of Environmental, Social and other technical staff	Without adequate technical staff, it would be difficult to implement ESMP as prescribed.	Contractors and BWDB shall hire all technical staff as described in institutional arrangement Section for effective implementation of the EMP. Contractor’s staff: Occupational Health and Safety Specialists, and Community Liaison Officers, BWDB staff: Environment Specialist, DSC, Resettlement specialist, GRM officer	—	Included in Contractor’s Budget	Contractors PIU/ BWDB
Preparation of guidelines for effective handling of excavated/dredged materials	Without proper guidelines for management of excavated/dredged materials, there will be social and environmental problems.	Prior to the mobilization of Contractors, BWDB will ensure that for selection of sites for temporary storage of excavated materials before subsequent beneficial use or permanent on land disposal, arrangement is made for such sites in consultation with local public representatives and concerned land owners.	—	Included in Contractor’s Budget	Contractors Supervised by BWDB/ PIU/ DSC
Site preparation for storing/ disposal of excavated materials	The excavated materials will be stored on banks and then will be disposed	The storing sites shall be compartmentalized with proper protections so that the materials cannot go back to the khal The excavated materials will be used in earthfilling sites		Included in Contractor’s Budget	Contractors Supervised by BWDB/ PIU/ DSC

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
Construction Phase: Bank and slope protection works and embankment repair/re-sectioning					
Noise level	May hamper lives of people, especially in residential areas and educational institutions. It may also disturb fauna, including endangered species.	• Reduce equipment noise at source by isolation of exhaust systems. • Limit the noisy work to daylight hours, where possible. • Inspect and maintain equipment in good working conditions. • Levels of engines or other noise producing sources will be ramped up, so that the noise will slowly increases.	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant, PIU
Air Quality	The air quality may deteriorate due to construction activities, i.e., exhaust emissions from construction machinery, dust generated by the movement of vehicles, production of CC block at the construction yards, sand filling of geo-bags etc.	• Water shall be sprayed at the construction yard and connected road twice a day in order to suppress fugitive dust; • Loading of the construction materials for concrete mixing shall be done carefully to avoid the emission of dust to the extent possible; • Construction materials shall be kept covered to avoid dispersion in air; • Construction equipment, namely batching plant/mixer machine, washing plant and grader, etc. shall be properly maintained; vehicles and equipment shall have proper fitness; • Vehicles and construction equipment shall use clean air technology; • Avoid earthen roads for carrying the construction materials to the extent possible; • Switch off / throttle down all site vehicles, construction equipment, generators, and machinery when not in use;	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant, PIU

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
		- Vehicle speed restriction must be enforced to control dust generation; - Plant different kinds of trees (Timber, Fruit bearing, medicinal) in the project area. - Air quality measurements during dry season for ensuring air quality standards (2 locations, 2 measurements PM_{2.5} & P₁₀ for 8 hours)			
Water Quality	Degradation of surface water quality	- A land fill/ dumping place (for debris/waste generated from construction activities, garbage from labour sheds etc.) shall be selected by BWDB and contractor in consultation with the Local Government Institute and Local Administration, before starting of the project activities, if there is no existing land - The construction wastes shall be segregated into biodegradable & non-biodegradable waste, in separate bins - The contractor shall arrange to transport the bins to the designated land fill site - Biodegradable waste or organic waste shall be disposed of at the land fill site or gathered for composting - The non-biodegradable waste shall be segregated into recyclable and rejected waste. - Recyclable waste like small pieces of rod, steel wire, rubber, plastic bottles, plastic bags, etc. to be collected and shall be sent to licensed traders for recycling - Rejected waste shall be dumped in landfill sites. - Surface water quality measurements during dry season for ensuring water quality standards for irrigation (2	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant, PIU, DOE

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
		locations, 2 measurements, PH, EC, Salinity, TDS) Ground water quality measurements during dry season for ensuring water quality standards for irrigation and drinking (2 locations, 2 measurements PH, EC, Salinity, As)			
Soil Erosion	Soil Erosion might occur from the base and surface of embankment.	The construction of embankment shall be completed immediately in the segment where vegetation will be cleared. The embankment surface shall be covered with turf immediately after completion of construction.	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant
Changes in Land Quality and environmental pollution	Haphazardly throwing of construction wastes (waste concrete, washed off aggregates, empty cement bags, litters etc.), WC wastes from labor shed, litters etc. will pollute surrounding environment and change land quality.	The onsite wastes shall be properly contained and prevented from escaping into surrounding lands; The process of disposing of the wastes mentioned under IEC-surface water quality shall be followed.	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant, BWDB, SRDI
Crop Production Loss	Crop production loss may occur, if CC blocks are constructed and stockpiled on the agriculture land.	- The bank protection works shall be done as per the design level. - The contractor shall ensure that no vehicular and equipment movements take place through agricultural fields. - The contractor shall maintain liaison with the communities. Compensation: Compensation shall be made for any standing crop damage. The compensation amount will be calculated after consultation with the local Department of Agriculture Extension	Negligible	-	Contractor Supervision by M&E consultant, PIU and DAE

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
		(DAE) officials.			
Terrestrial biodiversity	Impact on terrestrial flora and fauna due to damage of vegetation at the CC block production and stockyard, and embankment construction area.	• Use barren land, if possible, for production and stockpiling of CC blocks, • Carryout tree plantation with native species at the vegetation damaged sites after completion of construction works and other suitable areas. • The embankment shall be covered with grass turf immediately after construction. • Awareness shall be raised among the local people about wildlife and habitat conservation, so that the relocated wildlife may escape easily and take secured shelter in nearer habitat.	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant,
Navigation	No potential navigability impacts as the project interventions will be carried out in existing structure (regulator repair, embankment protection, slope protection). No channel will be blocked	• Conduct all works within the defined alignment and footprint of existing structures to avoid obstruction of navigation routes. • Schedule construction activities during low navigation periods, where applicable, to minimize disturbance. • Prohibit disposal of construction materials, debris, or waste into the khal or river. • Regularly remove any temporary blockages	Negligible	-	BWDB, contractor
		•			
		•			
Construction Phase: Regulator Repair					
Noise level	May hamper lives of people, especially in residential areas and educational institutions.	• Reduce equipment noise at source by isolation of exhaust systems. • Limit the noisy work to daylight hours, where possible.	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
	It may also disturb fauna, including endangered species.	Inspect and maintain equipment in good working conditions.			
Air Quality	The air quality may deteriorate due to construction activities, i.e., exhaust emissions from construction machinery, dust generated by the movement of vehicles, production of CC block (for regulator apron) at the construction yards, etc.	- Water shall be sprayed at the construction yard and connected road twice a day in order to suppress fugitive dust; - Loading of the construction materials for concrete mixing shall be done carefully to avoid the emission of dust to the extent possible; - Construction materials shall be kept covered to avoid dispersion in air; - Construction equipment shall be properly maintained; vehicles and equipment shall have proper fitness; - Vehicles and construction equipment shall use clean air technology; - Avoid earthen roads for carrying the construction materials to the extent possible; - Switch off / throttle down all site vehicles, construction equipment, generators, and machinery when not in use; - Plant different kinds of trees (Timber, Fruit bearing, medicinal) in the project area. - Air quality measurements during dry season for ensuring air quality standards (2 locations, 2 measurements PM_{2.5} & P10 for 8 hours)	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant
Surface and Ground Water Quality	Degradation of surface water quality	A land fill/ dumping place (for debris/waste generated from construction activities, garbage from labour sheds etc.) shall be selected by BWDB and contractor in consultation with the Local Government Institute and Local Administration, before starting of the	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
		project activities, if there is no existing land - The construction wastes shall be segregated into biodegradable & non-biodegradable waste, in separate bins - The contractor shall arrange to transport the bins to the designated land fill site - Biodegradable waste or organic waste shall be disposed of at the land fill site or gathered for composting - The non-biodegradable waste shall be segregated into recyclable and rejected waste. - Recyclable waste like damaged hand railings, rubber seals, small pieces of rod, steel wire, rubber, plastic bottles, plastic bags, etc. to be collected and shall be sent to licensed traders for recycling - Rejected waste shall be dumped in landfill sites - Surface water quality measurements during dry season for ensuring water quality standards for irrigation (2 locations, 2 measurements, PH, EC, Salinity, TDS) - Ground water quality measurements during dry season for ensuring water quality standards for irrigation and drinking (2 locations, 2 measurements PH, EC, Salinity, As)			
Soil Erosion	Soil Erosion might occur from the regulator approach area.	The regulator approach area shall be covered with turf immediately after completion of construction.	Negligible	Included in Contractor's Budget	Contractor supervision by M&E consultant
Changes in Land Quality and environmental	Haphazardly throwing of construction wastes (waste concrete, washed off	- The onsite wastes shall be properly contained and prevented from escaping into surrounding lands; - The process of disposing of the wastes mentioned	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
pollution	aggregates, empty cement bags, litters etc.), WC wastes from labor shed, litters etc. will pollute surrounding environment and change land quality.	under the issue of surface water quality shall be followed.			consultant, PIU, SRDI
Crop Production Loss	Drainage/irrigation may be hampered during regulator repair. Crop production loss may occur, if CC blocks (for regulator aprons) are constructed and stockpiled on the agriculture land.	- The construction period shall be chosen avoiding monsoon or alternate drainage/irrigation option shall be provided during the repair works; - The CC blocks will be constructed on the regulator approach or suitable empty space near the regulator avoiding any cropland; - The contractor shall ensure that no vehicular and equipment movements take place through agricultural fields. - The contractor shall maintain liaison with the communities. Compensation: Compensation shall be made for any standing crop damage. The compensation amount will be calculated after consultation with the local Department of Agriculture Extension (DAE) officials.	Negligible	-	Contractor Supervision by M&E consultant, PIU and DAE
Employment opportunity, livelihood improvement and Poverty reduction	Temporary employment opportunities will be created for local people different construction related activities.	- Local labor shall be given priority in recruitment for the construction activity. - Project authorities shall consider this issue and include a clause in the contract document for local labor recruitment based on their potential and availability for employment in the different project activities.	Negligible	-	Contractor Supervision by M&E consultant, PIU
Occupational	The labours might be injured	Labors shall be trained before engaging in the	Negligible	Included in	Contractor

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
Health and Safety	during various construction activities, some of these injuries may turn into the casualty, if not timely and properly treated.	construction activity; • PPEs shall be provided to the labors with proper training for using them during the working period; • First Aid medical facilities shall be ensured on the construction site; • Contact number of emergency ambulance services shall be hanged at the construction site.		Contractor's Budget	Supervision by M&E consultant, PIU
Fish pass design through sluices/regulators	Only regulator repair is recommended in the proposed project, no new regulator is proposed. There is no provision for fish pass in the exiting regulators and there is no significant impact on fisheries	• Schedule repair works outside peak fish migration and breeding seasons (typically pre-monsoon and monsoon months). • Avoid complete closure of the regulator gates for extended periods; ensure staggered operation of gates to maintain water connectivity. • Prevent discharge of construction debris, cement slurry, or oil/grease into the water to avoid degradation of aquatic habitat. • Monitor water quality (DO, turbidity) near the worksite during construction	Negligible		BWDB, D&S, contractor
Navigation	No potential navigability impacts as the project interventions will be carried out in existing structure (regulator repair, embankment protection, slope protection). No channel will be blocked	• Conduct all works within the defined alignment and footprint of existing structures to avoid obstruction of navigation routes. • Schedule construction activities during low navigation periods, where applicable, to minimize disturbance. • Prohibit disposal of construction materials, debris, or waste into the khal or river. • Regularly remove any temporary blockages	Negligible	-	BWDB, contractor
Excavation Phase: Re-excavation of khals					
Noise level	May hamper lives of people,	Reduce equipment noise at source by isolation of exhaust systems	Negligible	Included in	Contractor

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
	especially in residential areas and educational institutions. It may also disturb fauna, including endangered species.	of dredgers/excavators. Limit the noisy work to daylight hours, where possible. Inspect and maintain vessels/dredgers/excavators in good working conditions. levels of engines or other noise producing sources will be ramped up, so that the noise will slowly increases.		Contractor's Budget	Supervision by D&S consultant
Air Quality	The air quality may deteriorate due to construction activities, i.e., exhaust emissions from construction machinery, dust generated by the movement of vehicles, dredger, excavator, production of CC block at the construction yards, sand filling of geo-bags, disposal of excavated materials etc.	• Water shall be sprayed at the construction yard and connected road twice a day in order to suppress fugitive dust; • Loading of the construction materials for concrete mixing shall be done carefully to avoid the emission of dust to the extent possible; • Construction materials shall be kept covered to avoid dispersion in air; • Construction equipment, namely batching plant/mixer machine, washing plant and grader, etc. shall be properly maintained; vehicles and equipment shall have proper fitness; • Vehicles, construction equipment, dredger and excavator shall use clean air technology; • Avoid earthen roads for carrying the construction materials to the extent possible; • Switch off/ throttle down all site vehicles, construction equipment, and excavator, generators, and machinery when not in use; • Vehicle speed restriction must be enforced to control dust generation; • Plant different kinds of trees (Timber, Fruit bearing, medicinal) in the project area. • Air quality measurements during dry season for ensuring air quality standards (2 locations, 2	Negligible	Included in Contractor's Budget	Contractor Supervision by D&S consultant

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
		measurements PM _{2.5} & P10 for 8 hours)			
Surface and Ground Water Quality	Degradation of surface water quality	- A storage place for excavated materials shall be selected by BWDB and contractor in consultation with the Local Government Institute and Local Administration, before starting of the project activities, if there is no existing land. - Dredger/excavator shall be properly maintained to minimize release of oil and grease, mobiles, and diesel into water bodies. - Surface water quality measurements during dry season for ensuring water quality standards for irrigation (2 locations, 2 measurements, PH, EC, Salinity, TDS) - Ground water quality measurements during dry season for ensuring water quality standards for irrigation and drinking (2 locations, 2 measurements PH, EC, Salinity, As)	Negligible	Included in Contractor's Budget	Contractor Supervision by D&S consultant
Fish habitat, quality and fish production	Decline the water and fish habitat quality due to release oil and grease from the excavator. Furthermore, increased turbidity and decline of DO and PH temporarily in the khals. That increases the fish mortality and decreases fish production.	Bamboo barrier shall be installed to retain suspended sediment within excavated perimeter. This will reduce the occurrence of turbidity.	Minor positive	Included in Contractor's Budget	Contractor Supervision by D&S consultant
Fish movement and migration	Fish migration may be disturbed during excavation and bank protection work.	Avoid the month of May – July for excavation to consider the fish spawning period. If not, then excavation shall be carefully during the spawning period of fish through using barrier.	Minor positive	Included in Contractor's Budget	Contractor Supervision by M&E consultant

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
Spoil management (dredging material) for canal re-excavation	Improper spoil (dredged material) management during khal re-excavation can cause water pollution from increased turbidity and sediment runoff, soil degradation and drainage blockage from unsuitable disposal, and dust and noise pollution affecting nearby communities. It may damage aquatic habitats, vegetation, and agricultural land, while also posing health and safety risks to workers and residents due to dust, accidents, and mosquito breeding. Spoil transport can disrupt local access, damage roads, and affect livelihoods, and unrehabilitated spoil heaps can lead to visual and environmental degradation.	• If dredging material is suitable for embankment protection works, then it can be used which is subjective to testing. If suitable to use for embankment, then borrow pit will not be necessary • If not suitable to use for embankment purpose, then can be utilized in nearby filling purposes • Rehabilitate spoil disposal sites after completion through leveling, turfing, or tree plantation • Select designated and environmentally approved spoil disposal sites, avoiding agricultural land, wetlands, and residential areas. • Prepare Dredging material management plan if necessary	Minor Short-term	Included in Contractor's Budget	PIU, BWDB, ES Specialists, D&S

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
		•			
Post-Construction/Operation & Maintenance Phase: Bank and slope protection works and embankment repair/re-sectioning					
River bank stability	Riverbank will be stable at Gumati, Muhuri, Kahua, Little Feni, Feni, Haora River and WAPDA khal, Rahmatkhali khal, Matubhuiyan khal and Ruhita khal	- Bank protection works shall be closely monitored and emergency protection work shall be carried out. if failure of bank protection is observed. - O&M for protection works shall be done properly to combat the failure of the bank. - There shall be stockpile of geo-bag and CC block for tackling emergency situation. - Adequate budget shall be provided for operation and maintenance of river bank protection work.	Beneficial	Included in Contractor's Budget	PIU, BWDB
Flood protection	Embankment will protect crops and infrastructures from floods and storm surge.	- Embankment shall be properly monitored and maintained to avoid sudden breach. - Adequate budget shall be provided for operation and maintenance of embankment.	Beneficial	-	PIU, BWDB
Changes in Land Use	Land use and drainage patterns may be changed/improved	Adequate budget shall be provided for operation and maintenance of embankment.	Beneficial	Included in Contractor's Budget	PIU, BWDB and DAE
Increase Crop Production	Crop production may be increased.	- Crop land will be saved from river bank erosion. Hence, farmers of the study area and vulnerable locations is likely to be encouraged to apply more irrigation, as they can grow HYV/ Hybrid crop. In this case, the farmers need good support from the Govt. for a timely supply of inputs e.g fertilizers, pesticides, seeds, credits, etc. - Capacity building and awareness-raising of the farmers shall be carried out regarding the use of Integrated Crop Management (ICM) and Good	Beneficial		PIU, BWDB, DAE

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
		Agricultural Practices (GAP) to minimize the usage of chemical inputs. - The farmers shall be encouraged to use organic and green manure to increase soil fertility as well as avoid water contamination of water sources. - The farmers shall be encouraged to cultivate leguminous crops (N₂ fixing) to enhance the soil quality as well as soil productivity.			
Terrestrial biodiversity	Terrestrial flora and fauna may be enriched due to protection of lands from erosion and flooding.	- A smart plantation plan shall be prepared which shall include the species composition, location of plantation area, number of saplings to be planted. Indigenous plant species shall be given priority in the plan. Native and ornamental plant species shall receive preference for plantation, which will enhance vegetation coverage. - Ensure regular maintenance of green areas and implement plantation in each season of each year to enhance the green cover and complement the vegetation loss. - Avoid single species selection or clone monoculture as plantation	Minor Positive		PIU, BWDB, Department of Forest
Post-Construction/Operation & Maintenance Phase: Regulator Repair					
Surface water availability	Surface water availability will increase after repair of the proposed regulators.	- Maintenance shall be done as and when required. - Operation of water control structures shall be properly done.	Beneficial	Included in Contractor's Budget	PIU, BWDB
Drainage Improvement	Drainage conditions will improve after repair of the	- Drainage structures shall be properly operated to ensure smooth drainage. - Regular inspections, particularly following rainfall	Beneficial	Included in Contractor's	PIU, BWDB

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
	proposed regulators.	shall be conducted to ascertain the operation of outlet structures and also ensure smooth flow of runoff through the drainage system. • Adequate budget shall be provided for operation and maintenance of drainage system.		Budget	
Changes in Land Use and Drainage Patterns	Land use and drainage patterns may be changed/improved	• Regulators shall be properly monitored and maintained to avoid sudden breakdown. And adequate budget shall be provided for that.	Beneficial		PIU, BWDB and DAE
Increase Crop Production	Repair of the regulators will enhance drainage and irrigation which is likely to provide subsequent improvement of crop production.	• Regulators shall be properly monitored and maintained to avoid sudden breakdown. And adequate budget shall be provided for that.	Beneficial		PIU, BWDB, DAE
Post-Excavation/Operation & Maintenance Phase: Re-excavation of Khals					
Noise Level	Noise from maintenance excavation works	Mitigation measures similar to construction phase shall be taken.	Negligible	Included in Contractor's Budget	PIU, BWDB and contractor
Air quality	The air quality may deteriorate through maintenance excavation works	Mitigation measures similar to construction phase shall be taken.	Negligible	Included in Contractor's Budget	PIU, BWDB and contractor
Surface water quality	Degradation of water quality from maintenance excavation works	Mitigation measures similar to the construction phase	Negligible	Included in Contractor's Budget	PIU, BWDB and contractor

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
Surface water availability	Surface water availability will increase after implementation of proposed interventions.	- Maintenance re-excavation of khals shall be carried out as and when required. - Operation of water control structures shall be properly done.	Beneficial	Monitoring budget	PIU, BWDB and contractor
Drainage Improvement	Drainage conditions will improve.	- Siltation of khals shall be monitored and maintenance excavation shall be done when needed. - Adequate budget shall be provided for awareness building for not blocking the khals for fishing or not disposing garbage into khals	Beneficial	Monitoring budget	PIU, BWDB and contractor
Changes in Land Use and Drainage Patterns	Land use and drainage patterns may be changed/improved	Materials accumulated from excavation works shall not be dumped on agricultural lands. Such materials shall be spread over the agricultural lands and leveled over properly.	Beneficial	Monitoring budget	PIU, BWDB and DAE
Fish Habitat, quality and fish production	Habitat quality may improve, and incremental fish production is expected after one monsoon of completion.	- Incremental species diversity and fish production is expected. Fish fry of indigenous species will be released into the re-excavated khals by the local Department of Fisheries (DoF) as part of a conservation and stock enhancement initiative. - Restrict the use of high-impact destructive gear and successfully implement closed fishing seasons during spawning periods (May-July) to protect native fish populations. Use some device, red flag and signboard during fish spawning period for awareness raising to the local community. - Management committee shall be formed by (9-11) members by the adjacent village peoples based on selected area including the related Union Chairman / members. Activities shall be monitored by management committee.	Moderate Positive	Enhancement budget	BWDB in collaboration with related Upazila DoF officials. Financial support shall provide by the BWDB authority.

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact*	Budget	Responsible Agency
		- Protected area shall selected by the local community and finalized through discussion with the Upazila DoF official. - The related DoF officials through observation of the Fish week, World water day, World Environment Day. Provide training to the management committee by the DoF Officials and awareness raising to the local community by the management committee.			
Fish migration and movement	Fish migration and movement may be smooth in the re-excavated khals round the year.	- Fish fry of indigenous species will be into the re-excavated khals by the local Department of Fisheries (DoF) as part of a conservation and stock enhancement initiative. - Awareness activities shall be conducted for the local community of the area to make aware them for protection of wetland and the importance of fish and water bodies in our daily life.	Minor Positive	-	Project authority in collaboration with related Upazila DoF officials.

Table 8-2: Social Mitigation and enhancement measures

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact	Budget	Responsible Agency
<i>Pre-Construction Phase</i>					

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact	Budget	Responsible Agency
Site clearance, fencing, site preparation	Temporary displacement or loss of assets of squatters and non-titled people near embankment or slope protection works	• Conduct detailed social screening and census survey before work starts. • Prepare and implement RAP ensuring compensation and resettlement prior to displacement. • Provide relocation and livelihood support to affected persons. • An Indigenous People Plan (IPP) will be prepared to address the issues regarding potentially affected indigenous people	Minor, temporary	Included in RAP budget	BWDB / Social Safeguard Specialist
Land demarcation and boundary setting for embankment alignment	Land ownership dispute and grievances from landowners	• Conduct joint land verification with land office and community representatives. • Ensure transparent disclosure of land maps. • Establish and operationalize GRM for dispute resolution.	Negligible	Administrative cost	BWDB / DC Office
Establishment of labor sheds, stockyard, and construction camps	Social tension, women's safety concerns, GBV/SEA risks	• Locate labor sheds away from schools and residential areas. • Implement labor camp management plan and worker code of conduct. • Conduct SEA/SH and GBV awareness training for all workers. • Restrict unnecessary movement of workers outside camp.	Moderate	Part of ESMP cost	Contractor / BWDB
Mobilization of construction equipment, vehicles, and labor	Increased traffic movement, risk of community accidents	• Inform local administration before equipment mobilization. • Avoid peak school/market hours. • Use flagmen and warning signs during vehicle movement.	Negligible	Included in ESMP	Contractor / CSC

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact	Budget	Responsible Agency
Pre-construction community consultation	Lack of awareness, grievances during project initiation	• Conduct stakeholder meetings before work commencement. • Disclose project schedule, impacts, and mitigation plan. • Maintain grievance redress cell in each site.	Negligible	Administrative cost	BWDB / Social Specialist
Occupational Health and Safety (OHS)	The labours might be injured during various construction activities, some of these injuries may turn into the casualty, if not timely and properly treated.	• Conduct introduction training for all workers on OHS, emergency response, and use of PPE before work begins • Ensure availability of adequate PPE (helmets, gloves, boots, reflective vests, etc.) and enforce their use • Designate a Safety Officer responsible for daily site safety monitoring • Establish first-aid stations and emergency contact procedures at work and camp sites • Provide safe drinking water, sanitation, and hygienic accommodation for workers • Inspect machinery, lifting devices, and tools before use to ensure safety compliance	Negligible	Included in Contractor's Budget	Contractor Supervision by M&E consultant,
Community Health and Safety (CHS)	Potential safety risks to nearby community due to movement of construction vehicles and equipment, increased traffic and	• Conduct community consultations and information dissemination before commencing any work	Minor	Included in Contractor's Budget	Contractor, BWDB, Social Specialist

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact	Budget	Responsible Agency
	risk of accidents near regulator sites, possible community concern due to lack of information on upcoming works, temporary access obstruction near regulator or embankment areas	• Ensure proper fencing, warning signs, and restricted access around work sites • Designate separate entry/exit routes for workers and machinery, away from residential area • Establish a Grievance Redress Mechanism (GRM) to address community complaints			
Construction Phase					
Riverbank protection, embankment and regulator construction, khal re-excavation	Temporary livelihood disruption of fishermen, traders, and boatmen	• Schedule works during non-fishing season. • Provide temporary access for affected users. • Engage affected community members as unskilled laborers.	Minor, short-term	Included in ESMP	Contractor / BWDB
Construction activities near schools and settlements	Noise and dust disturbance, disruption of education and community life	• Restrict noisy works to daytime hours. • Regular water sprinkling to reduce dust. • Install sound barriers near sensitive areas.	Minor	Included in ESMP	Contractor / CSC
Movement of heavy vehicles and materials	Traffic congestion, road damage, accidents	• Prepare and enforce traffic management plan. • Install safety signage and flagmen. • Coordinate with local authority for alternate routes.	Negligible	Contractor's ESMP budget	Contractor / BWDB
Labor influx and external workforce	Social tension, GBV/SEA risks, disease transmission	• Prefer local hiring to minimize influx. • Enforce code of conduct and labor influx management plan.	Moderate	Included in ESMP	Contractor / BWDB / NGO Partner

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact	Budget	Responsible Agency
		• Conduct awareness on communicable diseases and gender sensitivity. • Operate grievance mechanism for community.			
Restricted access to roads, schools, and markets	Temporary communication disruption and inconvenience	• Provide alternative routes and crossings. • Coordinate with community leaders to minimize disruption. • Inform public in advance about construction schedule.	Negligible	Part of ESMP	Contractor / CSC
Construction site operations	Occupational health and safety risks to workers	• Provide PPE, first-aid facilities, emergency transport, and safety training. • Assign safety supervisor at each site. • Enforce compliance with OHS plan.	Negligible	Included in OHS budget	Contractor / BWDB
Construction near community areas	Risk to community health and safety	• Fence off construction zones and install warning signs. • Restrict unauthorized access. • Conduct awareness sessions for nearby residents.	Minor	Included in ESMP	Contractor / CSC
Waste disposal and storage of construction materials	Nuisance, visual pollution, safety hazards	• Designate approved waste disposal sites. • Ensure timely removal of debris. • Avoid stacking materials on access roads or farmland.	Minor	Included in ESMP	Contractor / BWDB
Employment opportunity, livelihood improvement and poverty reduction	Agricultural and commercial activities will increase in the study area consequent to land stability after erosion and flood protection, which will create new opportunities for income generation and livelihood improvement.	• Motivate and train the local people to develop skills to avail the possible scope of employment in industries to be established in the study area. • There shall be a provision in industries/ commercial	Moderate Positive	Included in Contractor's Budget	PIU, BWDB, DAE and different Government Organizations related to Commerce and Industry.

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact	Budget	Responsible Agency
		organizations for ensuring employment opportunities for local people as per their skill. - Local destitute people shall be given priority in recruitment of unskilled laboring activities in the newly developed commercial and industrial activities. - Farmers and labors shall be trained to works in modernized agricultural activities.			
Occupational Health and Safety (OHS)	The labours might be injured during various construction activities, some of these injuries may turn into the casualty, if not timely and properly treated.	- Labors shall be trained before engaging in the construction activity; - PPEs shall be provided to the labors with proper training for using them during the working period; - First Aid medical facilities shall be ensured on the construction site; - Contact number of emergency ambulance services shall be hanged at the construction site.	Negligible	Included in Contractor's Budget	Contractor, BWDB Supervision by M&E consultant,
Community Health and Safety (CHS)	Increased safety risks to local communities due to movement of heavy vehicles and equipment, accidental injuries from unauthorized access to work sites, dust, noise, and vibration affecting	Assess and manage specific risks and impacts to the community arising from Project activities, including wastes, noise, air, and wastes water emission, and include mitigation measures in	Negligible	Included in Contractor's Budget	Contractor, BWDB, Social Specialist

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact	Budget	Responsible Agency
	nearby households, public health risks from improper waste disposal, stagnant water, or poor sanitation in worker camps	the ESMPs to be prepared in accordance with the ESMF and will follow SEA/SH Mitigation Action Plan • Maintain fencing, signage, and restricted access zones around construction areas • Enforce traffic management plan with designated vehicle routes and speed limits • Provide flagmen or warning personnel at busy crossings or near schools and markets • Regularly spray water to suppress dust and limit construction noise to daylight hours • Implement proper waste management and drainage around worker camps • Conduct periodic health check-ups and awareness sessions for workers on hygiene and disease prevention • Provide first-aid facilities and emergency contact information at site			
Post-Construction / Operation & Maintenance Phase					
Demobilization of labor and equipment	Improper site clearance, leftover debris	• Conduct proper site clean-up and waste disposal. • Restore work areas to original or	Negligible	Included in ESMP	Contractor / BWDB

Activity/Issues	Likely Impacts	Proposed Mitigation and Enhancement Measures	Residual Impact	Budget	Responsible Agency
		improved condition. • Verify clearance through site inspection.			
Reinstatement of community access and facilities	Delayed restoration may affect local movement	• Restore access roads, pathways, and community facilities promptly. • Consult local users before reopening routes.	Negligible	Part of O&M cost	BWDB / Contractor
Employment opportunities in O&M activities	Limited engagement of local workforce	• Prioritize local labor for maintenance and monitoring works. • Provide short training on embankment maintenance.	Positive	Part of project benefit	BWDB / Local Authority
Community safety and awareness during operation	Risk of accidents near embankments, regulators, and khal	• Install safety signage and railings near risky zones. • Conduct awareness programs on safe use of infrastructure.	Negligible	Included in O&M budget	BWDB / Local Government
Livelihood restoration and community development	Temporary income loss during project may persist	• Support affected persons through skill training and livelihood grants where applicable. • Link with government social safety programs.	Minor, short-term	Included in RAP	BWDB / Social Development Specialist
Functioning of GRM during O&M	Unaddressed community complaints	• Maintain active grievance redress mechanism throughout operation phase. • Ensure timely resolution and feedback to complainants.	Negligible	Administrative cost	BWDB / Social Specialist
Long-term social benefits from improved protection and access	Enhanced safety, reduced flood risk, improved mobility and livelihoods	• Maintain embankments and drainage channels regularly. • Encourage community participation in maintenance monitoring.	Positive	Part of O&M cost	BWDB / Local Community

Table 8-3: Environmental and Social Monitoring Plan

VESC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (lac BDT)
Pre-Construction Phase: Bank and slope protection works and embankment repair/re-sectioning					
Construction Wastes	Visual inspection of waste generation and dumping area	Construction sites	Monthly before the commencement of the construction activities	BWDB and Contractor	
Water Quality deterioration and Waste generation	Sampling and analysis of surface (pH, EC, TDS, temperature, salinity, BOD and major ions) and ground water quality (pH, EC, TDS, temperature, salinity, As)	Construction camp and construction site	Once before the commencement of the construction activities and after any major natural disaster (flood/cyclone)	D&S Consultant through a recognized laboratory	9.60
Air quality	Air quality monitoring of parameters: SPM, PM ₁₀ , and PM _{2.5} , CO, NO _x , SO _x	Close to nearby School/ Madrasha/Hospital/Villages	Once before the commencement of the construction activities and after disaster events affecting site or access roads	BWDB/D&S Consultant	4.80
Noise level	Quality Assurance and Quality Control (QA/QC) procedures shall be maintained during the monitoring	Close to nearby School/ Madrasha/Hospital/Villages	Once before the commencement of the construction activities and after any disaster events	BWDB/D&S Consultant	1.60
Labor selection process	Physical monitoring, daily logbook checking for workers	The entire study area	Daily (during the recruitment process)	BWDB, D&S, Contractor	–
Resettlement	Identification of affected persons (non-titled) Household survey, asset	Along embankment, canal banks, and construction corridors	Once before construction	BWDB, D&S	

VESEC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (lac BDT)
	inventory, and socio-economic census, follow RAP and RPF				
Pre-Construction Phase: Regulator Repair					
Construction Wastes	Visual inspection of waste generation and dumping area	Regulator repair sites	Monthly before the commencement of the construction activities	BWDB, D&S Consultant and Contractor	
Water Quality deterioration and Waste generation	Sampling and analysis of surface (pH, EC, TDS, temperature, salinity, BOD and major ions) and ground water quality (pH, EC, TDS, temperature, salinity and As)	Construction camp and construction site	Once before the commencement of the construction activities and after any major natural disaster (flood/cyclone)	D&S Consultant through a recognized laboratory	2.00
Air quality	Air quality monitoring of parameters: SPM, PM ₁₀ , and PM _{2.5} , CO, NO _x , SO _x	Close to nearby School/ Madrasha/Hospital/Villages	Once before the commencement of the construction activities and after disaster events affecting site or access roads	BWDB/D&S Consultant	1.00
Noise level	Quality Assurance and Quality Control (QA/QC) procedures shall be maintained during the monitoring	Close to nearby School/ Madrasha/Hospital/Villages	Once before the commencement of the construction activities and after any disaster events	BWDB/D&S Consultant	0.40
Labor selection process	Physical monitoring, daily logbook checking for workers	Regulator repair sites	Daily (during the recruitment process)	BWDB, Contractor	-
Pre-Construction Phase: Re-excavation of Khals					

VESEC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (lac BDT)
Water Quality deterioration and Waste generation	Sampling and analysis of surface (pH, EC, TDS, temperature, salinity, BOD and major ions) and ground water quality (pH, EC, TDS, temperature, salinity and As)	Construction camp and construction site	Monthly before the commencement of the construction activities	D&S Consultant through a nationally recognized laboratory	1.00
Air quality	Air quality monitoring of parameters: SPM, PM ₁₀ , and PM _{2.5} , CO, NO _x , SO _x	Close to nearby School/ Madrasha/Hospital/Villages	Once before the commencement of the construction activities and after disaster events affecting site or access roads	D&S Consultant	0.50
Noise level	Quality Assurance and Quality Control (QA/QC) procedures shall be maintained during the monitoring	Close to nearby School/ Madrasha/Hospital/Villages	Once before the commencement of the construction activities and after ant disaster events	D&S Consultant	0.10
Construction Phase: Bank and slope protection works and embankment repair/re-sectioning					
Drainage Congestion and Water Logging	Visual inspection and public feedback	Total project area	Yearly and after any disaster	D&S Consultant & Contractor	
Water Quality deterioration and Waste generation	Sampling and analysis of surface (pH, EC, TDS, temperature, salinity, BOD) and ground water quality (pH, EC, TDS, temperature, salinity and As)	Construction camp and construction site	Half yearly (Surface & Ground Water) and after major flood or rainfall events	Contactor/D&S Consultant	26.00
	Visual inspection of collection,		Weekly (Solid Waste)		

VEESC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (lac BDT)
	transportation and disposal of solid waste and solid waste is deposited at designated site.				
Air Quality	Air quality monitoring	Close to nearby School/ Madrasha/Hospital/Villages	Half yearly and after natural disasters causing dust or debris spread	Contactor/D&SConsultant	18.00
Noise	Visual inspection to ensure good standard equipment are in use, periodic noise level test	Close to nearby School/ Madrasha/Hospital/Villages	Quarterly	Contactor/D&SConsultant	8.00
Labour Influx	Review of contractor records, site inspection, interviews with workers and community, field inspection checklist	Worker and labour camps and nearby communities	Monthly	BWDB, Contractor, D&S Consultant	
Impact on Education and Livelihood	Field survey and stakeholder consultations, interviews, identification and monitoring	Along construction corridors	Once before construction	BWDB, D&S, Contractor, NGO	
Communication Disruption / Road Closures	Field inspection, monitoring, site verification	Project Influence area	Before and during construction	BWDB, D&S, Contractor	
Occupational Health and Safety (OHS)	Inspection and verification of PPE availability and usage, worker training, integration into contractor contracts, onsite monitoring, adopt and	Construction sites, Labour Camps	Weekly	BWDB, D&S, Contractor	

VESEC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (lac BDT)
	implement an Occupational Health and Safety (OHS) Management Plan to assess and manage the OHS risks and impacts of the Project.				
Community Health and Safety (CHS)	Review of consultation record, visual inspection, traffic logs, field inspection	Project Area	Weekly	BWDB, D&S, Contractor	
Agriculture					
Soil erosion	Ocular observation and KII	Study area for bank and slope protection works and embankment repair/ re-sectioning	7 days interval during the construction phase	PIU of BWDB/D&S Consultant	—
Changes in land quality	Soil sample collection and laboratory test	Embankment repair and bank protection work (earth fill locations)	Once a year	PIU of BWDB/D&S Consultant	—
Terrestrial biodiversity	Visual observation and data collection	Tree plantation site, labor shed and stack yard site	Half-yearly	BWDB PIU/D&S Consultant	—
Occupational Health and Safety	Inspection of Emergency Preparedness and Response mechanism and facilities	At interventions sites	Monthly	BWDB, D&S Consultant and Contractor	—
Community Health and Safety (CHS)	Review of consultation record, visual inspection, traffic logs, field inspection	Project Area	Quarterly	BWDB, Contractor, Social Specialist	

VESEC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (lac BDT)
Construction Phase: Regulator Repair					
Drainage Congestion and Water Logging	Visual inspection and public feedback	Total project area	Yearly and after any disaster	BWDB/D&S Consultant and Contractor	—
Water Quality deterioration and Waste generation	Sampling and analysis of surface (pH, EC, TDS, temperature, salinity, BOD) and ground water quality (pH, EC, TDS, temperature, salinity and As)	Construction camp and construction (repair) sites	Half yearly (Surface Water) and after any major rainfall and flood	Contactor/D&S Consultant	3.20
	Visual inspection of collection, transportation and disposal of solid waste and solid waste is deposited at designated site.		Weekly (Solid Waste)		
Air Quality	Air quality monitoring	Close to nearby School/ Madrasa/Hospital/Villages	Half yearly and after natural disasters causing dust or debris spread	Contactor/D&S Consultant	2.00
Noise	Visual inspection to ensure good standard equipment are in use, periodic noise level test	Close to nearby School/ Madrasa/Hospital/Villages	Quarterly	Contactor/D&S Consultant	1.00
Fish pass design through sluices/regulators	Though there is no significant impact on fisheries as no new regulator is proposed, schedule repair works outside peak fish migration, avoid complete	Near regulator repair works site	During Construction		

VESEC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (lac BDT)
	closure of the regulator gate, prevent discharge of construction debris, cement slurry, or oil/grease into the water, monitor water quality can be helpful				
Labour Influx	Review of contractor records, site inspection, interviews with workers and community, field inspection checklist	Worker and labour camps and nearby communities	Monthly	BWDB, Contractor D&S Consultant	
Impact on Education and Livelihood	Field survey and stakeholder consultations, interviews, identification and monitoring	Along construction corridors	Once before construction	BWDB, D&S, Contractor, NGO	
Communication Disruption / Road Closures	Field inspection, monitoring, site verification	Project Influence area	Before and during construction	BWDB, D&S, Contractor	
Occupational Health and Safety (OHS)	Inspection and verification of PPE availability and usage, worker training, integration into contractor contracts, onsite monitoring, adopt and implement an Occupational Health and Safety (OHS) Management Plan to assess and manage the OHS risks and	Construction sites, Labour Camps	Weekly	BWDB, D&S, Contractor	

VEESC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (lac BDT)
	impacts of the Project.				
Community Health and Safety (CHS)	Review of consultation record, visual inspection, traffic logs, field inspection	Project Area	Quarterly	BWDB, D&S, Contractor	
Agriculture					
Soil erosion	Ocular observation and KII	Study area	7 days interval during the construction phase	PIU of BWDB/D&SConsultant	—
Occupational Health and Safety	Inspection of Emergency Preparedness and Response mechanism and facilities	At project sites	Monthly	BWDB, D&SConsultant and Contractor	—
Construction Phase: Re-Excavation of khals					
Drainage Congestion and Water Logging	Visual inspection and public feedback	Total project area	Yearly and after any disaster	BWDB/D&SConsultant and Contractor	
Water Quality deterioration	Sampling and analysis of surface (pH, EC, TDS, temperature, salinity, BOD) and ground water quality (pH, EC, TDS, temperature, salinity and As)	One location in each of the proposed khals	Half yearly (Surface Water) and after major flood or rainfall event	Contactor/D&SConsultant	3.40
Air Quality	Air quality monitoring	Close to nearby School/ Madrasha/Hospital/Villages on the banks of khals	Half yearly and after natural disasters causing dust or debris spread	Contactor/D&SConsultant	2.00
Noise	Visual inspection to ensure good	Close to nearby School/	Quarterly	Contactor/D&SConsultant	0.40

VESEC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (lac BDT)
	standard equipment are in use, periodic noise level test	Madrasha/Hospital/Villages on the banks of khals			
Spoil (dredge material) management	Site inspection and verification, observation of dust, blockage, sample testing for contamination	Near khal excavation	Before and during commencement of spoil disposal	BWDB/D&S Consultant and Contractor	
Labour Influx	Review of contractor records, site inspection, interviews with workers and community, field inspection checklist	Worker and labour camps and nearby communities	Monthly	BWDB, D&S, Contractor	
Impact on Education and Livelihood	Field survey and stakeholder consultations, interviews, identification and monitoring	Along construction corridors	Once before construction	BWDB, D&S, Contractor, NGO	
Communication Disruption / Road Closures	Field inspection, monitoring, site verification	Project Influence area	Before and during construction	BWDB, D&S, Contractor	
Occupational Health and Safety (OHS)	Inspection and verification of PPE availability and usage, worker training, integration into contractor contracts, onsite monitoring, adopt and implement an Occupational Health and Safety (OHS) Management Plan to assess and manage the OHS risks and	Construction sites, Labour Camps	Weekly	BWDB, D&S, Contractor	

VESEC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (lac BDT)
	impacts of the Project				
Community Health and Safety (CHS)	Review of consultation record, visual inspection, traffic logs, field inspection	Project Area	Quarterly	BWDB, D&S, Contractor	
Post-Construction/Operation & Maintenance Phase: Bank and slope protection works and embankment repair/re-sectioning					
Riverbank stability	Visual inspection of protected areas	Bank protected sites	Monthly and during flood events	BWDB/D&SConsultant and Contractor	—
Water Quality deterioration and Waste generation	Air quality monitoring of parameters: SPM, PM ₁₀ , and PM _{2.5} , CO, NO _x , SO _x	Construction camp and construction site	Once after completion Once after completion	D&SConsultant through a recognized laboratory	9.60
Air Quality	Air quality monitoring of parameters: SPM, PM ₁₀ , and PM _{2.5} , CO, NO _x , SO _x	Close to nearby School/ Madrasha/Hospital/Villages	Once after completion	BWDB/D&SConsultant	4.80
Restoration of Livelihood and Access	Field assessment of the affected community	Project affected area	Quarterly for 1-year post-construction	BWDB, Contractor	
Noise	Periodic noise level test	Close to nearby School/ Madrasha/Hospital/Villages	Once after completion	BWDB/D&SConsultant	1.60
Agriculture					
Soil erosion	Ocular observation and KII	Study area	Half yearly basis for 3-year monitoring plan	PIU of BWDB	—
Changes in land use and drainage patterns	Ocular observation and KII	Study area	Half yearly basis for 3-year monitoring plan	PIU of BWDB	—

VESC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (lac BDT)
Land stability	Ocular observation and KII	Footprint area (bank protection area)	Half yearly basis for 3-year monitoring plan	PIU of BWDB and D&S Consultant	—
Post-Construction/Operation & Maintenance Phase: Regulator repair					
Drainage Congestion & Water Logging	Ocular observation and KII	Study area	Half yearly basis for 3-year monitoring plan	PIU of BWDB	—
Water Quality deterioration and Waste generation	Sampling and analysis of surface (pH, EC, TDS, temperature, salinity, BOD and major ions) and ground water quality (pH, EC, TDS, temperature, salinity and As)	Construction camp and construction site	Once after completion Once after completion	BWDB/D&S Consultant through a nationally recognized laboratory	2.00
Air Quality	Air quality monitoring of parameters: SPM, PM ₁₀ , and PM _{2.5} , CO, NO _x , SO _x	Close to nearby School/ Madrasa/Hospital/Villages	Once after completion	BWDB/D&S Consultant	1.00
Noise	Periodic noise level test	Construction sites	Once after completion	BWDB/D&S Consultant	0.40
Restoration of Livelihood and Access	Field assessment of the affected community	Project affected area	Quarterly for 1-year post-construction	BWDB, D&S, Contractor	
Agriculture					
Soil erosion	Ocular observation and KII	Study area	Half yearly basis for 3-year monitoring plan	PIU of BWDB, D&S	—
Changes in land use and drainage	Ocular observation and KII	Study area	Half yearly basis for 3-year monitoring plan	PIU of BWDB, D&S	—

VESC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (lac BDT)
patterns					
Post-Construction/Operation & Maintenance Phase: Khal Re-excavation					
Drainage Congestion & Water Logging	Ocular observation and KII	Study area	Once a year for 3-year monitoring plan	PIU of BWDB	
Water Quality deterioration and Waste generation	Sampling and analysis of surface (pH, EC, TDS, temperature, salinity, BOD and major ions) and ground water quality (pH, EC, TDS, temperature, salinity and As)	One location in each of the proposed khals	Once after completion	BWDB/D&S Consultant through a nationally recognized laboratory	1.00
Air Quality	Air quality monitoring of parameters: SPM, PM ₁₀ , and PM _{2.5} , CO, NOx, SOx	Close to School, Madrasha, Hospital or Villages (2 locations in each khal)	Once after completion	BWDB/D&S Consultant	0.50
Noise	Periodic noise level test	Construction sites	Once after completion	BWDB/D&S Consultant	0.10
Restoration of Livelihood and Access	Field assessment of the affected community	Project affected area	Quarterly for 1-year post-construction	BWDB, D&S, Contractor	
Agriculture					
Soil erosion	Ocular observation and KII	Study area	Once after completion	PIU of BWDB, D&S	—
Changes in land use and drainage patterns	Ocular observation and KII	Study area	Once after completion	PIU of BWDB, D&S	—
Changes in land	Soil sample collection and	Land reclamation area	Once after completion	PIU of BWDB, D&S and	-

VESC/ Indicator	Method	Location	Frequency	Responsible Agency	Cost (lac BDT)
quality	laboratory test and verified with the previous result	(excavated earth dumping location)		third-party monitoring agency	
Total					106.0

8.2 Roles and Responsibilities

An appropriate institutional arrangement, with clear roles and responsibilities, is vital for the successful implementation of the EMP for the project. BWDB is the Implementing Agency (IA) of the project and has the responsibility of carrying out the project in an environmentally sustainable manner. Monitoring of ESMP by BWDB will require field surveys, analyses and technical reporting to DoE in addition to receiving environmental reports from the Contractor as well as the Supervision and Monitoring Consultants. At present, BWDB lacks such capability and will require a Project Implementation Unit (PIU) to address ESMP implementation. PIU will be responsible for all aspects of project implementation including technical, operational and financial management, and overseeing the implementation of ESMP.

8.3 Capacity Building and Training Needs

Capacity building is a key component of the Environmental and Social Management Plan (ESMP), targeting all levels of project implementation, including BWDB, the Project Implementation Unit (PIU), supervision consultants, and contractors. Training will focus on environmental and social awareness, project impacts, occupational health and safety (OHS), and waste management, with supervision consultants leading on-site efforts and contractors training their own staff. These activities will continue through the maintenance phase, led by BWDB. However, BWDB's organizational structure lacks dedicated units for environmental assessment and social impact analysis.

Given evolving challenges in flood and erosion control measures, BWDB has initiated efforts to reorganize and address capacity gaps. A new Environmental and Social Cell will be established within the PIU, staffed by specialists responsible for ensuring compliance with environmental and social issues, grievance redress, and sustainability measures. This unit will be trained and supported by the PU and will eventually take the lead on future planning, climate modelling, and investment preparation, embedding environmental and social governance into BWDB's core operations.

The scope of the capacity building program will cover general environmental and social awareness, regulatory requirements, key environmental and social sensitivities of the area, key environmental and social impacts of the project, ESMP requirements, operational health and safety aspects, gender issues and waste disposal. The capacity building program may be adjusted according to specific needs.

8.4 Contractor Management and Contractor's Environmental and Social Management Plan (CESMP)

To ensure effective on-ground implementation of environmental and social safeguards, each construction contractor engaged under the Project shall be required to prepare a **Contractor's Environmental and Social Management Plan (CESMP)** prior to the commencement of any physical works. The CESMP will be developed in alignment with the **Environmental and Social Management Plan (ESMP)** provided in this ESIA and will serve as the contractor's site-specific operational guide for managing all environmental, social, health, and safety (ESHS) aspects during construction. It will be ensured by including relevant and necessary clauses of ES requirements in bid documents.

The CESMP shall be consistent with the requirements of the **World Bank Environmental and Social Standards (ESSs)**, the **International Finance Corporation (IFC) Environmental, Health and Safety (EHS) Guidelines**, and all applicable **national environmental, labor, and occupational health and safety regulations** of Bangladesh. The CESMP must be reviewed by the **Supervision Consultant** and approved by the **Project Implementation Unit (PIU)** before mobilization of the contractor.

The CESMP shall include, but not be limited to, the following sub-plans and procedures:

- **Site Plans** need to be provided including site layout showing locations of site office, material stockyard along with site management plan for the duration of contract;
- **Occupational Health and Safety (OHS) Plan** following IFC General EHS Guidelines and WB ESS2;

- **Waste and Pollution Management Plan** (solid waste, wastewater, hazardous materials, spillage management);
- **Traffic and Community Safety Plan** as per WB ESS4;
- **Labor Management Plan and Workers' Code of Conduct** covering labor influx and GBV/SEA/SH prevention;
- **Emergency Preparedness and Response Plan**;
- **Erosion, Sediment and Drainage Control Plan**;
- **Grievance Redress Mechanism (GRM)** for workers and local communities; and
- **Site Restoration and Demobilization Plan** for post-construction rehabilitation.

The contractor will be responsible for implementing the CESMP on a day-to-day basis, ensuring that all workers are trained, equipped with necessary PPE, and comply with site safety and environmental requirements. Subcontractors must also adhere to the same standards under the supervision of the main contractor. The CESMP should include clear roles, responsibilities, and reporting arrangements to ensure accountability at all levels.

The PIU and **Supervision Consultant** will monitor compliance through regular field inspections, performance audits, and review of periodic ESHS progress reports submitted by the contractor. Any non-compliance identified shall be subject to corrective action within a defined timeframe. To strengthen enforceability, **key CESMP requirements and IFC/WB EHS guidelines shall be explicitly incorporated into bidding documents and contracts**, including ESHS performance clauses, penalty provisions for violations, and incentives for exemplary compliance.

8.4.1 Contractor Requirements for ESMP Implementation

Requirements for ESMP implementation by contractor has to be ensured by specifying the actions that have to be taken, and type of resources, and E&S professionals that may be required, and this has to be part of bid documents during tendering. To ensure effective implementation of the Environmental and Social Management Plan (ESMP), the ESIA requires that all contractors demonstrate adequate capacity and resources during the tendering stage. The bid documents shall specify the following requirements:

1. **ESMP Actions** – Contractors must outline how they will implement all ESMP mitigation measures, including timing, responsibilities, and monitoring procedures throughout construction.
2. **Resources** – Contractors must identify the equipment, financial, and logistical resources needed to carry out ESMP actions effectively, including tools for monitoring, environmental protection, and community safety.
3. **E&S Professionals** – Contractors must include qualified environmental and social staff in their organizational structure. This includes E&S officers, health and safety personnel, and specialists for biodiversity, water quality, and community engagement as relevant to project activities.
4. **Mandatory Submission for Evaluation** – Contractors shall submit an **E&S organizational chart, CVs of key personnel, records of past performance on similar projects, and a training plan** as part of their bid.
5. **Integration into CESMP** – Upon award, contractors shall integrate these arrangements into the **Contractor's Environmental and Social Management Plan (CESMP)** and ensure full implementation throughout the construction phase.

Contractor will prepare site establishment plan and shall obtain approval from the Construction Supervision Consultants (CSC) to followed upon approval by the Supervision, design firm and PMU. Contractor to prepare and implement a mobilization, traffic management plan for vehicular movements and will maintain liaison with communities. They will also prepare site specific management plans, an Occupational health and safety plan including training programs as well as an emergency response plan with early warning system and training programmes to be approved by the Supervision Consultant and PMU. Contractor will establish a labor grievance mechanism and documenting its use for complaints

8.4.2 Stockpile and Plant Site Management Requirements

To prevent environmental degradation and ensure health and safety, contractors shall prepare and implement a **comprehensive Stockpile & Plant Site Management Plan (SPSMP)**. This plan shall be submitted as part of the tendering process and included in the Contractor's Environmental and Social Management Plan (CESMP) upon award. The SPSMP shall include, but not be limited to, the following elements:

- 1. Site Layout and Drainage**
 - Proper layout to prevent surface runoff contamination.
 - Alternative drainage arrangements during construction of hydraulic structures to maintain water flow and minimize sedimentation.
- 2. Bunding and Spill Containment**
 - Bunding of fuel, chemical, and hazardous material storage areas.
 - Provision of spill containment and emergency response measures to prevent soil and water contamination.
 - Use of impermeable flooring in areas where fuels, lubricants, or chemicals are handled.
- 3. Stockpile Management**
 - Guidelines for stacking materials to reduce risk of collapse and accidents.
 - Segregation of incompatible materials (e.g., fuels, cement, hazardous chemicals).
 - Minimization of erosion and dust emissions through covering, compaction, or other control measures.
- 4. Restoration and Demobilization**
 - Temporary sites shall be restored to pre-construction condition or better upon completion of works.
 - Removal of temporary facilities, debris, and contaminated soil, with proper disposal according to environmental standards.
- 5. Cost Provisions and Resources**
 - Contractors shall include necessary cost allocations for SPSMP implementation in their bids.
 - Identification of personnel responsible for SPSMP implementation, including E&S officers and health & safety staff.
- 6. Mandatory Submission for Evaluation**
 - SPSMP, including cost, resource plan, and personnel assignments, shall be submitted as part of the bid documents.
 - Contractors without a satisfactory SPSMP shall be deemed non-compliant.

This requirement ensures **site operations are environmentally sound, safe for workers, and protective of surrounding communities**, while providing accountability through the tender evaluation process.

8.5 Budget Estimates

8.5.1 BOQ of Contractor

No separate payment shall be made for fulfilling the requirements of ESMP except as specified Table 8.2.

Table 8.2 : Bills of Quantities for ESMP

Item No	Items of Work	Unit	Quantity
1	Deployment of full time EHS Officer (cost will be managed by the contractor from the part of project personnel)	Man-month	-
2	Preparation and update of Environment and Social Management plan (ESMP)	Lump sum	-
3	Arrangement of PPE (Personal protective equipment)	Lump sum	-
4	Noise barrier in front of community (if required)	Lump sum	-
5	Provide First Aid Facilities (FAF)	Lump sum	-
6	Provide potable water	Lump sum	-
7	Separate toilets for male & female	Lump sum	-
8	Resting place for workers	Lump sum	-
9	Dust management in construction site	Lump sum	-
10	Management of infectious diseases	Lump sum	-
11	Arrangements for firefighting including provision of fire extinguisher	Lump sum	-

8.5.2 ESMP Implementation Cost

For successful implementation of ESMP, provision of appropriate budget shall be in place in the bid document with budget provision in Bill of Quantities. The breakdown of budget for implementing various mitigation and monitoring measures are presented in **Table 8-1** and **Table 8-2**. No separate payment shall be made for fulfilling the requirements of ESMP except as specified in the tables. For items not specified here, all costs shall be deemed to be included in the unit rates and/or lump sum prices of the various other items in the Bill of Quantities. The summary cost of the mitigation and monitoring measures are presented in **Table 8-3**.

Table 8-3: Summary of Environmental management and monitoring cost

SL	Item	Cost (lac BDT)
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1	Environment Mitigation Cost	140
2	Environment Enhancement Cost	08
3	Environment Monitoring Cost	106
	Total	254

Table 8-4: Breakdown of environmental management and monitoring cost

Sl. No.	Description	Cost (Lakh BDT)	Cost (mUSD)	Time Frame
1	Deployed full time EHS officer (cost will be meet up by contractor from the project personnel)			Pre-construction & Construction phase
2	Preparation and update of Environment and Social Management plan (site specific)	16.19	0.0133	Pre-construction & Construction phase
3	Air Quality monitoring (yearly)	5.00	0.0041	Construction phase
4	Surface Water Quality (80 monitoring (yearly)	8.00	0.0066	Construction phase
5	Drinking Water Quality (80 monitoring (yearly)	3.50	0.0029	Construction phase
6	Soil quality monitoring (N, P, K, S, , OM, pH etc.)	6.25	0.0051	All phases
7	Arrangements for PPE	43.75	0.0360	Construction phase
8	Arrangements for safety/OHS training for the management team by PMU	0.00	0.0000	Construction phase
9	Arrangements for the safety/OHS training for the workers by PMU	0.00	0.0000	Construction phase
10	Worker's health monitoring/checkup/hearing test	3.75	0.0031	Construction phase
11	Provide noise barrie	11.56	0.0095	Construction phase
12	Provide first aid facilities	2.29	0.0019	Construction phase
13	Provide potable water	6.94	0.0057	Construction phase
14	Separate latrines for male & female	11.56	0.0095	Construction phase
15	Arrangements for resting please	16.19	0.0133	Construction phase
16	Arrangements for solid waste,	12.43	0.0102	Construction phase

Sl. No.	Description	Cost (Lakh BDT)	Cost (mUSD)	Time Frame
	chemical and waste water management			
17	Awareness campaign for biodiversity and environment conservation	1.41	0.0012	Construction & Post-construction
18	Dust management around construction sites	20.81	0.0171	Construction phase
19	Training on IPM	5.00	0.0041	Construction & Post-construction
20	Conducting farm land survey	6.25	0.0051	Pre-Construction & Post-construction
21	Conducting aquatic survey	8.75	0.0072	Pre-Construction & Post-construction
22	Management of infectious diseases	16.19	0.0133	Construction phase
23	Arrangements for fire fighting including provision of fire extinguisher	6.94	0.0057	Construction phase
24	Tree plantation	13.75	0.0113	Construction & Post-construction
25	Monitoring of riverbank erosion	15.00	0.0123	Pre-Construction & Post-construction
26	Lumpsum for emergency management response	12.50	0.0103	
Total Estimated Budget		254.00 Lakh BDT	0.209 mUSD	

8.6 Environmental Enhancement: Biodiversity Management Plan

A Biodiversity Management Plan (BMP) is formulated to guide the effective conservation, sustainable use, and restoration of biodiversity in areas affected by development activities. The plan aims to prevent or minimize adverse impacts on ecosystems, protect native flora and fauna, and enhance the ecological resilience of the landscape. By integrating biodiversity concerns into planning, implementation, and monitoring processes, the BMP ensures that environmental sustainability is embedded within project design and execution. This section presents an overview of the biodiversity management plan and the detailed plan is in Annex.

The plan outlines a series of strategic mitigation measures to address key biodiversity threats, including habitat degradation, species loss, and unsustainable resource use. These measures focus on the protection and restoration of critical habitats, prevention of invasive species proliferation, and maintenance of ecological connectivity. Additionally, the BMP supports the establishment of community-managed conservation zones and promotes environmentally responsible practices in sectors such as aquaculture, agriculture, and forestry.

Table 8-5: Summary of Key Biodiversity Mitigation Measures

Thematic Area	Enhancement Measures
Habitat Conservation	Protect and restore ecologically critical habitats; establish buffer zones and sanctuaries.
Species Protection	Promote sustainable practices in fishing, farming, and forestry; restrict harmful gear use.
Ecosystem Connectivity	Prevent fragmentation through integrated land-use planning and infrastructure design.
Invasive Species Management	Monitor and control non-native invasive species that threaten native biodiversity.
Community Engagement	Support community-based conservation, co-management of resources, and livelihood alternatives.
Institutional Integration	Incorporate biodiversity into EIAs and development plans.

To ensure the effectiveness of these mitigation strategies, the BMP includes a robust biodiversity monitoring framework. This involves establishing ecological baselines, conducting periodic surveys, and tracking trends in species populations, habitat condition, and ecosystem services. A mix of scientific methods and community-based monitoring ensures comprehensive data collection and stakeholder participation.

Monitoring results are used to evaluate the performance of conservation actions, inform management decisions, and enable timely adjustments through adaptive management. Modern tools such as remote sensing, GIS, and biodiversity indicators are integrated to support analysis, while citizen science initiatives further enhance coverage and community ownership.

Table 8-6: Group-Specific Monitoring Approaches

Biodiversity Group	Monitoring Approaches
Fish	Bi-annual surveys; monitor native species and presence of exotic aquaculture species.
Reptiles	Visual encounter surveys; use of basking counts and camera traps for key species.
Birds	Seasonal point counts; track nesting success and involve local birdwatchers.
Mammals	Camera traps, scat and track surveys; monitor night-time activity and human-wildlife interaction.
Aquatic Plants	Seasonal vegetation mapping; monitor presence of invasive species and water quality trends.
Herbs/Shrubs/Trees	Permanent vegetation plots; participatory floristic surveys with local herbalists/farmers.

This Biodiversity Management Plan provides a comprehensive and participatory framework for conserving biodiversity while enabling sustainable development. Through strategic mitigation and structured monitoring, it seeks to balance ecological integrity with local socio-economic needs. Central to the plan is the engagement of communities, integration with institutional mechanisms, and the flexibility to adapt in response to ecological feedback. By applying this plan, stakeholders can contribute to a resilient, biodiverse landscape that supports both people and nature.

8.7 Institutional Arrangement

Clearly defined and functional institutional arrangements are essential for ensuring effective and sustainable implementation of the ESMP, particularly the mitigation measures identified in the ESIA. An Organogram showing the institutional setup of B-STRONG including organisation for implementation and monitoring of the ESMP shown in Figure

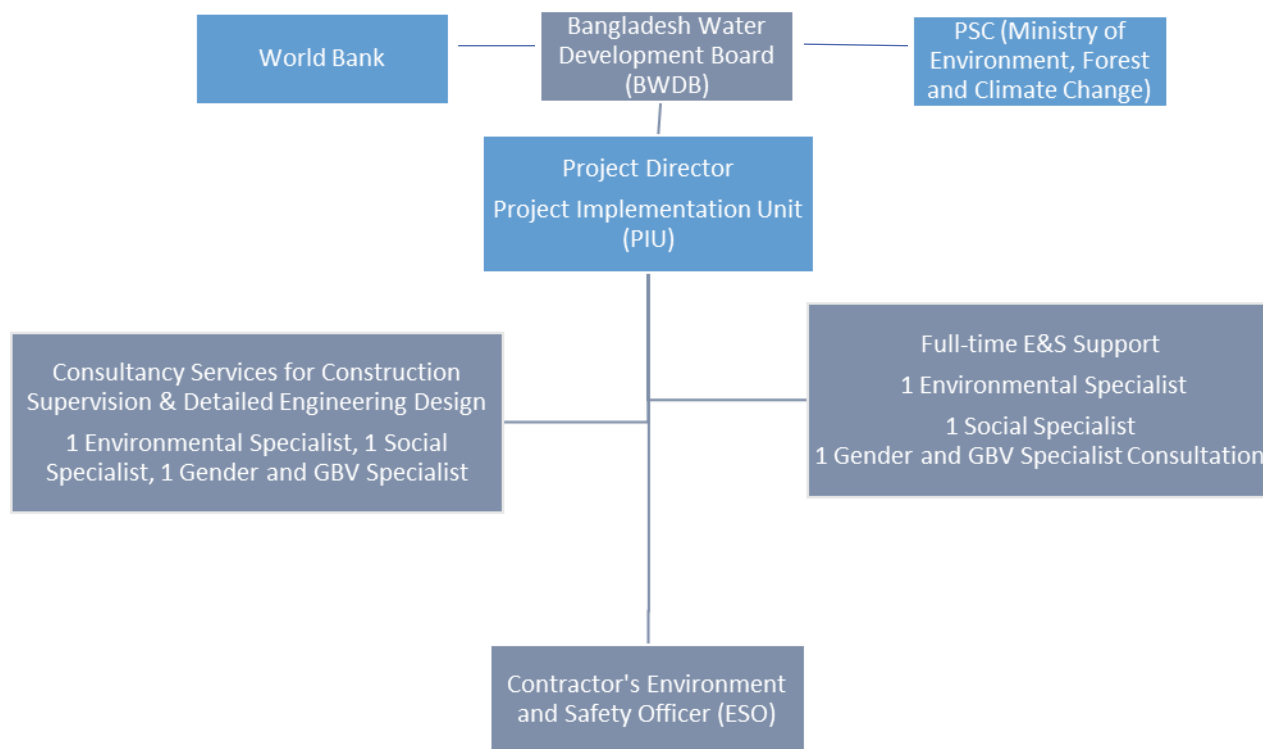


Figure 8.1: Project Implementation Arrangement Organogram

8.7.1 Overall Responsibility

The overall responsibility of ESMP implementation and fulfilling other environmental obligations during the Project lies with the Project Director (PD). For this purpose, PD will be supported by environmental and social staffs of the PMU, DCSC and contractors.

8.7.2 Construction phase

Environment and Social Staff in PMU

BWDB will set up the PMU to manage the Project implementation. The PMU will be led by the Project Director (PD). To manage and oversee the environmental and social aspects of the Project, the PMU will have one National Environment Specialist, Social Specialist, and Gender/GBV Specialist. The Unit will supervise compliance with and implementation of the ESMP. The ES team will maintain liaison with WB ES team, regulatory agencies, and other stakeholders during the Project implementation. The ES team will also coordinate with the environmental staff of the Consultancy Services for Construction Supervision & Detailed Engineering Design. In order to manage the ESIA process and ESMP implementation effectively, the ES staffs will be onboarded before awarding the contract to contractor. BWDB will update the ESIA report, if necessary.

Environment and Social Staff with DCSC

The Supervision firm will be responsible for the overall supervision of embankment, slope protection, canal re-excavation and regulator repair works related activities. The team will ensure quality control and report to the PD. The firm will also assist the individual ES Specialist for ensuring environmental and social compliance and monitoring of progress including ESMP and/or ESCoP implementation. They will supervise the contractors, ensuring design compliance and quality of works. For supervising the ESMP implementation, the Supervision firm will have dedicated and adequately qualified and experienced environmental staff including field-based environmental and social monitors. The Supervision firm will supervise and monitor contractors to ensure compliance with the ESMP. The firm's environmental staff will maintain coordination with the individual ES Specialists for the effective implementation of ESMP and other environmental commitments and obligations of the Project.

Contractor's Environment and Social Personnel

The construction contractors will have to have adequate number of dedicated, properly qualified and experienced, Environment and Social personnel to ensure compliance of ESMP at the construction sites. It will be part of the contractors staffing that will be ensured by including necessary requirements in bid documents to provide CVs of ES staffs as part of the technical proposal. The overall organizational chart of the contractor's proposal must include the ES personal as part of the core team.

The ES staff of the contractor(s) will be responsible to implement various aspects of the ESMP particularly the mitigation measures to ensure that the environmental and social impacts of the construction works remain within acceptable limits. The ESs will maintain coordination with the Supervision firm's consultant at the site level. The ESs will also be responsible to conduct trainings for the construction crew.

8.7.3 Post-construction Phase

The BWDB monitoring unit has to oversee the overall environmental and social compliance of BWDB implemented projects. Under B-STRONG, the ES Specialist will provide training to the BWDB people responsible for monitoring of ES compliance. Thus, a smooth transition to BWDB will happen to ensure ES compliance during the O&M after the completion of the project. These staff will be responsible to manage the environmental aspects of the operation and maintenance of the embankment, its structures, and other relevant issues such as protection of key environmental resources. The Environmental and Social Management Unit of BWDB will ensure and oversee the ES management during project implementation and operation.

CHAPTER-9: STAKEHOLDER ENGAGEMENT

Stakeholder Engagement is mandatory for any development project according to guidelines of DoE which includes approaching people to engage them in the project and take their concern about the impact and benefit of the project from people's point of view. The stakeholder Consultation Meeting was conducted at the specific locality of the proposed project. In the consultation process, local stakeholders shared project interventions, taking into account local needs and aspirations in line with identified issues, as well as engaging with study consultants and advising on solutions by stakeholders. Ideas, opinions, and feedbacks from local stakeholders were expressed that the implementation of the proposed intervention could lead to potential environmental and socio-economic changes in the project-affected areas.

9.1 Stakeholder Identification and Analysis

The stakeholder analyzed considering the level of involvement and potential influenced by the project. Stakeholders can be groups of people, organizations, institutions and sometimes even individuals. The people who would be directly benefited or impacted by the project interventions e.g. people affected or likely to be affected by the project (project affected parties, may have interest in the project (other interested parties) and disadvantaged vulnerable groups. The other part of stakeholders involved in project interventions in various stages.

Table 9-1: Level of stakeholder groups' interest and influence in the project

Key Stakeholders	Interest	Influence
People residing within the flood affected area	H	L
Women, children, disabled	H	L
Residence live on the slope of the embankment	H	H
Residence live at the bank erosion site of identified rivers/khals	H	H
Residence whose lands would be affected by the project interventions	H	H
Embankment users	H	M
Local laborer's to be engaged in the project work	M	M
Local leadership	H	H
Transport Owners and Transport Workers	H	M
Businessmen community around the project area	H	M
Contractors, subcontractors	H	M
Project implementing agency	H	H
Definitions: H= High (The peak level of interest and as per the law the highest power of		

Key Stakeholders	Interest	Influence
influence, M= Moderate (Greater than the normal/usual level of power and interest, L= Low (No/Less than the normal/usual level of interest and power)		

In this project, various water and flood control infrastructures will be rehabilitated which will be implemented by BWDB. Therefore, people residing within the flood affected area in 5 districts, women and children, disabled rural communities, laborers, flood affected people, people living by the embankments, river/khal sides, local government officials, environmental protection authorities, health authorities, residents, business entities, individual entrepreneurs and so on can be identified as stakeholders of the project. The flood affected communities will be the direct beneficiaries of improved infrastructure, embankments, fluvial, pluvial, and flash floods protection standard through a combination of structural and non-structural interventions. The government officials and environmental protection authorities will be responsible for oversight and coordination of development activities, ensuring compliance with regulations and maintaining public health and environmental integrity. The business entities, individual entrepreneurs are likely to stand to benefit from enhancement of infrastructure, increased employment opportunities, and improved flood protection, contributing to local economic development.



Executive Engineer, Noakhali



Executive Engineer, Lakshmipur

Figure 9-2: Key Informant Interviews with stakeholders

Engagement with all identified stakeholders will help ensure the greatest possible contribution from the stakeholder parties toward the successful implementation of the project and will enable the project to draw on their pre-existing expertise, networks and agendas. It will also facilitate both the community's and institutional endorsement of the project by various parties. Access to the local knowledge and experience also becomes possible through the active involvement of stakeholders. A general list of stakeholder groups identified is presented in **Table 9-3**.

Table 9-3: General List of Stakeholder Groups

#	Stakeholder group	Interest /cause in engagement
1	Donor Agencies	Financing the project
2	Bangladesh Water Development Board (BWDB)	Implementing agency
3	Union Parisad (UP)	Implementing agency (local level)
5	Community people (project beneficiaries)	Embankment and river resources users
9	The people of socio-economic impacted area	To save life and assets from flash flood
10	Project employees and Project's consultants, vendors, suppliers, contractors, sub-contractors and labors	Will be engaged with this project.
11	Vulnerable people	Free access to infrastructure services

9.2 Engagement Activities and Consultation Process

Consultation with various cross sections of the people is essential for better planning and implementation process of the project. People living in the project surrounding area and other stakeholders including local government representatives are to be meaningfully consulted at the initial stage of the project to obtain their knowledge and experience about the baseline information, potential impacts, and probable mitigation measures. This section describes the nature and level of the consultation carried out in the proposed project area. Consultation meetings are the best resolutions to bridge the gap between the project affected people/beneficiary groups and primary stakeholders of the project.

A total 28 discussion sessions of Informal Consultation and Focus Group Consultation were conducted in December 2024 to February 2025. More than 10 key informant were interviewed e.g. official of BWDB, Teacher, Persons losing residences, social workers etc. were conducted.

Table 9-4: General List of Stakeholder Consultation Meetings and FGDs

#	Place	Upazila	Participant categories	Participants
1	Khoshkandi	Daudkandi	Loosing residence and land by river erosion	9
2	Ghoshkandi	Titas	Students, Residence houses on the slope	6
3	Chandpur	Debidwar	Local People	8
4	Dhamgor	Muradnagar	Local People	10

#	Place	Upazila	Participant categories	Participants
5	Nagerkandi,	Muradnagar	Residence on the slope of the embankment	8
6	Haripur,	Titas	Loosing land due to river erosion	5
7	Atberpur	Burichang	Local residence	8
8	Mithilapur	Burichang	Local residence	6
9	Purbahura	Burichand	Residence on the slope of the embankment	10
10	Narandyia	Titash	Loosing houses and land due to river erosion	10
11	Kamarkhara	Burichang	Local residence	5
12	Fakirkhil	Parshuram	People affected by earlier flash flood	6
13	Bottoli	Parshurma	Affected people & businessman by flash flood.	6
14	Uttar Tetswar	Parshuram	Affected people & businessman by flash flood.	12
15	Guthuma Sluice gate	Parshuram	Local residence and businessman	3
16	Bubhuyerghat	Feni, Sonagazi	People of erosion proven area	5
17	Jagatjibonpur	Feni, Sonagazi	People of erosion proven area	5
18	Matubhuiyan	Dagarbhuiyan	Local residence and businessmen	7
19	Uttarchar Shahabikari	Sonagazi	Loosing houses due to river erosion	3
20	Awarakhil	Sonagazi	Women of losing houses due to bank erosion	10
21	Kazirhat	Sonagazi	Loosing houses and land due to river erosion	10
22	Janata Bazar	Companiganj	Loosing houses/ land due to river erosion	7
23	Bagdara Bazar	Companiganj	Businessmen and local people	6
24	Moulvibazar	Companiganj	Loosing houses/ land due to river erosion	5

#	Place	Upazila	Participant categories	Participants
25	Musapur Closure	Companiganj	Fishermen and Businessmen	5
26	Aminbazar,	Laxmipur Sadar	Businessmen and local people	8
27	Pearapur	Laxmipur Sadar	People of erosion proven area	9
28	Darkhai	Akhaura	Local People	9

In addition of the stakeholders consultations listed in the above table, the representatives from World Bank (WB), the implementing agency (BWDB) and the study team jointly had conducted some consultation meetings and the overview is presented in **Table 9-5**.

Table 9-5: Summary of joint consultation meetings

#	Date	Venue	Main Participant Groups	No. of Participants		Key Issue Discussed
				Male	Female	
01	02 Nov 2024	Feni	FGD with the flood affected communities	8	4	Potential locations for the project activities Potential E&S Impacts and mitigation measures
02	02 Nov 2024	Feni	Local level consultation with government officials	30	3	Discussed the potential scopes of the project activities, and potential E&S impacts and mitigation measures
04	03 Nov 2024	Cumilla	Consultations with the flood-affected communities	18	4	Discussed the project scopes, benefits, and E&S issues, GRM and future consultation meetings
05	03 Nov 2024	Cumilla	Local level consultation with vulnerable communities	28	9	Discussed the project scopes, benefits, and E&S issues, GRM and future consultation meetings



Choighoria, Fakirkhil, Parshuram



Janata Bazar, Companignaj



Consultations near Gomati River, Cumilla

Figure 9.1: Consultations with stakeholders

9.3 Key Issues Raised and Responses

Various issues were raised by the informants which are presented below:

(a) Vulnerable slopes on both banks of Gumti River:

- The slope is so close to the river at proposed points;
- The place is vulnerable to damage, if severe flash happened in future;
- If damaging this place, then most of the socio-economic area of left bank including Cumilla – Sylhet highway would be affected;
- No households found at the both site of the embankment, where slope protection proposed;
- No ES issued to be faced to implement the proposed interventions;
- High demand of people to improve the slope;

(b) Vulnerable bank erosion along Gumti River:

- Severe Erosion during/after earlier flash flood;
- High Demand of community people;
- Many household losing houses and land by river erosion;
- Sub-merged embankment is under bank erosion;
- Severity increased during early flash flood;
- No. ES issue to be come to implement the proposed interventions;

(c) Vulnerable embankment on the both banks of Gumti River:

- Low height embankment and vulnerable for strong flash flood;
- Local people say that there is land acquired by the BWDB on both sides of the embankment even after the embankment. According to them, 5 feet to more than 100 feet of land has been acquired after the embankment on the country side, depending on the places. On the river side, 15 feet to 100 feet and even sub-land is available somewhere;
- The places where immediate activities can be taken up, except for the settlements and social institutions on both sides of the embankment, have been identified, which is presented in the Screening form;
- The proposed improvement area of the embankment has no any ES issues;

(d) Vulnerable embankment on the both banks of Muhuri and Kahua River:

- There are no land acquired by the BWDB from Fakirkhil to Bottoli, the embankment was built on the private land according to discussants live on the slope and adjacent area at the proposed intervention area;
- There are minimum number of household live on the slope of the embankment found proposed embankment improvement places. They will be affected if improvement works implemented as per World Bank SIA guideline. They would be under resettlement plan of the proposed project;
- Those who live on the slope of the embankment, they are agreed to temporary shifting during intervention works from the present residence setting. After completion of improvement works, they have to resettle in previous places, where they were before;
- It would be wise to acquire adequate land by the BWDB for the embankment at the (if not acquired yet) chainage 1+537 km to 2+695 km for thinking of future. On the acquisition issue, the discussant said, many households would be fallen in critical situation, as they have minimum or no land except residence land;
- The discussant of proposed embankment improvement at chainage 3+006 to 3+728 /km 2.582 to km 3.292, Bottoli stated that BWDB acquired land for the embankment up to Bottoli Bazar. BWDB can be improved the embankment using acquired land. At the country site 35 feet and river site 45 feet land available from the slope of the embankment;
- Severe damages are found at several points and some people have lost their households. The embankment need either re-sectioning or rebuilding here and the eroding points need protections;

(e) River bank erosion of Muhuri and Selonia River:

- Severe erosion found at Terobaria area (chainage 19.912 to 20.112 km). A key informant stated that due to deposit silt on the opposite bank erosion happens more here. A few residence houses and plinth damaged during the last flash flood and till in a vulnerable position;
- Erosion found at the adjacent upstream of right bank of Silenia River. More than five households affected during the last flash flood;
- Severe erosion found at adjacent upstream at the left bank of Sileneah River;
- If flash flood happens future then it can be alarming for bridge;
- The discussant of Bubhuyer ghat point suggested to increase protection works at the upstream site where already BWDB completed, they want to improved otherwise their residence will be fallen in erosion during monsoon. They mentioned that the proposed point is a turning point of the river with huge depth, it needs to protect from bank erosion;
- The proposed point of Jagatjibonpur, erosion damaged at least 3 households lost their plinth and residence houses;
- Immediate bank erosion protection measure is essential at all proposed places;
- Erosion will be increased during upcoming monsoon at all proposed points;

(f) River bank erosion of Little Feni River and Matubhuyian khal:

- The proposed points of Little Feni River and Matubhuyain flows with tidal flow from after damaging Musapur Closure, As a result, the severity has been increasing more. The tidal water comes upstream of the bridge on Feni to Laxmipur highway;
- The proposed points of Little Feni River including Matubuyina khal has fallen in two types of natural calamities e.g. irregular flash flood and tidal surge;
- During monsoon, erosion will be increased at all proposed points;
- Due to damage of Musapur closure, this area would be severe impacted during monsoon, if strong water surge happened during upcoming monsoon specially the first of the full moon and last of the full moon. If cyclones happens during upcoming monsoon and late monsoon, total socio-economic impacted would be affected. So that up to build a closure on the mouth of Little Feni River, it is important to intervene for pre-caution measures like bank erosion protection;
- Due to tidal flow a portion of bank land are goes down uncultivable; it is found at the turning points of the river, where if char area develop at one bank and erosion happens at another bank of the river;

(g) Bank erosion points at Musapur area of Little Feni River:

- As an immediate step after collapsing Musapur Closure, BWDB introduced a dredger to dredged char area, which is important to decrease erosion of the right bank;
- The local residence said that it was said by the BWDB official that a channel will be created by dredging which right bank erosion would be decreased; which will be saved land, residences and assets of the households;
- The area found regular erosion from Bridge to meeting point of closure canal to the Meghna River. The canal of the closure has been eroding regularly at the both banks, the width has been increasing swiftly;
- The upcoming monsoon is critical for the residence at the right bank of the river;
- The local residence argued to immediate protection measures up to bridge; They also claimed to build Musapur Closure as early as possible;
- Many lands at the both site of the river, remain uncultivable due to tidal flows;
- The people got lost to fishing in the river during closure period at the upstream point of the river;
- The most important to create a channel at the strait of the middle portion of the river; then it might be decreased the erosion of the right bank of the river as a result, business places, residence houses, roads, social institution will be saved from the river erosion;
- The left bank adjacent of damaged closure identified point is very vulnerable due to severe erosion. Executive Engineer, BWDB Noakhali emphasized to improve the area as priority basis;
- Create a channel at the middle point of the river from bridge to Musapur meeting point is better option to get relief from the river erosion at the right bank of the river;

(h) Bank erosion points of WAPDA Khal/Rahmatkhali Khal:

- The bank erosion has found in many places of the khal during observing period; it is happened due to drain out water of earlier flash flood;
- Those are is pointed out by the engineering division, it is important under planning for improvement;
- The local people said that erosion will be increased during monsoon;
- Residence houses, homestead and agriculture land has been damaging due to bank erosion found at the proposed intervention point;
- Road has been damaged found at few proposed points;

(I) Slope protection at Haora River:

- Haora River entered into at Chaoghroria village of Akhaura; The river is flashy in nature;
- The river flow is continuing in the year round;
- After enter in to Bangladesh, there are many turned, that is why it takes more time to drain out flash flood water. It is the major cause of bank and slope damaging of the river;
- The farmers of socio-economic impacted area irrigate water from the river in the year round;
- It is found no embankment at the lower stream area and it is the cause of inundation of cropland and homestead during flash flood;

(j) Slope protection points at Ruhita Khal

- Ruhita Khal drains out the polluted water of Cumilla EPZ;
- People did not use it their crop field;

- Due to polluted water, flora & fauna and environment are very vulnerable;
- Pollution due to discharge of spoil from the EPZ, Cumilla reduce crop yield and people suffer from health hazard;
- Fish is not available due to pollution of water;
- The people of the area less interested to re-excavate the khal due to losing crop land by disposing re-excavated earth on the bank;
- The khal was re-excavated before 7 to 8 years back;
- An earthen/HBB road found in some area on both bank of Khal developed by previous re-excavated earth;
- The re-excavated earth can be managed on the roads developed on the both banks of the khal;

(L) Guthuma Sluicgate and Bodormokam Sluicgate:

- Guthuma khal entered from India from Guthuma area and falls to Kahura River;
- The khal flows round the year but water flow has been decreased. The farmer use water for irrigation. However, it flows more or less round the year;
- The sluice gate is completely unmaintained. One door is opened in the year round;
- It is needed to clean and necessary improvement according to engineering planning;
- Bodormokam Sluicgate found active; protection works has been done by BWDB at the river side of the sluicgate after damage during the last flash flood;
- There is an open khal found adjacent of the sluice without any control system;

9.4 Grievance Redress Mechanism

A bottom up Grievance Redress Mechanism (GRM) system will be established in this Project which will be implemented by Project Implementation Unit (PIU) of BWDB. Under the GRM, queries or clarifications about the project will be responded to, the problems with implementation will be resolved, and complaints and grievances will be addressed. The Grievance Redress Mechanism (GRM) will prioritize swift, cost-effective corrective measures that address implementation issues before they escalate into significant problems. GRM will serve as a channel for early warning, aid target supervision to where it is most needed and identify systemic issues.

A three-tier grievance mechanism will be established in this project. Detailed grievance management procedures at flood affected communities. Before specialists are hired, designated focal points will handle grievances. A description of the grievance mechanism is presented in **Table 9.6**.

Table 9.6: Description of Grievance Mechanism (GM)

Step	Description of process	Timeframe	Responsibility
GM Implementation Structure Flood Affected	Local level GRC Composition (all Upazilas where IA has activities: • Sub-divisional Engineer	Specialists to be hired within 3-6 months of effectiveness.	• All complaints will be received at the Office of the respective Sub-divisional Engineer (BWDB)

Step	Description of process	Timeframe	Responsibility
Communities	(BWDB)/nominated official by the PD- Convener (from Upazila where complaint originates) • Environment Specialist and/or Social Specialist or both, from the PIU (asper nature of the complaint)- Member- Secretary(s) (will be common across the GRCs for that particular IA) • Environment Specialist and/or Social Specialist from the Supervision Firm hired by IA - Member. • Representative from respective Union Parishad (from where the complaint originates; must be female if the complainant is female) - Member. • Representative from the community (teacher, NGO, or local person nominated by the complainant)- Member.	All cases at the local level will be heard within 10 days of their receipt.	
	PIU Level GRC • Project Director- Convener • Social Specialist and Environmental Specialist of PIU- Member- Secretary • Local Government Representative (can be the same representative who was present at the local GRC hearing, or other as required; must be female if the complainant is female) - Member • Representative from the community (teacher, NGO, or local person nominated by the complainant- preferably the same person who was present at the local GRC hearing)-Member	The decisions on unresolved cases will be communicated to the PIU level GRC and will be solved within 15 working days.	If the resolution attempt at the local level fails, the GRC will refer the complaint with the minutes of the hearings of the local GRC to the project level for further review. With active assistance from the PIU will make a decision and communicate it to the concerned GRC. The Social/Environmental Specialist at PIU with the support of member secretary of local GRC will make periodic visit to the subproject sites, interact with the communities and affected persons, and pick up issues of concerns, complaints and suggestions to register with the GRM books

Step	Description of process	Timeframe	Responsibility
	PSC Level GRC • Representative of secretary from Respective ministry- Convener • Project Director- Member-Secretary	Four weeks	All the unsolved cases at the project level, decisions on unresolved cases, if any, will be made in no more than four weeks representative of the Secretary, respective ministry. A decision agreed with the aggrieved person(s) at any level of hearing will be binding upon IAs.
Grievance uptake	Face-to Face: There will be a few field offices by the supervision firms/contractors, and each field office will nominate an individual to register complaints. He/ She will register to note the complaints and complaint forms to fill up. The form will be signed by both the staff and the Complainant. Disclosure and documented responses to community complaints should be in Bangla.	Will operate 7 am to 7pm (at flood affected communities). This information will be disseminated to the public.	• The complaint desk will be manned during working days only. For non-working days, virtual means (SMS, Telephone, email etc.) will be suggested. • The field level staff will welcome the Complainant and make him/her comfortable and begin with greetings. The staff will note, fill up the company form, get complainant's signature and sign the form him/herself. • The Staff will also provide estimated timeline and a tracking number. • The Staff will also intimate the local GRC level for eligibility checking. After eligibility check by the local level, the Staff will inform the complainant if the complaint is eligible to be considered or otherwise. If not eligible, the complainant will be provided with other options (NGO, police, legal etc.)

Step	Description of process	Timeframe	Responsibility
	Telephone: 01711882100 Phone number of the Member Secretaries (this will be a cell phone number which can receive calls, SMS, WhatsApp with voice/ picture of damage), and the official number of the Sub-division office (BWDB) of the respective IAs – (this is a cell phone number which can receive calls, SMS, WhatsApp with voice/picture of damage) All level telephone number will be attached with SEP. There will be telephone numbers available for all IAs.	Will be operated from 6 AM to 10 PM	Grievance site focal and E&S Specialist Following will be noted (Action 1): Name and address (none required if anonymity sought) Complaint, in summary Nature of Complaints. If it is project related. Complaint against, if any Operator will (Action 2): Register the complaint in a register Provide a tracking number. Provide a timeline. Fill up Complaint Form for filing Complainant's copy may not be feasible for virtual filing). Intimate the first level of GRC about the complaint Intimate Central GRC aggregator After eligibility check by first/local level, inform the complainant if the complaint is eligible to be considered or otherwise. If not eligible, the complainant will be provided other options (NGO, police, legal etc.)
	Email: Project.GRM@email.com	Will be monitored as per above timing (12 hours)	Will be operated by the Social Development Specialist/Communication Specialist/ Any other nominated staff of the PIU at Project Office. If no details are given will request number (Action 1) above. If phone number is given, the Complainants will be called to get the above information;

Step	Description of process	Timeframe	Responsibility
			else email will suffice. Then the Staff will carry out Action 2 above.
	Website: www. project.com/GRM	Will be monitored as per above timing (12 hours). The site will provide a format for complaint registration. This will include info required in Action 1 above. The complaint will be redirected to the email above with a Subject GRM From Web – Date and Time.	As Above
	Letter: Social Specialist Environmental Specialist	Will be received and opened during office hours	After the letter is received, the complaint will be studied and if ineligible, it will be sent to the Complainant including provision of other options. If eligible Action 1 and 2 above will be implemented
	Drop- Box: Suggestion Boxes will be placed in front of every field office	Will remain open round the clock. Will be opened during the beginning of office hours by the staff responsible to register complaints in each field office	As above
Sorting,	Any complaint received is	Upon receipt of	Local grievance focal

Step	Description of process	Timeframe	Responsibility
Processing	forwarded to local GRC office; logged in by member secretary of Local Recategorized according to the complaint types	complaint	points
Acknowledge ment and follow-up	Receipt of the grievance is acknowledged to the complainant by cell or written as suitable	Within 2 days of receipt	Local grievance focal points
Verification, investigation, action	- Investigation of the complaint is led by local GRC. - Member Secretaries document unresolved complaints, promptly address non-project- related grievances and consider anonymous complaints. - SEA/SH/GBV-related complaints go to the Gender and GBV Specialist. - The Convener and Member Secretaries work with site managers to resolve issues. - Unresolved complaints escalate to the full GRC for resolution within 10 days. - Compensation follows RPF/RAP procedures; complainants are notified. - Unresolved issues may go to the PIU Level GRC and then to the Project Steering Committee GRC. - If necessary, the Project Director may conduct field investigations within 15 days. - Complainants can seek legal recourse if issues persist. - Bank-received complaints are reported to GRS and forwarded to the Project Director. - A proposed resolution is formulated by local GRC and communicated to the complainant by	Within 5 working days of receipt	Local GRC

Step	Description of process	Timeframe	Responsibility
	cell or email or physically as suitable.		
Monitoring and evaluation	Supervision Firm hired including: • Environmental Specialist • Social Specialist Both will be members of all the local level GRCs convened at the Upazilas where the IA will be active and where complaints will originate from.	Within 6-9 months of project effectiveness	PIU & Monitoring and Supervision Firm
	Data on complaints are collected in every month and reported to PIU every month	Every month	PIU & Monitoring and Supervision Firm
Provision of feedback	Feedback from complainants regarding their satisfaction with complaint resolution is collected by monitoring and supervision firm and local GRCs	Every month	Local GRC and Monitoring and Supervision firm
Training	Training needs for staff/consultants in the PIU, Contractors and Supervision Consultants are grievance uptake, sorting, record, response, address, and Feedback mechanism	Every quarter	Monitoring and supervision firm
If relevant, payment of reparations following complaint resolution	Following the guidelines of RPF, ESMF and SECPF	As warrant	Respective PIU and Monitoring and supervision firm
Appeals process	If the aggrieved person is not satisfied with the decision of the local GRC, can appeal to the project level GRC	Within 10 working days of the decision of the local GRC	Aggrieved person with the support of local GRC or directly to the PIU

A separate mechanism will be available for the laborers working under contractors and sub-contractors. For contracted workers, the Contractor is obligated under the Contract to set up the Workers' Grievance Management (GM) to redress complaints relating to workers

deployed for construction works under this Project. It is mandated that contractors set up a Workers' GM according to contractual obligations, ensuring compliance with international standards such as transparency, confidentiality, and protection against retribution. Upon engagement, workers are required to sign the Labor Code of Conduct (CoC) and undergo training on the GRM processes. A structured process is outlined for resolving grievances, involving an inquiry, opportunity for the worker to be heard, and communication of findings within a stipulated timeframe. Overall, the labor GRM aims to ensure fair and transparent handling of labor-related issues within the project's operational framework.

Grievance Resolution Process

All complaints will receive at the GRCs facilitated by the implementing agency. The aggrieved persons may opt to make complaints directly to the Project Director or Secretary of the MoWR or even to the court of law for resolution. The Member Secretary will review and sort the cases in terms of nature of grievance, urgency of resolution, and schedule hearings in consultation with the Convener. All cases will be heard within four weeks from the date of receiving the complaints.

If the resolution attempt at the local level fails, the GRC will refer the complaint with the minutes of the hearings to the Project Director at PMU for further review. The Project Director will assign the ES specialist at PMU for review the grievance cases and assist Project Director in making decision. The ES specialist will review the case records, and pay field visits for cross-examining and consult the GRC members and aggrieved persons, if required. If decision at this level is found unacceptable by the aggrieved person(s), BWDB can refer the case to the MoWR with the minutes of the hearings at local and headquarters levels. At the ministry level, decisions on unresolved cases, if any, will made in no more than four weeks by an official designated by the Secretary, MoWR

9.5 Future Engagement Plan

Stakeholder engagement is a comprehensive process that involves meaningful consultation with stakeholders at every stage of the project life cycle. It has begun in the project preparation phase and will continue through the implementation and operation and maintenance phases. The overall Stakeholder Engagement Plan (SEP) is summarized in **Table 9.7**.

Table 9.7: SEP Summary Table

Stage	Target Stakeholders	Topic(s) of Engagement	Method(s) Used	Location/ Frequency	Responsibility
PHASE 1: Project Preparation/Pre- construction	Project Affected People: Flood Affected people residing in project area, Vulnerable households	ESMF, LMP, SEP, ESCP, Gender and SEA/SH action Plan and RPF; Project scope and rationale; Project E&S principles, Grievance mechanism process	Public meetings, Separate meetings for women and the vulnerable group, Face-to-face meetings, Mass/ social Media communication (As needed), Disclosure of Written information: brochures, posters, flyers, website Information boards or desks, Grievance mechanism, Local newspaper	Quarterly meetings at project sites and as various components are executed and put to operation, continuous communication through mass/ social media and routine interactions.	BWDB
	Other Interested Parties (External)-NGO Working in waste management, climate resilience issues and GBV sectors	ESMF, LMP, SEP, ESCP, Gender and SEA/SH action plan and RPF. Project scope, rationale, and E&S principles, Grievance mechanism process	Face-to-face meetings Joint public/ community meetings with PAPs	Quarterly meetings with affected communities. Disclosure meetings in local and national levels	BWDB
	Other Interested Parties (Internal) Press and media Local NGOs,	ESMF, LMP, SEP, ESCP, Gender and SEA/SH action plan and RPF; Grievance mechanism, Project scope, rationale and E&S principles	Public meetings, trainings/ workshops (separate meetings specifically for women and vulnerable people as needed), Mass/ social media	Project launch Meetings with relevant stakeholders, Meetings in affected	PIU

Stage	Target Stakeholders	Topic(s) of Engagement	Method(s) Used	Location/ Frequency	Responsibility
	Different Government Departments having link with project implementation General public, job seekers etc.		communication, Disclosure of Written information: Brochures, posters, flyers, website Information boards Grievance mechanism Notice board for employment recruitment	locations/ Communities as needed Communication through mass/ social media (as needed) Information desks With brochures/ posters in affected villages (continuous)	
	Other Interested Parties (External) Other Government Departments from which permissions/ clearances are required. Businessmen, Contractors and suppliers	Legal compliance issues, Project information scope and rationale and E&S principles, Coordination activities, Grievance mechanism process, ESMF, LMP, SEP, ESCP, Gender and SEA/SH action plan and RPF	Face-to-face meetings Invitations to public/ community meetings, Submission of required reports	Disclosure meetings, Reports as required	PIU
PHASE 2: Construction Phase	Project Affected People, including Vulnerable community	Grievance mechanism Health and safety impacts (RAP, ESMP, ESIA community H&S, community concerns) Employment opportunities	Public meetings, open houses, trainings/ workshop, Separate meetings as needed for women and vulnerable group. Individual outreach to PAPs as needed.	Quarterly meetings during construction phase Communication through mass/ social media as	PIU

Stage	Target Stakeholders	Topic(s) of Engagement	Method(s) Used	Location/ Frequency	Responsibility
		Project status	Disclosure of written information: brochures, posters, flyers, website Information boards. Notice board(s) at construction sites Grievance mechanism Local monthly newsletter	needed. Notice boards updated weekly. Routine interactions Brochures in local offices	
	Other Interested Parties (External)	Project scope, rationale and E&S principles Grievance mechanism Project status	Face-to-face meetings Joint public/ community meetings with PAPs	As needed (monthly during construction phase)	PIU
	Other Interested Parties (External) Press and media Various Government Departments General public, jobseekers	Project information-scope and rationale and E&S principles, Project status, Health and safety impacts, Employment opportunity, Environmental concerns, GBV related consultation, Grievance mechanism process	Public meetings, open houses, trainings/workshops Disclosure of written information: brochures, posters, flyers, website, Information boards Notice board(s) at construction sites. Grievance mechanism, GBV related issues would be handled and awareness on the issue including change of mind on the matter by the society at large would be addressed by implementing agencies including,	Same as for PAPs/ at regular intervals throughout the project period to educate and raise awareness amongst the population about the pitfalls of GBV and making them capable of addressing GBV in respective community.	PIU

Stage	Target Stakeholders	Topic(s) of Engagement	Method(s) Used	Location/ Frequency	Responsibility
			NGOs, NGOs specifically working on GBV matter, local leadership, religious leaders, elders including women representatives, teacher of the local schools and Madrassas.		
PHASE 3: Operation and Maintenance	Project Affected People including the vulnerable community	Satisfaction with engagement activities and GRM	Outreach to individual PAPs, PIU website, Grievance mechanism, Newsletter	Outreach as needed. Meetings in affected people and villages (as needed/ requested)	PIU
	Other Interested Parties (External), Press and media, NGOs linked with on GBV issue, Various Government Departments, local people, etc.	Grievance mechanism process Issues of concern Status and compliance reports	Grievance mechanism PIU websites Face-to- face meetings Submission of Reports as required	As needed	PIU

CHAPTER-10: INSTITUTIONAL ARRANGEMENTS AND CAPACITY

10.1 Implementation and Oversight Structure

A strong institutional arrangement is essential for effective implementation and oversight of compliance with the stipulated mitigation and monitoring measures given under the ESMP. It involves collaboration among governmental and non-governmental organizations, consultants, contractors, and key institutions.

The Project Implementation Unit (PIU) will have overall responsibility for project implementation and management. Monitoring of ESMP by BWDB will require field surveys, analyses and technical reporting. Environmental and Social Monitoring reports will be prepared by the Design and Supervision Consultants on a regular basis. BWDB have established a project implementation Unit (PIU) to address ESMP and SEP implementation as shown in **Figure 10.1**.

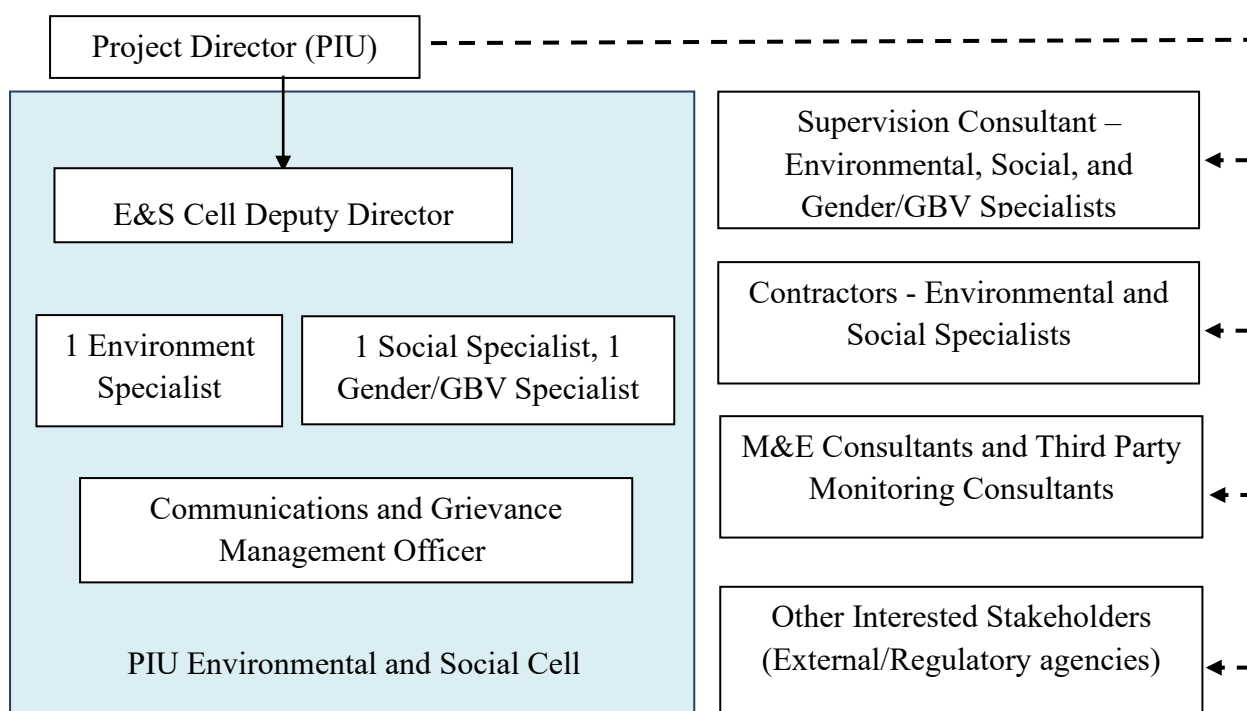


Figure 10.1: Institutional and oversight structure for Environmental and Social Management of the project

For project implementation from BWDB side, relevant key staffing 1 Environmental Specialist, 1 Social Specialist, and 1 Gender and GBV Specialist. The PIU also have other additional human resources like Procurement Specialist, Financial Management Specialist to strengthened the PIU and implement the project effectively. In addition, an M&E firm will

be hired to perform M&E of all project activities. A Design and Supervision Consultancy firm will be hired to supervise project implementation, including ESMP compliances.

10.2 Roles of Government, Proponent, Contractors, etc.

The Government of Bangladesh (GoB) will have overall responsibility for project implementation and management through its Ministry of Local Government, Rural Development, and Cooperatives (MoLGRD&C) and Ministry of Water Resources (MoWR). The proposed sub-project will be implemented by Project Implementation Unit (PIU) of BWDB. The PIU will hire 1 Environmental Specialist, 1 Social Specialist, and 1 Gender and GBV Specialist for technical support regarding project implementation. At the project level, a third party monitoring and evaluation consultancy firm will monitor the activities., LGED will be responsible for procuring the monitoring and evaluation firm that will also monitor activities of BWDB. The M&E firm will prepare monitoring reports as per the project components and share with authorities on a quarterly basis. Moreover, Department of Environment (DoE) and other external regulatory agencies of the GoB will ensure project's compliance with the laws of Bangladesh and also engage with the stakeholders of the project on E&S issues.

Following the Government's Rules of Business, the PIUs will report to their respective Ministerial Project Steering Committee (PSC), chaired by the respective Sr. Secretary/Secretary. The PSC will be responsible for: (i) providing implementation advice and operational guidance; (ii) reviewing financial and physical progress; (iii) resolving implementation problems; and (iv) providing any other necessary direction for effective implementation. The PSC will meet at least every six months.

Design and Supervision Consultants will be responsible for supervising the contractors for the implementation of ESMP. For this purpose, the *Design and Supervision Consultants* will appoint environmental, social and gender/GBV specialists, to ensure the ESMP implementation during the project period. They will supervise the contractor for the ESMP implementation, particularly the mitigation measures. They will also be responsible for implementing the monitoring of effects of these measures. The Environmental, Social, and Gender/GBV Specialists shall have relevant master's degrees with a minimum 10 years of experience in their relevant fields.

Contractors need to inform the PIU about issues related to the ESMP and SEP, resolve the environmental and grievance management issues, and also ensure health and safety of the labours and relevant stakeholders. They also have to collaborate the local communities and other local-level stakeholders on the E&S monitoring. Therefore, they need to appoint an environmental health and safety (EHS) officer, a sociologist and other related professionals.

3rd Party Monitoring and Evaluation Consultants will be engaged by the PIU to conduct external and independent monitoring and evaluation of the ESMP and SEP implementation. The main purpose of the 3rd party monitoring consultants will be to ensure that all the key entities, including E&S Cell and the Contractors, are effectively and adequately fulfilling their designated role for ESMP implementation and that all the ESMP requirements are being

implemented in a timely and effective manner. The Monitoring and Evaluation Consultancy team will appoint Environmental Specialist, Social Specialist, and Gender and GBV Specialist for effective monitoring of ESMP implementation. These relevant professionals shall have a minimum master's degree related to environmental/social sciences and have experience of more than 10 years in relevant fields.

The Project may also hire several other consultants to carry out various studies such as ESIA studies for future proposed investment activities; collection of baseline data on biodiversity at sensitive locations and implementation of a biodiversity conservation program; sustainable long-term maintenance of the bank protection and flood mitigation schemes.

10.3 Environmental and Social Capacity Assessment

Capacity building for effective implementation of the environmental and social requirements is a key element of the ESMP. Capacity building for environmental and social management will need to be carried out at all tiers of the project, including BWDB, PIU, supervision consultants, and contractors. At the construction site, supervision consultant will take the lead in implementing the capacity building plan, though the contractors will also be responsible to conduct trainings for their own staff and workers. The various aspects that are covered under the capacity building will include general environmental and social awareness, key environmental and social sensitivities of the area, key environmental and social impacts of the project, ESMP requirements, Occupational Health and Safety (OHS) aspects, and waste disposal. PIU may revise the plan during the Project implementation as required. During the maintenance phase of the Project, these trainings will continue to be conducted by BWDB for all relevant maintenance personnel and community.

10.4 Recommendations for Institutional Strengthening

The **Community Empowerment and Institutional Strengthening** sub-component will build local self-reliance through institutional strengthening. Cluster-level offices will function as resource hubs, training community leaders in governance, conflict resolution, and financial management. To enhance resilience and climate-smart practices, Village Development Fund sub-grants will be provided for climate-smart agriculture and income-generating projects.

Moreover, following institutional strengthening and capacity building programs are proposed for PIU of BWDB for strengthening their capacity in ESMP implementation:

- An Environmental and Social Cell need to be created within BWDB/PIU which will include relevant professionals described in Section 10.1.
- Capacity building initiatives need to be taken involving required trainings for the staff engaged in the project activities. A tentative summary of the training requirements are presented in the table below.
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Table 10.1: Tentative summary of training requirements for institutional strengthening

Contents	Participants	Responsibility	Schedule
General environmental and social awareness; Environmental and social sensitivity of the project influence area; Key findings of the ESIA; Mitigation measures; ESMP; Social and cultural values of the area; Community issues; Awareness of transmissible diseases Social and cultural values.	Selected staff of BWDB, Relevant individual consultants, Supervision & Monitoring Consultant and Contractor	BWDB with support from Supervision & Monitoring Consultant	Before the commencement of the project
ESMP; Waste disposal; OHS	BWDB Project team; all contractor staff / laborers at site	Contractor, with support from Supervision & Monitoring Consultant	Before commencement of the project
Camp operation; Waste disposal; OHS; Natural resource conservation; Housekeeping	Camp staff	Contractor, with support from Supervision & Monitoring Consultant	Before commencement of the project
Restoration requirements; Waste disposal.	Restoration teams	Contractor	Before commencement of the project

- BWDB needs to engage External Monitors during construction and excavation period to measure the effectiveness and residual impact of ESMP, as stated earlier. The External Monitors will submit the quarterly reports throughout the contract period, an impact evaluation report at the end of each year and finally a completion Report at the end of the contract period.
- A Grievance Redress Committee needs to be formed to implement the GRM depicted in Section 9.4.
- BWDB is committed to ensure that its operations will not create adverse environmental impacts. In this regard, the BWDB needs an appropriate Environmental Management System (EMS). It is intended to serve as a basis for discussion between the lending agencies and the BWDB to work out an appropriate EMS acceptable to both parties.

CHAPTER-11: MONITORING AND REPORTING

11.1 Monitoring Indicators and Methodology

During the pre-construction, construction and operation & maintenance phases of the project, environmental and social monitoring is essential to ensure compliance with regulations and promote sustainable development. Environmental and social indicators include air quality, noise level, water quality, soil quality, waste generation, drainage congestion and water logging, riverbank erosion, crop production, aquatic ecology, health and safety etc.

These indicators need to be monitored closely during all phases of the project. Monitoring methodologies involve baseline studies to establish pre-project conditions, regular monitoring through scheduled observations and measurements, participatory monitoring involving local communities, and systematic reporting to inform stakeholders and guide decision-making. These practices help in mitigating adverse effects and ensuring positive outcomes for both the environment and society. The monitoring indicators and methodology are clearly discussed in **Table 8-** under **Section 8.1**.

11.2 Frequency and Responsibility

Environmental and social monitoring is essential throughout the three main phases of a project: pre-construction, construction, and operation and maintenance. The monitoring works will be continuous throughout the project life cycle in specific frequencies.

Pre-construction Phase: Monitoring focuses on establishing baseline environmental and social conditions, ensuring that all necessary permits and approvals are obtained, and verifying that project designs incorporate appropriate mitigation measures. Responsibilities typically lie with the project proponent, supported by third-party consultants and contractors, to ensure that planning aligns with environmental and social standards, the sites are properly cleared without much impact on the surroundings and the baselines are properly established.

Construction Phase: During this phase, monitoring aims to ensure compliance with environmental and social management plans. This includes regular site inspections to assess air and water quality, noise levels, waste management, and labor conditions. Contractors are responsible for implementing mitigation measures, while third party monitoring consultants will conduct audits and report on compliance.

Operation and Maintenance Phase: Monitoring continues to assess the long-term effectiveness of mitigation measures and to detect any unforeseen impacts. This may involve periodic assessments of environmental parameters and social impacts. BWDB typically assumes responsibility for ongoing monitoring, with oversight from regulatory bodies to ensure continued compliance and to address any emerging issues.

Throughout all phases, the frequency and intensity of monitoring are determined by the project's scale, potential impacts, and regulatory requirements, ensuring that environmental

and social considerations are effectively managed. The project implementing agency, BWDB, and its PIU will take the major responsibility of monitoring whether the ESMP and the relevant regulations are being effectively implemented. Moreover, specific responsibilities will be taken by the Contractors, the Third Party Monitoring Consultants too. Furthermore, the regulatory bodies of the government will also monitor the compliance of relevant rules and regulations. The frequency and responsibility of the monitors are outlined in **Table 8-**.

11.3 Reporting Requirements

Monthly Compliance Reports

Contractor ESHS Officers will prepare and submit a monthly compliance report to the third-party Third Party Monitoring Consultants and PIU. The short report will contain the compliance activities completed throughout the month and record the resolution of any issues that may have arisen. The reports shall contain the following information:

- Summary of compliance activities;
- The updated list of all ESHS issues that arisen during the project period;
- Follow up information on any past issues that will still being resolved;
- Photographs of project activities related to the implementation of ESMP mitigation measures.

Biannual Compliance Reports

The PIU will prepare and submit an annual/biannual compliance report to the World Bank, detailing the compliance activities completed during the period and tracking the resolution of any issues that may have arisen for the ongoing sub-projects. The PIU will utilize the compliance checklists and monthly/bi-annual reports from the construction contractors and the third-party monitoring consultants to compile the biannual report.

The biannual report shall include the following information:

- Significant follow-up issues, actions, time frame, and responsible parties;
- Introduction, reporting period, and monitoring locations;
- Estimate of remaining construction and schedule;
- Summary of compliance activities;
- Progress made in ESMP implementation including key monitoring indicators;
- Site visits or other oversight activities by PIU and supervisory consultants;
- The updated list of all ESHS incidents occurred during the project, including attached notices of non-compliance issues;
- Follow up information on any outstanding issues that are still being resolved.

The reporting template for the environmental and social compliance monitoring is presented in Annex-8. It can be used as a guideline to prepare the sub-project-specific monitoring plan but it does not indicate the limitation of work. Rather, it can be modified based on project circumstances and depends on the project-specific activities. The required changes will be done with the consent of the ES specialist of BWDB and the World Bank.

11.4 Adaptive Management Measures

Adaptive Environmental and Social Management Measures are sometimes essential for addressing unforeseen challenges or changes during project implementation that may not have been anticipated in the original Environmental and Social Management Plan (ESMP). These measures involve a structured, iterative process that allows for the modification of mitigation and monitoring strategies in response to new information or changing conditions. When deviations from the ESMP are necessary due to project changes or unforeseen circumstances, adaptive management ensures that environmental and social risks are effectively managed by updating the ESMP accordingly. This approach promotes continuous learning and improvement, ensuring that project outcomes remain sustainable and aligned with environmental and social objectives.

Any modifications to the Environmental and Social Management Plan (ESMP) will be implemented following consultation and agreement with the Environmental and Social (ES) specialist of the Bangladesh Water Development Board (BWDB) and the World Bank. This collaborative approach ensures that all changes align with the project's environmental and social objectives and comply with the relevant standards and guidelines.

CHAPTER-12: CONCLUSION AND RECOMMENDATIONS

12.1 Conclusion

The proposed project has been initiated as a emergency response to the flood and bank protection measures of BWDB affected by the August 2024 flood and also mitigate the impacts from future flood events. The ESIA reveals that there will be both negative and positive impacts due to the proposed bank and slope protection works, repair of embankments and water control structures (regulators) as well as khal re-excavationct works.

The key positive impacts of the project are: better protection from riverbank erosion, flood control, drainage improvement and consequent increase in crop production, better fish migration, improvement in lives and livelihoods of the people residing within the catchments when the construction/rehabilitation activities are done. The major negative environmental impacts of the project are: air, noise and water pollution during the construction phase. Moreover, negative impacts due to contruction/rehabilitation activities are also likely on the lives and livelihoods living close to the structures to be repaired. Khal re-xcavation works are likely to damage benthic environment but it is very likely that it would replenish after the excavation works are completed.

An EMP has been formulated to mitigate the negative impacts during various phases (pre-construction, construction and Post construction /O&M) of the Project to acceptable levels. Moreover, public consultations have been organized as per the national legislations and World Bank ESSs. To ensure that the mitigation, enhancement and compensation measures are implemented correctly and negative impacts avoided, the EMP along with adequate budget is to be included in the contract documents of the Project with a separate line item on environmental management in the BOQ. The main monitoring parameters include monitoring of environmental quality monitoring (air, noise, surface water, ground water), biological monitoring and enhancement, social monitoring and GRM issues, health and safety, etc. Most of the potential impacts are short-term that can be avoided or mitigated by adopting mitigation measures and relevant ECoPs.

To keep the project influence area environmentally friendly, BWDB shall ensure that the Contractor prepare site specific ESMPs including Emergency response plan, Workers Health and Safety plan, Environmental Pollution Abatement and Mitigation Measures Plan, regular and effective monitoring of environmental quality parameters as indicated in this ESIA report.

Based on the assurance of minimal disturbance to the natural environment and implementation of ESMP in every step of the project activities, the proposed repair, rehabilitation, re-construction and excavation activities can proceed and DOE may issue necessary environmental clearance to such a nationally important project. BWDB shall follow the guidelines illustrated in the ESAMP and other legal and administrative requirements to carry out the activities for flood response and future preparedness.

12.2 Recommendation

Recommendations are made based on baseline conditions, impacts, mitigations measures, stakeholder consultations and importance of the project:

- It is suggested to implement the project interventions in the five districts following the recommended mitigation measures as specified in the ESMP. The ESMP shall be included in the bid document of civil works of all packages and need to become part of the civil works contracts;
- Timely implementation of ESMP shall be ensured by engaging a third-party as the Monitoring Consultant;
- The affected people shall be compensated before start of the project;
- In order to ensure contractor's compliance with the mitigation measures the Environmental and Social Monitoring Plan shall be strictly followed;
- Both BWDB and the contractor shall abide by relevant environmental rules, regulations including workers' health and safety aspect, prevention of air and water pollution and protection of fauna and flora.

REFERENCES

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- International Union for Conservation of Nature (IUCN). 2002. *Bio-ecological Zones of Bangladesh*.
- Danish Hydraulic Institute (DHI), Deltares, Institute of Water Modelling (IWM), University of Colorado Boulder, Columbia University, IHE Delft. 2021. *Climate Change Scenarios - Deliverable 4C: Meteorology - Long term Monitoring Research and Analysis of Bangladesh Coastal Zone (Sustainable Polders Adapted to Coastal Dynamics)*.

Annex A: ToR of ESIA

Bangladesh Water Development Board

Terms of Reference
of
Environmental and Social Impact Assessment (ESIA)
for
Bangladesh Sustainable Recovery, Emergency Preparedness and Response Project (B-STRONG)

Background

Bangladesh experienced extreme rainfall from mid-August to mid-September 2024, resulting in significant flooding that affected nearly six million people. The floods were primarily caused by a very severe rainfall event between 20th and 25th August 2024 at the end of the monsoon season.

This devastating floods in eastern Bangladesh caused severe damage, requiring immediate emergency interventions. As such, an emergency project is being prepared by Bangladesh Water Development Board (BWDB) with financing from The World Bank to mitigate the impacts from severe flooding.

1. Project Authority

The project is being undertaken by Bangladesh Water Development Board under the Ministry of Water Resources (MoWR) of the Government of Bangladesh.

Following are the focal persons of the project at BWDB:

Name	Designation	Email	Contact Number
Naba Kumar Chowdhury	Additional Chief Engineer and Focal Officer	pdpmuceip@gmail.com	02-222230289
Mohammad Samiul Hoque	Executive Engineer	samiul1979@gmail.com	01726233262

2. ESIA Team

The ESIA will be carried out through a Firm Consultancy service. Following is an indicative list of key professionals, who may be engaged for the satisfactorily delivery of this service. The Consultant retains the flexibility to involve additional resources and adjust the man-months and skill sets as deemed necessary. However, any claims beyond the negotiated contract amount will not be entertained during the execution of services to meet the objectives and scopes of this assignment.

Serial No.	Expert	Qualifications	Input (man-months)
1.	Environmental Specialist and Team Leader	- Master of Science in Environmental Science, Environmental Engineering, Civil Engineering, Water Resources Engineering or similar academic background - Minimum 10 years of professional experience	6

		▪ Minimum 5 years' experience with ESIA study ▪ Minimum 3 years' experience in position of Team Leader/Deputy Team Leader	
2.	Social Specialist and Deputy Team Leader	▪ Master of Science in Social Science, or similar academic background ▪ Minimum 10 years of professional experience ▪ Minimum 5 years' experience with ESIA study ▪ Minimum 2 years' experience in position of Team Leader/Deputy Team Leader	6
3.	Civil Engineer/ Water Resources Engineer	▪ Bachelor of Science Civil Engineering, Water Resources Engineering or similar academic background ▪ Minimum 8 years of professional experience ▪ Minimum 5 years' experience with hydraulic structures, embankments ▪ Experience of working in BWDB projects	4
4.	Gender Specialist	▪ Bachelor of Science in Social Science, Gender Studies or similar academic background ▪ Minimum 7 years of professional experience ▪ Minimum 3 years' experience of working with ESIA study ▪ Knowledge of gender-based issues and context in Bangladesh	2
5.	Communication Specialist	▪ Bachelor of Science in Journalism, Mass Media or similar academic background ▪ Minimum 5 years of professional experience ▪ Experience of working with government project in Bangladesh	2
6.	GIS Specialist	▪ Bachelor of Science in Geography, Environment, Engineering, or similar academic background ▪ Minimum 5 years of work experience ▪ Expertise in GIS, Remote Sensing	3
7.	Surveyor	▪ Diploma in Civil Engineering/Surveying ▪ Experience of digital surveying	4

3. Statement of Need

The B-STRONG project is an emergency initiative, aimed at mitigating the impacts of severe flooding in August 2024 in eastern Bangladesh. The August-September 2024 floods have severely impacted 11 eastern districts, affecting over 5.8 million people, causing damages of at least US\$1.676 billion.

From 19th to 25th August 2024, continuous rainfall in Feni District, coupled with upstream flood waters from India's Tripura state, caused a significant rise in the water levels of the Muhuri, Kahua, Selonia, and Feni Rivers. This resulted in a sudden flood that exceeded danger levels, triggering severe riverbank erosion along the Selonia River near Lemua Market. The erosion poses a serious threat to houses, shops, roads, and key structures, including schools, colleges, madrassas, and mosques, leaving the affected community at risk of displacement and severe public distress.

The broader impact of the floods extended across multiple districts in Chattagram Division, causing extensive damage to infrastructure, agriculture, and livelihoods. Over 17,000 km of roads, bridges, and culverts were destroyed, along with 28,000 houses and healthcare facilities. In addition, nearly 300,000 hectares of cropland were devastated, undermining food security and rural economies. The loss of 490,000 livestock and widespread damage to fisheries further exacerbated the economic challenges for affected populations, many of whom are already socio-economically vulnerable.



The project aims to address the urgent need for recovery and resilience-building in the affected districts, focusing on the restoration of critical infrastructure, protection against riverbank erosion, and rehabilitation of livelihoods. This includes implementing social action and environmental management plans, providing technical and hydrological support, and ensuring long-term disaster preparedness.

By enhancing resilience, improving livelihoods, and strengthening the capacity to respond to future crises, the project will contribute to the sustainable recovery and development of the affected regions by repairing damaged infrastructure which protect people and assets against future flooding.

The project aligns with Bangladesh's development priorities, emphasizing sustainable recovery, socio-economic stabilization, and enhanced resilience against future climate-related disasters. By integrating immediate relief efforts with strategies for long-term resilience, the initiative seeks to mitigate public distress, restore livelihoods, and safeguard communities against future risks. In such circumstances, it is essential to implement restoration works on an urgent basis.

4. Project Description/Concept

The objectives of this Project are:

- a) Increase the area protected in selected districts from flooding and rain fall, which are expected to worsen due to climate change,
- b) Improve agricultural production by reducing saline water intrusion in selected Districts;
- c) Improve the Government of Bangladesh's capacity to respond promptly and effectively to an eligible crisis or emergency;
- d) increase agricultural production of the net cultivable area through repair of embankments, drainage regulators, flushing sluices and drainage channels in the 5 Districts;
- e) increase crop yield through reduction of crop damages resulting from flooding and rain fall of the magnitudes of August 2024.

The major components of the project are as follows:

Component	Description	Tasks to be Undertaken
A.	Repair and Restoration of damaged structures in the 5 Districts	This component will finance activities that aim to increase community resilience to tidal flooding and storm surges. Investments include: (i) Repair of drainage and flushing structures, critical portions of flood embankments including slope protection works, (ii) River Bank Protection work in flood damaged location, (iii) upgrading drainage and flushing systems, and (v) improving operations and maintenance (O&M).
B.	Implementation of Social Action and Environment Management Plans	Embankments and water resources infrastructure are closely linked, with the operation and maintenance of sluice gates and associated infrastructure acting as critical regulation mechanisms for water management. Aiming at achieving this goal, Water Management Organizations (WMOs) will be formed in each district. In addition, this component will also cover compensation of any affected people, environmental and social assessment works.
C.	Construction Supervision, Monitoring & Evaluation of Project Impact, Supervision of Social and Environment Plans, and River basin Monitoring	This component will cover consulting services for (i) surveys, review and update if needed of designs prepared. This will include facilitating consultations with local communities in identifying needs and suitable design of the embankment as well as with other stakeholders such as local government, Upazila and Union level governments (ii) construction supervision (iii) quality control (iv) IPC preparation etc. In addition, this component will also cover early warning system related interventions, long term monitoring and research.

D.	Project Management, Technical Assistance, Training and Strategic Studies	This component will support BWDB in implementing the Project through Project management support and audits; whereby a fully functioning Project Management Unit (PMU) will be established and maintained and all necessary audit reports financed.
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Following are the proposed physical interventions under the project, aimed at restoring protection levels to their pre-flood standards:

- **Repair of embankments:** River embankments serve as critical flood barriers. Repair works involve restoring these structures to their original height and width, after damage from a flood event, ensuring they provide adequate protection against recurrent flooding. Materials like locally sourced silty clay are typically used, while compaction and maintenance are essential to prevent structural failures during high flood stages. Damages in embankments could be combined factors from flood, delayed maintenance, piping and seepage due to pipes passing through the embankment as well as sand mining.
- **Bank protection works:** Protection of the bank mitigates erosion of the toe of the embankment for the sake of its stability. For this, one of two basic principles is applied, which are either localized protected sections that aim to deflect the flow away from the bank or longer revetments (bank protection works) constructed along the affected riverbanks. In highly dynamic rivers with high sediment loads, the application of bank protection works is generally preferable as the resulting scour depths, scouring rates and associated geotechnical risks are comparable lower. Bank protection works tend to produce about half the scour rates compared with spurs or other protruding works.¹ In terms of hard structures, bank protection works are considered in this report considering an optimized variation of material. Two types of bank protection works are considered in this Study, permanent bank protection works (consisting of filter layers, geobags and CC-blocks) and precautionary bank protection works (consisting of filter layers and geobags). The selection of each type of measure is influenced by factors such as the urgency of implementation, alignment with an adaptive management plan, anticipated lifespan, and budget constraints.
- **Slope protection works:** Key requirement for protection of the embankment slope is to keep the embankment slopes stable and prevent erosion caused by wave attack. To safeguard embankment slopes, vegetation such as vetiver grass is planted, which anchors soil and minimizes erosion. Additionally, geotextiles and jute-based materials are often used to reinforce slopes against wave action and rain-induced slumping but also use of CC-blocks for more significant wave attacks.
- **Repair of regulators:** Regulators control water flow between rivers and polders, mitigating waterlogging and salinity intrusion. Repairs focus on ensuring operational gates, strengthening structures against seepage, and addressing sedimentation that hinders efficient drainage.

¹ AECOM, 2011. *Final Design Report River Training Works Annex F: Launching Aprons*. Prepared for Bangladesh Bridge Authority by AECOM in association with NHC, SMEC International, ACE Consultants.

- **Re-excavation of Canals:** Over time, canals become silted, reducing their capacity to drain excess water. Re-excavation restores these waterways, improving drainage and reducing flood risks. This intervention also enhances agricultural irrigation, vital for local livelihoods in the District areas.

Post-flood assessments have been conducted by each BWDB district to evaluate damage to flood protection infrastructure and identify additional vulnerable sections requiring intervention. Based on these assessments, BWDB compiled a comprehensive list of proposed interventions for the affected stretches.

ESIA Objectives : The primary objectives of the environment and social assessment are:

- Evaluate the environmental and social impacts of the B-STRONG project interventions.
- Identify measures to mitigate adverse impacts and enhance positive impacts.
- Ensure compliance with the World Bank Environmental and Social Framework (WB ESF) and Bangladesh Environmental Conservation Rules, 2023 (ECR,2023).
- Ensure meaningful stakeholder engagement, including participation of affected and vulnerable groups.
- Prepare an Environmental and Social Management Plan (ESMP) with monitoring measures.
- Integrate environmental and social considerations into project planning and decision-making.

5. Project Options

The project scope includes primarily repair and rehabilitation of damaged infrastructures. There are not much alternative options to the project works except No project alternative. Following is a brief discussion on these alternatives:

Option-1: No Project Scenario	Option-2: Project Implementation Benefit
The targeted project areas that were damaged during the floods will remain damaged and vulnerable to future disasters.	The targeted project areas will be improved through rehabilitation of damaged infrastructures, and resilient to future disasters.

6. Description of Existing Environment

Majority of the site areas under the project are situated around water channels like rivers, and canals.

There is no presence of the any designated sensitive environmental areas within the project influence area.

7. Baseline Information of the Proposed Project Area

Conduct field surveys to collect data on the current environmental and social conditions in including physical, biophysical and human environment in the project area.

Review existing literature, reports, and databases to supplement field data.

Engage with local communities, government agencies, and other stakeholders to gather additional information and perspectives.

Identify sensitive areas, cultural heritage sites, and potential social risks in accordance with WB ESF and ECR 2023 guidelines.

Ensure all baseline data is gender-disaggregated and age-sensitive where applicable, supporting risk analysis and impact mitigation planning.

I) Extent of Study Area or Impact Zones

In accordance with the applicable laws, and anticipated project impacts, the study will cover the surrounding area of the project site that may be affected during any stage of the project.

II) Applicable Policy and Institutional Considerations

All relevant policies related to industry operation in Bangladesh will apply to this planned ship recycling industry, including requirements to carry out an Environmental Impact Assessment, followed by an Environmental Management Plan (EMP), in accordance with the ECR, 2023 and other relevant regulations of the Department of Environment (DoE) of Bangladesh. The ESIA will also adhere to the relevant standards World Bank Environmental and Social Framework (ESF). Following are some of the most important Laws, Rules, and Regulations of the Government of Bangladesh that applies to the project:

- National Environmental Policy
- Environment Conservation Act 1995 (amended in 2000, 2002, & 2010)
- Environmental Conservation Rules 2023
- Bangladesh Solid Waste Management Rules 2021
- Bangladesh Air Pollution Control Rules 2022
- Ship Breaking and Recycling Rules 2011
- Bangladesh Ship Recycling Act 2018

III) Studies to be Carried out

All required studies for a comprehensive ESIA will be carried out. Following is a satellite image of the area around the site showing important features:

a. Survey and Data Collection on Existing Environment

- i. Topography,
- ii. Land use,
- iii. Geography,
- iv. Forestry,
- v. Weather and Climate

b. Baseline study

Parameters	Method of Data Collection and Analysis
Air quality	On-site air quality test

Soil type	Soil boring, followed by laboratory testing
Ground water	Laboratory test of ground water sample from on-site well
Surface water	Laboratory test of surface water sample from river
Noise levels (dB)	On-site test
Flora and fauna	Field survey and data collection from relevant organizations
Wildlife including birds	Field survey and data collection from relevant organizations
Biodiversity	Field survey and data collection from relevant organizations
Ecology	Field survey and data collection from relevant organizations

c. Socio Economic data

- i. Local community including vulnerable population,
- ii. Local infrastructures including cultural and religious establishments,
- iii. Livelihood characteristics,
- iv. Residential areas and
- v. Commercial activities,
- vi. Communication and media usage,
- vii. Transportation facilities,
- viii. Education levels.

d. Household level data

- i. Housing structures with available facilities,
- ii. Household income levels including Poverty (in comparison to national average).

Data collection will be carried out through Field Survey, Secondary data, Key Informant Interviews, Focus Group Discussions.

8. Site Location and Land Use

Project implementation area of the project are as follows:

Division	District	Upazilas
Chattogram	Feni	Feni Sadar, Dagonbhuiyan Fulgazi, Parshuram, Shonagazi, Chagolnaiya

	Noakhali	Companiganj, Hatiya, Subarnachar
	Cumilla	Adarsha Sadar, Burichang, Debidwar, Muradnagar, Titas, Daudkandi
	Laxmipur	Laxmipur Sadar, Ramgoti, Raipur
	Brahmanbaria	Akhaora

The lands under the project area are currently used for the same purpose by BWDB. Majority of the project works are going to rehabilitate existing infrastructures. The project will not acquire any additional lands but use existing BWDB owned lands.

9. Potential Significant Impacts

Identify and evaluate potential environmental and social impacts of the project activities. Assess the significance of identified impacts based on their magnitude, duration, and likelihood.

Following are the potential impacts that will be considered during conducting the ESIA:

- Impact on Physical Environment:
 - Geology,
 - Topography,
 - Soil Quality,
 - Surface Water Quality,
 - Ground Water Quality,
 - Air Quality,
 - Noise levels.
- Impact on Biological Environment:
 - Flora and fauna
 - Natural habitats
 - Wildlife
 - Biodiversity
- Impact on Socio-Economic Environment:
 - Infrastructures,
 - Livelihood,

- Household income,
- Residential areas,
- Commercial activities,
- Communication,
- Transportation,
- Education,
- Health and Safety risks to staffs, workers, and local residents.
- Impact on Local Communities:
 - Public health,
 - Vulnerable groups.
- Physical and Cultural Heritage:
 - Cultural heritage establishments,
 - Religious establishments,
 - Graveyards/Burial grounds/Crematorium

Impacts will be considered in 4 different stages for the following activities:

Stage	Major Activities	Anticipated Negative Impacts	Anticipated Positive Impacts
Pre-construction	Site preparation: ▪ Fencing the area ▪ Transportation of materials ▪ Stacking of materials	▪ Increased traffic ▪ Dust ▪ Soil ▪ Air pollution ▪ Movement restrictions ▪ Livelihood	▪ Livelihood opportunities

Construction	Civil works: ▪ Transportation of materials ▪ Construction of structures, and roads ▪ Movement of project officials and workers'	▪ Increased traffic ▪ Dust ▪ Noise ▪ Air pollution ▪ Water pollution ▪ Soil contamination ▪ Waste generation ▪ Health and safety risks ▪ Labor influx	▪ Livelihood opportunities
Operation and Maintenance	Ship recycling: ▪ Repair of damages ▪ Operation of hydraulic structures	▪ Dust ▪ Noise ▪ Waste generation ▪ Health and safety risks	▪ Increased disaster resilience ▪ Economic development
Decommissioning	▪ Demolition of structures	▪ Dust ▪ Noise ▪ Air pollution ▪ Water pollution ▪ Soil contamination ▪ Waste generation	▪ Livelihood opportunities

10. Mitigation and Abatement Measures

Appropriate mitigation measures to manage all the anticipated adverse impacts will be identified and corresponding plan will be outlined in the Environment and Social Management Plan (ESMP). All required mitigation measures will be addressed in the ESMP to later incorporate into operating procedures of the plant.

The waste management will be done in an environmentally friendly way to avoid any harm to public health. An Effluent treatment plant will be included to treat relevant wastes. Hazardous wastes will be decontaminated within the industrial compound. Some solid waste that are not hazardous will be dumped in landfill outside of the industrial compound.

11. Residual Impacts

The analysis will look into any possible residual impacts.

12. Stakeholder Consultation and Grievance Redress Mechanism

Organize public meetings, focus group discussions, and interviews to engage with a diverse range of stakeholders, including affected communities, vulnerable groups, and relevant institutions to solicit feedback from stakeholders.

Ensure consultations are inclusive, accessible, and culturally appropriate, with prior disclosure of project information in local languages and understandable formats.

Document stakeholder concerns, suggestions, and recommendations.

Incorporate stakeholder feedback into the impact assessment and mitigation measures.

Establish a grievance redress mechanism (GRM) to address concerns and complaints throughout the project lifecycle, in accordance with WB ESF and ECR 2023 requirements.

13. Environmental and Social Management Plan (ESMP)

The Environment and Social Management Plan (ESMP) will include action plans for implementing mitigation measures. ESMP provisions will be divided into Pre-construction, Construction, and Operationalization phases of the project. Special focus will be given to the operational phase as it will be the longest. The ESMP will also include emergency management plan. Nonetheless, The ESMP will also be supplemented by other relevant and required plans such as spoil management plan for canal re-excavation, waste management plan etc., as required.

14. Monitoring and Follow-up Plan

Periodic monitoring requirements, and responsibilities will be outlined in ESMP. There will be recommendation for provisioning following personnel to monitoring and addressing environmental issues:

- Environmental Specialist
- Health and Safety Specialist
- Medical personnel
- Social and Communication Specialist
- Communications officer

15. Decommissioning

The study will consider the requirements for decommissioning and include some procedural guidelines in EMP.

16. Tentative ToC

Tentative Table of Contents – ESIA Report

1. Executive Summary

- Project Overview
- Key Environmental and Social Impacts
- Summary of Mitigation Measures
- Residual Risks and Monitoring Needs
- Summary of Stakeholder Engagement

2. **Introduction**
 - Purpose of the ESIA
 - Legal and Institutional Framework
 - Scope of the Study
 - Structure of the Report
3. **Project Description**
 - Project Location and Components
 - Project Activities and Phases (construction, operation, decommissioning)
 - Project Alternatives Considered
 - Associated Facilities and Ancillary Projects
4. **Policy, Legal, and Regulatory Framework**
 - National Environmental and Social Laws
 - Applicable World Bank ESF Standards
 - Other Relevant International Obligations
5. **Baseline Environmental and Social Conditions**
 - Physical Environment (air, water, soil, noise, climate)
 - Biological Environment (flora, fauna, habitats, biodiversity)
 - Socioeconomic Environment (land use, livelihoods, vulnerable groups, gender)
 - Cultural Heritage (if applicable)
 - Summary of Data Sources and Methods Used
6. **Environmental and Social Risks and Impacts**
 - Identification of Key Risks and Impacts
 - Impact Assessment Methodology
 - Significance of Impacts
 - Cumulative and Induced Impacts
7. **Mitigation Measures and Impact Management**
 - Environmental and Social Mitigation Hierarchy
 - Residual Impacts After Mitigation
 - Climate Change Considerations and Adaptation Measures
 - Resource Efficiency and Pollution Prevention
8. **Environmental and Social Management Plan (ESMP)**
 - Mitigation and Monitoring Measures
 - Roles and Responsibilities
 - Implementation Schedule
 - Capacity Building and Training Needs
 - Budget Estimates
9. **Stakeholder Engagement**
 - Stakeholder Identification and Analysis
 - Engagement Activities and Consultation Process
 - Key Issues Raised and Responses
 - Grievance Redress Mechanism
 - Future Engagement Plan
10. **Institutional Arrangements and Capacity**
 - Implementation and Oversight Structure
 - Roles of Government, Proponent, Contractors, etc.

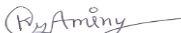
- Environmental and Social Capacity Assessment
- Recommendations for Institutional Strengthening

11. Monitoring and Reporting

- Monitoring Indicators and Methodology
- Frequency and Responsibility
- Reporting Requirements
- Adaptive Management Measures

Annex B:

Physical Baseline Test Reports

Institute of Water Modelling (IWM)																			 Water Environment & Climate		
Water Quality Lab Test Report																					
SL No		Sample ID	PH	EC (µS/cm)	Salinity (ppt)	TDS (mg/L)	DO mg/L	TSS (mg/L)	Turbidity (NTU)	Fluoride (mg/L)	Potassium (mg/L)	Bromine (mg/L)	Nitrate_NO ₃ (mg/L)	Orthophosphate (mg/L)	BOD (mg/L)	Nitrite (mg/L)	Iron (mg/L)	Ammonia (mg/L)	Chloride (mg/L)	Color (PtCo)	Magnnagense (mg/L)
1	Laxmipur_Rahmatkha li Regulator	SW_01	7.73	3470	1.76	1741	6.5	4	42	0.13	38.1	0.07	1.8	0.68		0.132			1550		
2	Wapda Khal	SW_02	7.67	880		496	6.99	7	9.92	0.2	13.7	2.28	0.04	3.5		0.007	0.03	0.4	594	59	0.065
3	Haora River_BBaria	SW_03	8.39	95.5		51.5	3.63	45	3.48	0.05	3.5	0.09	1.34	0.62		0.139	1.74	1.25	53	530	0.149
4	Musapur Regulator	SW_04	6.98	27300	16.14	15780	7.36	10	255	0.85	62.9	0.06	0.35	0.54	1.2	0.003			19500		
5	Noler Char	SW_05	6.88		11.56	11280	7.4	18	821	0.53	88.5	0.06	0.49	0.28	1.5	0.05			7625		
6	Boyer Char	SW_06	7.32	13210	7.35	7140	7.04	7	230	0.62	72.2	0.63	0.15	0.55	1.4	0.005			5750		
7	Char Maksumul Hakim	SW_07	6.91	20200	15.47	16060	6.87	25	1131	1.08	77.6	0.13	0.85	0.2	1.6	0.005			9375		
8	C Khal	SW_11	8.25	212.2		115.1	3.17	8	7.2	0.41	7.7	0.05	0.16	1.54		0.014	0.32	2.28	89	99	0.259
9	Laxmipur_Rahmatkha li Regulator	GW_01	7.8	1492	0.73	729	6.4		47.5	0.32	12.5	0.1	4.47	0.69		0.536	0.77	0.13	536		
10	Haora River_BBaria	GW_03	8.56	164		88.6	1.78	7	26.3	0.34	3.2	0.02	0.08	5.08		0.012	1.19	0.91	41	120	0.393
11	Musapur Regulator	GW_04	7.71	1326	0.64	640	1.65		5.81	1.29	50.7	0.1	1.19	3.5		0.521	0.09	3.5	386		
12	Noler Char	GW_05	8.36	716	0.34	338	7.13		20.5	0.22	7.5	0.05	4.36	0.51		0.522	0.15	0.01	204		
13	Boyer Char	GW_06	7.29	4240	2.19	2155	4.54		100	0.19	33.3	0.48	4.44	0.26		0.533	0.45	0.57	1475		
14	Char Maksumul Hakim	GW_07	7.87	1211	0.58	584	6.12		1.79	0.59	30.4	0.07	4.33	0.81		0.402	0.01	0.02	259		
15	Little Feni	GW_08	7.68	950	0.46	458	5.55		3.17	2.03	14.2	0.13	4.48	3.5		0.54	0.46	0.14	272		
16	Selonia River	GW_09	7.71	1038	0.5	500	5.98		9.27	0.88	25.7	0.28	4.49	1.99		0.533	0.01	0.03	369		
17	Muhuri River	GW_10	7.68	1071	0.52	523	3.57		2.05	0.44	2.2	0.09	0.15	1.12		0.01	0.01	0.73	453		
18	C Khal	GW_11	8.47	274		153.6	4.29	2	6.27	0.31	6.1	0.01	0.04	3.5		0.029	0.22	0.34	47	18	0.05
Tested By																			Checked By		
																					
Md. Ashikur Rahman (HKR)																			Khusbo Yea Aminy (KYT)		
Lab Technician																			Junior Specialist/Lab Manager (In-Charge)		
Survey and Data Division (SDT)																			Survey and Data Division (SDT)		
Institute of Water Modelling (IWM)																			Institute of Water Modelling (IWM)		

Institute of Water Modelling (IWM)

Water Quality Lab Test Report



SL No	Parameter	Unit	Gomti SW	Ruita SW	Gomti GW	Ruita GW	Remarks
1	pH		7.95	7.91	8.05	7.84	
2	Temperature	°C	23.70	23.30	23.40	23.60	
3	EC	μS/cm	116.70	384.00	143.10	123.50	
4	TDS	mg/L	56.90	192.00	70.10	60.30	
5	DO	mg/L	6.06	2.17			
6	Salinity	ppt	0.06	0.19	0.07	0.06	
7	Turbidity	NTU	38.90	76.80			
8	TSS	mg/L	47.00	58.00			
9	Ca ²⁺	mg/L	2.58	1.35			
10	Mg ²⁺	mg/L	0.86	0.54			
11	Ca as CaCO ₃	mg/L	2.91	3.68			
12	Mg as CaCO ₃	mg/L	3.53	2.23			
13	Cl ⁻	mg/L	34.50	103.00			
14	NO ₃ ⁻	mg/L	3.68	3.86			
15	BOD	mg/L	1.40	6.00			
16	Fe	mg/L			0.04	1.06	
17	Mn	mg/L			0.07	0.24	

Tested By

Ashik

Md. Ashikur Rahman (HKR)

Lab Technician

Survey and Data Division (SDT)
Institute of Water Modelling (IWM)

Checked By

K. Amini

Khusbo Yea Amini (KYT)
Junior Specialist/Lab Manager (In-
Charge)
Survey and Data Division (SDT)
Institute of Water Modelling (IWM)

Institute of Water Modelling (IWM)

Water Quality Lab Test Report



SL No	Parameter	Unit	Dakatia River	Selsonia River	Muhuri River	Remarks
1	pH		8.72	8.40	8.17	
2	EC	μS/cm	725	185.10	139.9	
3	TDS	mg/L	364	91.10	68.3	
4	DO	mg/L	1.87	2.22	4.7	Measured on 13.01.2025
5	Temp.	°C	23.70	23.70	23.7	
6	Salinity	ppt	0.36	0.09	0.07	
7	TSS	mg/L	1394	5.00	17	
8	Ca ²⁺	mg/L	1.71	5.05	1.14	
9	Mg ²⁺	mg/L	0.25	0.74	0.69	
10	Cl ⁻	mg/L	200	49.50	40	
11	NO ₃ ⁻	mg/L	0.30	0.11	0.11	
12	BOD	mg/L	46	2.80	0.2	measured the sample 48-72 hours after collecting it
13	Ca as CaCO ₃	mg/L	1.07	5.99	4.71	
14	Mg as CaCO ₃	mg/L	1.04	3.06	2.86	

Tested By

Ashik

Md. Ashikur Rahman (HKR)
Lab Technician
Survey and Data Division (SDT)
Institute of Water Modelling (IWM)

Checked By

K. Aminy

Khusbo Yea Aminy (KYT)
Junior Specialist/Lab Manager (In-Charge)
Survey and Data Division (SDT)
Institute of Water Modelling (IWM)

Form No. QSF-22

Revision No. 13

Revision Date: 04 November, 2023



জীবনের জন্য বিজ্ঞান



বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Institute of National Analytical Research and Service (INARS)

ANALYSIS REPORT

ASC Ref No. : IN-223 of Analytical Service Cell
BCSIR, 17/05/2025

Lab/Sample ID : A-771-774

Client's Details : আহসান হাবীব

ইনস্টিটিউট অফ ওয়াটার মডেলিং (আইডব্লিউএম)

INSTITUTE OF WATER MODELLING (IWM)

House 06, Road-3C, Block-H, Sector-15, Uttara, Dhaka-1230.

Number of Sample : 04 (Four)

Sample Description : ড্রুজেন/ডিসপোসাল ম্যাটেরিয়াল এর পরীক্ষা প্রসংগে, তারিখঃ ১৭-০৫-২০২৫ ইং।

Test Commencement Date : 17/05/2025

Test Completion Date : 03/06/2025

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-771	Surface Water (C Khal)	TOC (Total Organic Carbon)	5.07 mg/L	5310.B
A-772	Surface Water (Musapur Regulator)	TOC (Total Organic Carbon)	1.03 mg/L	5310.B
A-773	Surface Water (Selonia River)	TOC (Total Organic Carbon)	3.95 mg/L	5310.B
A-774	Surface Water (Ruita Khal-02)	TOC (Total Organic Carbon)	11.3 mg/L	5310.B

04.06.25

Analyst

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

04/06/25

Supervisor

Dr. Md. Ahedul Akbor
Principal Scientific Officer
Institute of National Analytical
Research & Service (INARS)
BCSIR, Dhaka-1205

04/06/25

Director

Dr. Md. Salim Khan
Director (Additional In-Charge)
Institute of National Analytical
Research and Service (INARS)
BCSIR, Dhaka-1205.

Page 1 of 1

Note:

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Analytical Service Cell

Dr. Quadrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Bangladesh

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

Form No. QSF-22

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Revision Date: 04 November, 2023



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BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Institute of National Analytical Research and Service (INARS)

ANALYSIS REPORT

ASC Ref No. : IN-227 of Analytical Service Cell

BCSIR, 17/05/2025

Lab/Sample ID : A-766-770

Client's Details : আহসান হাবীব

ইনস্টিটিউট অফ ওয়াটার মডেলিং (আইডব্লিউএম)

INSTITUTE OF WATER MODELLING (IWM)

House 06, Road-3C, Block-H, Sector-15, Uttara, Dhaka-1230.

Number of Sample : 05 (Five)

Sample Description : ড্রুজ/ডিসপোসাল ম্যাটেরিয়াল এর পরীক্ষা প্রসঙ্গে, তারিখঃ ১৭-০৫-২০২৫ ইং।

Test Commencement Date : 17/05/2025

Test Completion Date : 02/06/2025

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-766	Ground Water (Laxmipur_Rahmatkhali Regulator)	Arsenic (As)	Less than 0.005 mg/L	3114.C
A-767	Ground Water (C Khal)	Arsenic (As)	Less than 0.005 mg/L	3114.C
A-768	Ground Water (Haora River_BBaria)	Arsenic (As)	Less than 0.005 mg/L	3114.C
A-769	Ground Water (Ruita Khal-01)	Arsenic (As)	Less than 0.005 mg/L	3114.C
A-770	Ground Water (Ruita Khal-02)	Arsenic (As)	Less than 0.005 mg/L	3114.C

[Signature]
02/06/25

Analyst

Md. Ripaj Uddin

Scientific Officer

Institute of National Analytical Research & Service (INARS)

Noted: BCSIR, Dhaka-1205

[Signature]
02/06/25

Supervisor

Dr. Muhammad Abdullah Al-Mansur

Principal Scientific Officer

Institute of National Analytical Research & Service (INARS)

BCSIR, Dhaka-1205

[Signature]
02/06/25

Director

Dr. Md. Salim Khan

Director (Additional In-Charge)

Institute of National Analytical Research & Service (INARS)

BCSIR, Dhaka-1205.

- a. BCSIR, Dhaka-1205 here are based only on the supplied sample in the laboratory.
b. Any complain about test report will not be accepted after the date of issuing of the test report.
c. This report/result shall not be reproduced/published without prior approval of the authority.

Analytical Service Cell

Dr, Quadrat-I-Khuda Road, Dhanmondi, Dhaka-1205, Bangladesh

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Form No. QSF-22

Revision No. 13

Revision Date: 04 November, 2023



বাংলাদেশ বিজ্ঞান ও শিল্প গবেষণা পরিষদ

BANGLADESH COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Institute of National Analytical Research and Service (INARS)

ANALYSIS REPORT

ASC Ref No. : IN-229 of Analytical Service Cell

BCSIR, 17/05/2025

Lab/Sample ID : A-775-776

Client's Details : আহসান হাবীব

ইনস্টিটিউট অফ ওয়াটার মডেলিং (আইডব্লিউএম)

INSTITUTE OF WATER MODELLING (IWM)

House 06, Road-3C, Block-H, Sector-15, Uttara, Dhaka-1230.

Number of Sample : 02 (Two)

Sample Description : ড্রুজেন/ডিসপোজাল ম্যাটেরিয়াল এর পরীক্ষা প্রসংগে, তারিখঃ ১৭-০৫-২০২৫ ইং।

Test Commencement Date : 17/05/2025

Test Completion Date : 03/06/2025

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-775	Soil (C Khal)	Magnesium (Mg)	2646 mg/kg	3111.B
		Potassium (K)	1002 mg/kg	3500-K.B
		TOC (Total Organic Carbon)	3.35 %	5310.B
		Cadmium (Cd)	< 0.001 mg/kg	3111.B
		Lead (Pb)	6.37 mg/kg	3111.B
A-776	Soil (Ruita Khal-02)	Magnesium (Mg)	848 mg/kg	3111.B
		Potassium (K)	678 mg/kg	3500-K.B
		TOC (Total Organic Carbon)	2.28 %	5310.B
		Cadmium (Cd)	< 0.001 mg/kg	3111.B
		Lead (Pb)	8.37 mg/kg	3111.B

04.06.25

Analyst
A. H. M. Shofiul Islam Molla Jamal
Senior Scientific Officer
Institute of National Analytical
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4/6/25

Supervisor
Dr. Md. Ahdul Akbor
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04/06/25

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Note:
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Analytical Service Cell

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প্রাণিবিদ্যা বিভাগ

ঢাকা বিশ্ববিদ্যালয়

ঢাকা ১০০০, বাংলাদেশ

ফোনঃ ৮৮০-২-৯৬৬১৯০০-৭৩

এক্সঃ ৭৫৮০, ৭৫৮১; ফ্যাক্সঃ ৮৮০-২-৯৬৬৭২২২

01 June 2025

Project Director

Institute of Water Modelling (IWM)

IWM Bhaban, House-06, Road#3C,

Block-H, Sector-15, Uttara, Dhaka-1230

Bangladesh

Benthos Organism Analysis Report

Organism type	Sample/Site Name	Group Name	Species Name	Number of organisms
Benthos	C Khal	Insect larvae	<i>Chironomus</i> sp.	04
		Annelids	<i>Tubifex</i> sp.	05
		Molluscs	<i>Bellamya</i> sp.	02
	Ruita Khal	Molluscs	<i>Corbicula</i> sp.	02
		Annelids	<i>Tubifex</i> sp.	03

Md. Mizanur Rahman PhD

Associate Professor

Email: mizan.rahmanzool@du.ac.bd

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Annex C: Air Quality and Noise Measurement Report

Annex D: Ecological Survey Reports

Aquatic and Terrestrial Biodiversity of Noakhali and Feni: Fish, Reptiles, Birds, Mammals, and Plant Species

Visited Sites:

- Bank protection and slope protection locations and surrounding area on banks of Feni River, Little Feni and Matubhuyan River, and Selonia River
- Bank protection and slope protection locations and surrounding area near Musapur regulator
- Embankment Re-sectioning locations and surrounding area near Kahua River, Muhuri River, and Selonia River
- Bank protection locations and surrounding area along Noler Char coast
- Some regulator sites which are proposed for repair

Identified Species:

Fish

The project sites in Noakhali and Feni district continue to exhibit rich aquatic biodiversity, with Feni representing freshwater ecosystems and Noakhali featuring both freshwater and brackish water environments. These regions support diverse fish assemblages that are critical for sustaining local livelihoods, food security, and ecosystem services.

Aquaculture practices in both Noakhali and Feni are characterized by the dominance of key indigenous species such as *Labeo rohita* (Rohu), *Catla catla* (Katla), *Cirrhinus mrigala* (Mrigal), and *Pangasius suchi* (Pangas), which are widely cultured in ponds and canals, coastal in Noakhali and freshwater in Feni. In both regions, there is a noticeable trend toward polyculture systems, as evidenced by the increasing inclusion of introduced species like *Oreochromis niloticus* (Nile Tilapia), *Cyprinus carpio* (Common Carp), and *Barbonymus gonionotus* (Thai Sorputi). This reflects a shared evolution in aquafarming practices, aimed at enhancing productivity and diversification in local aquaculture systems.

A wide range of wild capture species is also present in both districts. Seasonal monsoon floods and pond overflows facilitate the migration of cultured species into nearby canals and floodplain wetlands, which serve as important habitats for resident and migratory fish species.

Common native species found in these riverine and canal systems include:

- Small indigenous species (SIS) such as *Puntius* spp. (Puti), *Mystus vittatus* (Tengra), *Gudusia chapra* (Chapila), *Parambassis ranga* (Chanda), *Heteropneustes fossilis* (Shing), *Clarias batrachus* (Magur), *Channa punctata* (Shol), *Channa marulius* (Gajar), *Mastacembelus* spp. (Biam), and *Amblypharyngodon mola* (Mola)
- Predatory species like *Channa striata* (Snakehead), *Wallago attu* (Boal), and *Channa marulius* (Gajar).
- Seasonally introduced aquaculture species, such as *Pangasianodon hypophthalmus* (Thai Pangas) and *Barbonymus gonionotus* (Thai Sarputi), along with various native aquaculture species, often escape into natural water systems, contributing to the dynamic interaction between cultured and wild fish populations.

These river and canal fisheries not only support the subsistence and commercial needs of local fishing communities but also demonstrate the ecological productivity and resilience of the aquatic systems in the project area.

Following table provides a detailed inventory of both cultured and wild-caught fish species observed within the Noakhali and Feni districts. This information serves as an essential baseline for resource management and informs the project's efforts to preserve traditional knowledge and implement sustainable environmental and social management strategies.

Table . Fish species observed in the Noakhali and Feni areas.

Local Name	English Name	Local Name	Scientific Name	Aquaculture/ Natural
Rui	Roho labeo	রুই	<i>Labeo rohita</i>	Aquaculture
Katla	Catla	কাতলা	<i>Labeo catla</i>	Aquaculture
Mrigel	Mrigal carp	মৃগাল	<i>Cirrhinus mrigala</i>	Aquaculture
Tilapia	Tilapia	নাইলটিকা	<i>Oreochromis niloticus</i>	Aquaculture
Commonr Carp	Common Carp	কার্পিও	<i>Cyprinus caprio</i>	Aquaculture
Thai sorputi	Silver barb	থাই সরপুটি	<i>Barbonymus gonionotus</i>	Aquaculture
Grass Carp	Grass Carp	গ্রাস কার্প	<i>Ctenopharyngodon idella</i>	Aquaculture
Silver Carp	Silver Carp	সিলভার কার্প	<i>Hypophthalmichthys nobilis</i>	Aquaculture
Thai pangus	Striped catfish	থাই পান্ডাস	<i>Pangasianodon hypophthalmus</i>	Aquaculture
Ayre/Aor	Longwhiskered Carfish	আইড়	<i>Aorichthys aor</i>	Natural
Bele/Bailla	Tank Goby	বেলে	<i>Glossogobius giuris</i>	Natural
Boal	Freshwater Shark	বোয়াল	<i>Wallago attu</i>	Natural
Chela	Large razorbelly minnow	চেলা	<i>Salmophasia bacaila</i>	Natural
Chela	Silver Razorbelly Minnow	চেলা	<i>Salmophasia acinaces</i>	Natural
Gajar/Gajal	Giant Snakehead	গজার মাছ	<i>Channa marulius</i>	Natural
Guizza Ayer	Giant Rivercatfish	আইড়	<i>Sperate seenghala</i>	Natural
Kaikla	Freshwatr Garfish	কাকিলা	<i>Xenentodon cancila</i>	Natural
Koi	Climbing Perch	কৈ	<i>Anabas testudineus</i>	Natural and aquaculture
Cuchia	Gangetic Mudeel	কুচিয়া	<i>Monopterusuchia</i>	Natural
Magur/Jagur	Walking catfish	মাগুর	<i>Clarias batrachus</i>	Natural
Mola	Mola Carplet	মলা	<i>Amblypharyngodon mola</i>	Natural
Tengra/Gols ha-tengra	Day's Mystus	টেংরা	<i>Mystus bleekeri</i>	Natural
Pholoi	Grey Featherback	কানলা	<i>Notopterus notopterus</i>	Natural
Jatputi	Pool barb	জাতপুটি	<i>Puntius sophore</i>	Natural
Teri puti	Onespot barb	টেরি পুটি	<i>Puntius terio</i>	Natural
Rita	Rita	রিটা	<i>Rita rita</i>	Natural
Pangus	Pangus catfish	পান্ডাস	<i>Pangasius pangasius</i>	Natural
Leijja Poa	Pama croaker	লেইজা পোয়া	<i>Otolithoides pama</i>	Natural

Local Name	English Name	Local Name	Scientific Name	Aquaculture/ Natural
Shol mach	Striped snakehead	শোল মাছ	<i>Channa striata</i>	Natural
Shing	Stinging Catfish	শিং মাছ	<i>Heteropneustes fossilis</i>	Natural
Deshi Sarputi	Olive Barb	সরপুটি	<i>Systomus sarana</i>	Natural
Taki	Spotted Snakehead	টাকি	<i>Channa punctatus</i>	Natural
Tel Taki	Asiatic Snakehead	গাছুয়া	<i>Channa orientalis</i>	Natural
Tit Punti	Ticto barb	তিত পুটি	<i>Puntis ticto</i>	Natural
Kata chanda	Glassy perchlet	কাঁটা চান্দা	<i>Parambassis sp.</i>	Natural
Tengara	Striped dwarf catfish	টেংরা	<i>Mystus vittatus</i>	Natural
Tengara	Tengara catfish	ডোরা টেংরা	<i>Mystus tengara</i>	Natural
Chingri (Large)	Prawn	গলদা চিংড়ি	<i>Macrobrachium rosenbergii</i>	Natural
Chingri (Small)	Prawn	ছোট বা গুড়া চিংড়ি	<i>Macrobrachium sp.</i>	Natural
Chingri (Large)	Shrimp	বালদা চিংড়ি	<i>Penaeus monodon</i>	Natural
Kakra	Crab	কাঁকড়া	<i>Austrotelphusa sp</i>	Natural
Kaitta	Red-crowned Roofed Turtles	কাইট্টা	<i>Batagur kachuga</i>	Natural

Reptiles

The project areas of Noakhali and Feni currently support a notable diversity of reptilian fauna, reflecting the region's ecologically rich and varied habitats. Commonly observed species include lizards such as *Calotes versicolor* (Garden Lizard) and *Hemidactylus brookii* (Spotted House Gecko), which thrive in both natural and human-modified environments. Several species of monitor lizards, including *Varanus bengalensis* (Bengal Monitor) and *Varanus flavescens* (Yellow Monitor), are also present. However, the occasional sightings of freshwater turtles such as *Geoclemys hamiltonii* (Spotted Pond Turtle) and *Batagur kachuga* (Red-crowned Roofed Turtle) highlight the ecological significance and conservation value of these habitats in supporting reptilian biodiversity. A detailed list of reptile species currently recorded in the project areas is provided in following table.

Table . Reptile species recorded within the project area.

Local Name	Local Name	Scientific Name
Striped grass skink	স্ট্রিপ গ্রাস সাইনক/আচিল	<i>Mabuya dissimilis</i>
Dora shap/ Buff Striped keel back	ডোরা সাপ	<i>Amphiesma stolatum</i>
Painna Shap, Common-Smooth-scaled Water Snake	পাইন্না সাপ	<i>Enhydryis enhydryis</i>
Gui shap/Clouded monitor	গুই সাপ	<i>Varanus nebulosus</i>
Holdey Gui Shap/yellow monitor	হলদে গুই সাপ	<i>Varanus flavescens</i>
Maitta Shap/Split keelback	মাইট্টা সাপ	<i>Atretium schistosum</i>

Local Name	Local Name	Scientific Name
Original garden lizard	বাগানের গিরগিটি	<i>Calotes versicolor</i>
Tiktiki/spotted house gecko	টিকটিকি	<i>Hemidactylus brookii</i>
Bengal monitor, Gui shap	গুইসাপ	<i>Varanus bengalensis</i>
Spotted Pond Turtle	কালো কাছিম	<i>Geoclemys hamiltonii</i>
Red-crowned roofed turtle	কড়ি কাইট্টা	<i>Batagur kachuga</i>

Birds

The project areas of Noakhali and Feni currently support a wide variety of common bird species, highlighting the continued presence of vibrant and ecologically diverse avian habitats. Key species include *Copsychus saularis* (Doel) and *Passer domesticus* (House Sparrow), which remain prevalent around human settlements. **Following table** presents the bird species currently documented in these areas, based on updated baseline ecological surveys and verified secondary sources.

Predatory birds such as *Milvus migrans* (Black Kite) and *Aviceda jerdoni* (Jerdon's Baza) are frequently observed soaring above, while waterbirds like *Ardea insignis* (Large Egret), *Ardeola grayii* (Indian Pond Heron), and *Halcyon smyrnensis* (White-throated Kingfisher) are commonly seen in and around wetland habitats. The continued presence of species such as *Eudynamis scolopacea* (Asian Koel), *Acridotheres tristis* (Common Myna), and *Sturnus contra* (Asian Pied Starling), along with woodpeckers like *Dinopium benghalense* and various drongos and doves, underscores the ecological richness of the region and the critical need to conserve these habitats to support sustained bird populations.

Table . Bird species documented within the project area.

Local Name	Local Name	Scientific Name
Babui	বাবুই	<i>Ploceus philippinus</i>
Baj	বাজ	<i>Aviceda jerdoni</i>
Bhat Shalik	ভাত শালিক	<i>Acridotheres tristis</i>
Bhutum Pencha	ভুতুম পেচা	<i>B. bengalensis</i>
Bulbuli	বুলবুলি	<i>Pycnonotus cafer</i>
Charui	চড়ুই	<i>Passer domesticus</i>
Chil	চিল	<i>Milvus migrans</i>
Choto Fingey	ছোট ফিংগে	<i>D. aeneus</i>
Dahuk	ডাউক	<i>Amaurornis akool</i>
Dar Kak/Jungle crow	দাড়কাক	<i>Corvus macrorhynchos</i>
Doel	দোয়েল	<i>Copsychus saularis</i>
Fingey	ফিংগে	<i>Dicrurus macrocercus</i>
Gangchil	গাংচিল	<i>Gelochelidon nilotica</i>
Ghughu (Spotted)	তিলা ঘুঘু	<i>Spilopelia chinensis</i>
Gobrey Shalik	গোবরে শালিক	<i>Sturnus contra</i>
Holdey Pakhi	হলদে পাখি	<i>Oriolus xanthornus</i>
Jalali Kobutar	জালালি কবুতর	<i>Columba livia</i>
Kalo Shalik	কালো শালিক	<i>Aplonis panayensis</i>
Kana Bok	কানা বক	<i>Ardeola grayii</i>

Local Name	Local Name	Scientific Name
Kaththokra	কাঠঠোকা	<i>Dinopium benghalense</i>
Kokil	কোকিল	<i>Eudynamys scolopacea</i>
Kura	কূড়া	<i>Gallicrex cinerea</i>
Maachranga	মাছরাঙ্গা	<i>Halcyon smyrnensis</i>
Pan Kauri	পান কৈরী	<i>Rynchops albicollis</i>
Pati Kak	পাতিকাক	<i>Carvus splendens</i>
Pencha/Owl	পেচা	<i>Bubo nipalensis</i>
Sada Bok	সাদা বক	<i>Ardea insignis</i>
Shankho Chil	শঙ্খ চিল	<i>Haliastur Indus</i>
Tia	টিয়া	<i>Psittacula krameri</i>
Tuntuni	টুনটুনি	<i>Orthotomus sutorius</i>

Mammals

The project areas of Noakhali and Feni currently support a variety of common mammalian species, reflecting the ecological richness of their natural and semi-urban landscapes. Frequently observed small mammals include *Callosciurus pygerythrus* (Irrawaddy Squirrel) and *Mus musculus* (House Mouse), particularly in homestead areas and along forest edges. Multiple bat species, such as *Pipistrellus* spp. (Small Bats) and *Megaderma lyra* (Chamchika), remain abundant and continue to play vital ecological roles in pollination and seed dispersal.

Predatory mammals like *Felis chaus* (Jungle Cat) and *Herpestes auropunctatus* (Small Indian Mongoose) are occasionally sighted in forest patches and wetland zones. The presence of *Vulpes bengalensis* (Bengal Fox) and *Canis aureus* (Golden Jackal) indicates a relatively intact trophic structure in the landscape. Additionally, the continued occurrence of insectivores such as *Suncus etruscus* (Pygmy Shrew) highlights the diversity of ground-dwelling fauna in the area. **Following table** provides a current list of mammalian species documented in the project areas, based on recent baseline ecological surveys.

Table . Mammalian species recorded in the project area.

Local Name	Local Name	Scientific Name
Badami Kathbiral	বাদামি কাঠবিড়ালি	<i>Callosciurus pygerythrus</i>
Rangchita Badur	রংচিত্রা বাদুর	<i>Pipistrellus sp.</i>
Ban Biral/Jungle Cat	বন বিড়াল	<i>Felis chaus</i>
Mecho Biral	মেছো বিড়াল	
Beji	বেজি	<i>Herpestes auropunctatus</i>
Bara Indur	বড় ইদুর	<i>Bandicota bengalensis</i>
Chamchika	চামচিকা	<i>Megaderma lyra</i>
Chika	চিকা	<i>Suncus etruscus</i>
Khek Shial	খেক শিয়াল	<i>Vulpes bengalensis</i>
Pati Shial	পাতি শিয়াল	<i>Canis aureus</i>
Nengti Indur	নেংটি ইদুর	<i>Mus musculus</i>

Aquatic Plants

The aquatic ecosystems of the project areas in Noakhali and Feni currently exhibit a rich diversity of aquatic plant species, which continue to play a vital role in sustaining fish habitats, improving water quality, and supporting overall ecological balance. *Eichhornia crassipes* (Water Hyacinth), though invasive, remains widespread and provides temporary shelter for fish during breeding seasons. Species such as *Ipomoea carnea* (Pink Morning Glory) and *Ipomoea aquatica* (Kolmi) are commonly found along the edges of canals and ponds.

Alternanthera philoxeroides (Alligator Weed) and *Lemna minor* (Duckweed) frequently form dense mats in stagnant waters, offering essential cover and foraging grounds for aquatic organisms. Floating and emergent plants like *Nymphaea nouchali* (Nil-Shapla), *Nymphaea pubescens* (Sada-Shapla), and *Nymphaea rubra* (Lal-Shapla) continue to enrich the floral diversity and enhance both the ecological function and visual appeal of wetlands and seasonal waterbodies. **Following table** presents the aquatic plant species currently recorded in the project areas, based on recent baseline ecological surveys.

Table . Aquatic plant species recorded in the project area,

Local Name	English name	Scientific Name
Kachuri pana	Common water hyacinth	<i>Eichhornia crassipes</i>
Dhol Kolmi	Pink morning glory	<i>Ipomoea carnea</i>
Kolmi	Water Spinach	<i>Ipomoea aquatica</i>
Helencha, Malancha	Alligator weed	<i>Alternanthera philoxeroides</i>
Khudi pana	Common duckweed	<i>Lemna minor</i>
Nil-Shapla	Blue Water lily	<i>Nymphaea nouchali</i>
Sada-Shapla	Water lily	<i>Nymphaea pubescens</i>
Lal-Shapla	Red water lily	<i>Nymphaea rubra</i>

Creepers

The project areas of Noakhali and Feni currently support a diverse range of common creeper plant species that contribute significantly to local ecosystems, traditional medicine, and household uses. *Quisqualis indica* (Madhabi Lata) remains a popular ornamental creeper, frequently seen adorning fences and home gardens. *Cuscuta reflexa* (Swarnalata), although parasitic, continues to be valued for its role in traditional healing practices.

Edible creepers such as *Momordica charantia* (Teet Karela) are actively cultivated for their nutritional and medicinal properties. Medicinal species like *Vitis quadrangularis* (Harjora) are commonly used in folk remedies, especially for treating bone-related conditions. Wild creepers such as *Piper peepuloides* (Pipul) and *Abrus precatorius* (Kuch) also persist in the area, holding cultural and herbal importance, though caution is advised when handling the highly toxic *Abrus precatorius*. *Calamus viminalis* (Bet) continues to be found locally and is prized for its durable canes, commonly used in traditional crafts.

Collectively, these creeper species contribute to the botanical diversity of the region and support local livelihoods and traditional knowledge systems. following table presents the current list of creeper species recorded in the project areas, based on recent baseline ecological surveys.

Table . Creepers species recorded in the project area.

Local Name	Common name	Scientific Name
Assamlata	Jack in the Bush	<i>Eupatorium odoratum</i>
Bet	Bitter Rattan palm	<i>Calamus viminalis</i>
Harjora	Veld grape	<i>Vitis quadrangularis</i>

Local Name	Common name	Scientific Name
Kuch	Rosary pea	<i>Abrus precatorius</i>
Madhabi lata	Rangoon creeper or Burma creeper	<i>Quisqualis indica</i> / <i>Combretum indicum</i>
Pipul	Wild pepper	<i>Piper peepuloides</i>
Swarnalata	Dodder or Amarbel	<i>Cuscuta reflexa</i>
Teet Karela	Bitter melon or bitter gourd	<i>Monordica charantia</i>
Thankuni	Indian pennywort	<i>Centella asiatica</i>
Libuji lota	Perennial creeping climber	<i>Mikania cordata</i>

Herbs

The project areas of Noakhali and Feni currently host a diverse range of common herbaceous plant species that continue to play important ecological and practical roles. Edible herbs such as *Oxalis corniculata* (Amrul Shak) and *Eryngium foetidum* (Bon Dhonia) remain widely used in local diets and traditional medicine. Various banana cultivars, including *Musa paradisiaca* (Anaji Kala) and *Musa* spp. (Bangla, Sabri, and Sagar Kala), are actively grown for both their fruits and multipurpose leaves.

Medicinal herbs like *Aloe barbadensis* (Ghrit Kumari) and *Leucas aspera* (Shetdrone) continue to be valued for their therapeutic uses. Wild herbaceous species such as *Polygonum hydropiper* (Bish Katali) and *Datura metel* (Dhutura) thrive in moist habitats and are still used in folk remedies, though *Datura* requires careful handling due to its toxic nature. Additionally, ground-covering species like *Cynodon dactylon* (Durba) play a vital role in soil stabilization and are integral to local religious practices.

These herbaceous plants underscore the region's rich ethnobotanical knowledge and biological diversity. Following table presents the current list of herb species recorded in the project areas, based on recent baseline ecological surveys.

Table . Herbs species recorded in the project area.

Local Name	Common name	Scientific Name
Amrul Shak	Creeping woodsorrel	<i>Oxalis corniculata</i>
Anaji Kala	Musa paradisiacal	<i>Musa x paradisiaca</i>
Bangla Kala	Banana plant	<i>Musa sp.</i>
Bish Katali	Water pepper	<i>Polygonum hydropiper</i>
Bon Dhonia	Culantro	<i>Eryngium foetidum</i>
Dhutura	Devil's trumpet	<i>Datura metel</i>
Durba	Scutch grass	<i>Cynodon dactylon</i>
Gandharaj	Cape jasmine	<i>Gardenia jasminoides</i>
Ghrit Kumari	Aloe vera	<i>Aloe barbadensis</i>
Mankachu	Indian Taro	<i>Alocasia indica</i>
Jangli kachu	Water lily taro	<i>Colocasia nymphaeifolia</i>
Sabri Kala	Banana plant	<i>Musa sp.</i>
Sagar Kala	Banana plant	<i>Musa sp.</i>
Shetdrone	Thumbai	<i>Leucas aspera</i>
Kalmegh	Creast or Green chiretta,	<i>Andrographis paniculata</i>

Shrubs

The project areas of Noakhali and Feni currently support a rich variety of common shrub species that continue to play vital roles in local ecosystems, homestead gardens, and cultural practices. Aromatic and flowering shrubs such as *Jasminum sambac* (Beli), *Jasminum auriculatum* (Jui), and *Hibiscus rosa-sinensis* (Jaba) are widely cultivated for their ornamental beauty and aesthetic appeal.

Medicinal shrubs like *Lawsonia inermis* (Mehedi), traditionally used for body art and cooling treatments, and *Justicia adhatoda* (Bashok), valued for its respiratory benefits, remain common in household gardens. *Ocimum americanum* (Tulshi) continues to hold religious significance and is widely utilized in herbal remedies. Shrubs such as *Citrus aurantifolia* (Lebu) provide essential culinary and nutritional value, while *Murraya paniculata* (Kamini) is frequently planted as a natural hedge, appreciated for its dense foliage and fragrant blossoms.

These shrub species collectively enhance the biodiversity, environmental quality, and cultural richness of the project communities. Following table presents the currently documented shrub species in the project areas, based on recent baseline ecological surveys.

Table . Shrubs species recorded in the project area.

Local Name	Common name	Scientific Name
Mehedi/ Mendi	Henna	<i>Lawsonia inermis</i>
Bashok	Malabar nut	<i>Justica adhatoda/ Adhatoda vasica</i>
Beli	Jasmine	<i>Jasminum sambac</i>
Jaba	Chinese hibiscus	<i>Hibiscus rosa-sinensis</i>
Lebu	Key lime	<i>Citrus aurentifolia</i>
Tulshi	Hoary Basil	<i>Ocimum americanum</i>
Jui	Juhi – Flowers of India	<i>Jasminum auriculum</i>
Kamini	Orange jessamine	<i>Murraya paniculata</i>

Trees

The project areas of Noakhali and Feni presently support a diverse assemblage of common tree species that play a critical role in maintaining local biodiversity, promoting ecological resilience, and supporting community livelihoods. Fruit-bearing trees such as *Mangifera indica* (Mango), *Syzygium cumini* (Java Plum), *Psidium guajava* (Guava), *Artocarpus heterophyllus* (Jackfruit), and *Litchi chinensis* (Lychee) are widely cultivated for their nutritional benefits and economic value.

Shade- and timber-producing species like *Ficus benghalensis* (Banyan), *Samanea saman* (Rain Tree), *Swietenia mahagoni* (Mahogany), and *Tectona grandis* (Teak) are commonly found along homesteads, roadsides, and within institutional premises. Trees of medicinal and cultural importance, including *Phyllanthus emblica* (Amlaki), *Aegle marmelos* (Bael), and *Terminalia arjuna* (Arjun), remain prevalent across the landscape.

In addition, bamboo species such as *Bambusa balcooa*, *Bambusa tulda*, and *Bambusa longispiculata* continue to serve as key resources for construction, household applications, and handicrafts. The coexistence of indigenous and exotic species highlights the region's ecological diversity and its strong potential for agroforestry development. Following table presents the currently recorded tree species in the project areas, based on recent baseline ecological assessments.

Table . Tree species recorded in the project area.

Local Name	Common name	Scientific Name
Aam	Mango	<i>Mangifera indica</i>
Acacia/ Babla	Gum Arabic tree	<i>Acacia nilotica</i>
Amlaki	Indian gooseberry or amla	<i>Phyllanthus emblica</i>

Local Name	Common name	Scientific Name
Arjun	Arjun tree	<i>Terminalia arjuna</i>
Ata fal	Sugar apple	<i>Annona squamosa</i>
Barak Bansh	Clumping bamboo	<i>Bambusa balcooa</i>
Bael	Golden apple	<i>Aegle marmelos</i>
Borro	Indian jujube	<i>Zizipus mauritiana</i>
Bot	Banyan	<i>Ficus benghalensis</i>
Chalta	Elephant apple	<i>Dillenia indica</i>
Deshi Nim	Chinaberry	<i>Melia azadirachta</i>
Dumur Khoska)	Opposite leaf	<i>Ficus hispida</i>
Jam	Java Plum	<i>Syzygium cumini</i>
Jambura	Pomelo	<i>Cytus grandis</i>
Jamrul	Java apple	<i>Syzygium samarangense</i>
Talla Bansh	Tulda bamboo	<i>Bambusa. tulda</i>
Kadam	Burflower tree	<i>Anthocephalus chinensis</i>
Kalo Karoi	Lebbeck	<i>Albizia lebbek</i>
Kathal	Jackfruit	<i>Artocarpus heterophyllus</i>
Khejur	Silver date palm	<i>Phoenix sylvestris</i>
Krishnachura	Royal poinciana	<i>Delonix regia</i>
Lichu	Lychee	<i>Litchi Chinensis</i>
Mahogani	American mahogany	<i>Swietenia mahogoni</i>
Mandar	Indian Coral Tree	<i>Erythrina variegata</i>
Sajna	Moringa	<i>Moringa oleifera.</i>
Narikel	Coconut	<i>Cocos nucifera</i>
Tal	Asian Palmyra palm	<i>Borassus flabellifer</i>
Peara	Common guava	<i>Psidium guajava</i>
Raintree Koroi	Rain tree	<i>Samanea saman</i>
Segun	Teak	<i>Tectonia grandis</i>
Shal	Sal tree	<i>Shorea rubusta</i>
Shawra	Nyireh batu	<i>Xylocarpus moluccensis (Lam)</i>
Shimul	Cotton tree	<i>Bombax ceiba</i>
Supari	Areca palm	<i>Areca catechu</i>
Tarla Bansh	Mahal bamboo	<i>Bambusa longispiculata</i>
Tetul	Tamarind	<i>Tamarind indica</i>

Biodiversity Assessment in Lakshmipur: Aquatic and Terrestrial Species Including Fish, Reptiles Amphibians, Birds, Mammals, and Plant Diversity

Visited Sites:

- Precautionary bank protection locations and surrounding area on banks of Rahmatkhali Khal and WAPDA Khal
- Area on the banks of C- Khal and surroundings

Identified Species:

Fish

The project sites encompassing Laxmipur Sadar, Ramgoti and Raipur Upazilas exhibit a high degree of aquatic biodiversity, encompassing both freshwater and brackish water ecosystems. These areas support diverse fish assemblages critical for local livelihoods and food security. The dominant aquaculture species in the areas such as *Labeo rohita* (Rohu), *Catla catla* (Katla), and *Cirrhinus mrigala* (Mrigal) are primarily cultured in ponds, alongside introduced species like *Oreochromis niloticus* (Nile Tilapia) and *Cyprinus carpio* (Common Carp), reflecting the growing trend of polyculture systems in local aquafarming practices. Following table presents a comprehensive list of fish species observed in the project area, encompassing both cultured species and those harvested through wild capture fisheries. During the monsoon and flood seasons, overflow from aquaculture ponds facilitates the migration of cultured species into adjacent canals and floodplain wetlands, which serve as critical habitats for both resident and migratory species. These canals support a range of native catfish, including *Ompok pabo* (Pabda), *Mystus vittatus*, *Batasio batasio*, and *Heteropneustes fossilis* (Shing), along with predatory species, such as *Channa straiatus* (Snakehead). Seasonal overflows also introduce additional cultured species like *Pangasianodon hypophthalmus* (Thai Pangas) and *Puntius sophore* (Spotfin Barb) contributing further to the biodiversity. Traditional fishing practices such as the use of *Katha* (fish aggregating devices) remain prevalent across the project areas. These structures attract a wide variety of economically and ecologically important species, including *Wallago attu* (Freshwater Shark), *Notopterus notopterus* (Grey Featherback), and multiple prawn species, both giant and small. These practices not only sustain local fishing communities but also highlight the ecological complexity and productivity of the aquatic systems within the project area. This baseline and preserving traditional knowledge systems as part of the project's environmental and social management planning.

Table . Fish species observed in the project area.

Local Name	English Name	Local Name	Scientific Name
Rui	Rohu	রুই	<i>Labeo rohita</i>
Katla	Catla	কাতলা	<i>Catla catla</i>
Mrigel	Mrigal	মৃগাল	<i>Cirrhinus mrigala</i>
Tilapia	Tilapia	নাইলটিকা	<i>Oreochromis niloticus</i>

Local Name	English Name	Local Name	Scientific Name
Commonr Carp	Common Carp	কার্পিও	<i>Cyprinus caprio</i>
Thai sarputi	Thai sarputi	থাই সরপুটি	<i>Barbonymus gonionotus</i>
Grass Carp	Grass Carp	গ্রাস কার্প	<i>Ctenopharyngodon idella</i>
Silver Carp	Silver Carp	সিলভার কার্প	<i>Hypophthalmichthys nobilis</i>
Thai pangas	Thai pangas	থাই পান্ডাস	<i>Pangasianodon hypophthalmus</i>
Pabda	Pabo Catfish	মধু পাবদা	<i>Ompok pabo</i>
Ayre/Aor	Longwhiskered Carfish	আইড়	<i>Aorichthys aor</i>
Bele/Bailla	Tank Goby	বেলে	<i>Glossogobius giuris</i>
Batashi	Indian Potasi	বাতাসী/পাতাসী	<i>Pseudeutropius atherinoides</i>
Boal	Freshwater Shark	বোয়াল	<i>Wallago attu</i>
Chela	Large razorbelly minnow	চেলা	<i>Salmophasia bacaila</i>
Chela	Silver Razorbelly Minnow	চেলা	<i>Salmophasia acinaces</i>
Chhep Chela	Silver Hatchet fish	হেটচেট মাছ	<i>Chela cachius</i>
Chital	Humped Featherback	চিতল	<i>Chitala chitala</i>
Gajar/Gajal	Giant Snakehead	গজার মাছ	<i>Channa marulius</i>
Guizza/Guizza Ayer	Giant Rivercatfish	আইড়	<i>Sperate seenghala</i>
Kaikla	Freshwatr Garfish	কাকিলা	<i>Xenentodon cancila</i>
Koi	Climbing Perch	কৈ	<i>Anabas testudineus</i>
Cuchia	Gangetic Mudeel	কুচিয়া	<i>Monopterusuchia</i>
Magur	Magur	মাগুর	<i>Clarias batrachus</i>
Mola	Indian Carplet	মলা	<i>Amblypharyngodon mola</i>
Tengra/Golsha-tengra	Day's Mystus	টেংরা	<i>Mystus bleekeri</i>
Pholoi	Grey Featherback	কানলা	<i>Notopterus notopterus</i>
Punti	Spotfin Barb	পুটি	<i>Puntius sophore</i>
Rita	Rita	রিটা	<i>Rita rita</i>
Shoal	Striped snakehead	শোল মাছ	<i>Channa striatus</i>
Singh	Stinging Catfish	শিং মাছ	<i>Heteropneustes fossilis</i>
Swar Punti	Olive Barb	সরপুটি	<i>Puntius sarana</i>
Taki	Spotted Snakehead	টাকি	<i>Channa punctatus</i>
Tel Taki	Asiatic Snakehead	গাছুয়া	<i>Channa orientalis</i>
Tit Punti	Ticto barb	তিত পুটি	<i>Puntis ticto</i>
Tengra	Striped dwarf catfish	টেংরা	<i>Mystus vittatus</i>
Batashi tengra	Tista Batasio	বাতাসি টেংরা	<i>Batasio batasio</i>

Local Name	English Name	Local Name	Scientific Name
Chingri (Large)	Prawn	গলদা চিংড়ি	Macrobrachium sp.
Chingri (Small)	Prawn	ছোট বা গুড়া চিংড়ি	Macrobrachium sp.

Reptiles

The project areas of Laxmipur Sadar, Ramgoti and Raipur support a notable diversity of reptilian fauna, indicative of region's varied and ecologically rich habitats. Among the commonly encountered species are lizards such as *Calotes versicolor* (Garden Lizard) and *Hemidactylus brookii* (Spotted House Gecko), which are well-adapted to both natural and human-modified environments. Following table provides a list of reptile species recorded within the project areas during baseline assessment. Several snake species, including *Ahaetulla nasuta* (Common Vine Snake) and *Amphiesma stolata* (Buff Striped Keelback), are frequently observed. Monitor lizards such as *Varanus bengalensis* (Bengal Monitor) and *Varanus flavescens* (Yellow Monitor) also inhabit these areas. In addition, the presence of freshwater turtles like *Geoclemys hamiltonii* (Black Pond Turtle) and *Pangshura tecta* (Indian Roofed Turtle) highlights the ecological richness and importance of these habitats for reptilian fauna.

Table. Reptile species recorded within the project area.

Local Name	Local Name	Scientific Name
Striped grass skink	স্ট্রিপ গ্রাস সাইনক/আচিল	<i>Mabuya dissimilis</i>
Common vine snake	লাউডগা সাপ/ডারাস	<i>Ahaetulla nasuta</i>
Dora shap/ Buff Striped keel back	দোড়া সাপ	<i>Amphiesma stolata</i>
Gui shap/Clouded monitor	গুই সাপ	<i>Varanus nebulosus</i>
Holdey Gui Shap/yellow monitor	হলদে গুই সাপ	<i>Varanus flavescens</i>
Maitta Shap/Split keelback	মাইট্টা সাপ	<i>Atretium schistosum</i>
Original garden lizard	বাগানের গিরগিটি	<i>Calotes versicolor</i>
Tiktiki/spotted house gecko	টিকটিকি	<i>Hemidactylus brookii</i>
Bengal monitor, Gui shap	গুইসাপ	<i>Varanus bengalensis</i>
Black Pond Turtle	কালো চিত্রা দীঘি কাইট্টা	<i>Geoclemys hamiltonii</i>
Indian Roofed turtle	দেশি কড়ি কাইট্টা	<i>Pangshura tecta</i>
Brahminy River Turtle	মুকুটি নদ-কাছিম	<i>Hardella thurjii</i>

Birds

The project areas of Laxmipur Sadar, Ramgoti and Raipur support a wide array of common bird species, reflecting the presence of vibrant and ecologically diverse avian habitats. Important species include the *Copsychus saularis* (Doel), Bangladesh's national bird, and *Passer domesticus* (House Sparrow), which thrives near human settlements. Following table presents the bird species documented within the project area, based on baseline ecological surveys and relevant secondary sources. Predatory birds like *Milvus migrans* (Black Kite) and *Aviceda jerdoni* (Jerdon's Baza) patrol the skies, while waterbirds such as *Ardea cinerea* (Grey Heron) and *Amaurornis akool* (White-breasted Waterhen) frequent wetlands. The

presence of *Psittacula krameri* (Rose-ringed Parakeet), *Oriolus xanthornus* (Black-hooded Oriole), and *Eudynamys scolopacea* (Asian Koel) adds to the acoustic and visual diversity of the region. Additionally, species like *Dinopium benghalense* (Woodpecker), *Halcyon smyrnensis* (White-throated Kingfisher), and various drongos and doves indicate the ecological richness and the importance of preserving these habitats for sustained bird populations.

Table. Bird species documented within the project area.

Local Name	Local Name	Scientific Name
Babui	বাবুই	<i>Ploceus philippinus</i>
Baj	বাজ	<i>Aviceda jerdoni</i>
Bhat Shalik	ভাত শালিক	<i>Acridotheres tristis</i>
Bhutum Pencha	ভুতুম পেচা	<i>B. bengalensis</i>
Bulbuli	বুলবুলি	<i>Pycnonotus cafer</i>
Charui	চডুই	<i>Passer domesticus</i>
Chil	চিল	<i>Milvus migrans</i>
Choto Fingey	ছোট ফিংগে	<i>D. aeneus</i>
Dahuk	ডাউক	<i>Amaurornis akool</i>
Dar Kak/Jungle crow	দাড়কাক	<i>Corvus macrorhynchos</i>
Dhushor Bok	ধূসর বক	<i>Ardea cinerea</i>
Doel	দোয়েল	<i>Copsychus saularis</i>
Fingey	ফিংগে	<i>Dicrurus macrocercus</i>
Gangchil	গাংচিল	<i>Gelochelidon nilotica</i>
Ghughu (grey)	বাদামী ঘুঘু	<i>Streptopelia senegalensis</i>
Ghughu (Spotted)	তিলা ঘুঘু	<i>Spilopelia chinensis</i>
Gobrey Shalik	গোবরে শালিক	<i>Sturnus contra</i>
Holdey Pakhi	হলদে পাখি	<i>Oriolus xanthornus</i>
Jalali Kobutar	জালালি কবুতর	<i>Columba livia</i>
Kalim	কালিম	<i>Porphyrio porphyrio</i>
Kalo Shalik	কালো শালিক	<i>Aplonis panayensis</i>
Kana Bok	কানা বক	<i>Ardeola gragii</i>
Kaththokra	কাঠঠোকরা	<i>Dinopium benghalense</i>
Kokil	কোকিল	<i>Eudynamys scolopacea</i>
Kura	কুড়া	<i>Gallicrex cinerea</i>
Maachranga	মাছরাঙ্গা	<i>Halcyon smyrnensis</i>
Pan Kauri	পান কৈরী	<i>Rynchops albigollis</i>
Pati Kak	পাতিকাক	<i>Carvus splendens</i>
Pencha/Owl	পেচা	<i>Bubo nipalensis</i>
Sada Bok	সাদা বক	<i>Ardea insignis</i>
Shankho Chil	শঙ্খ চিল	<i>Haliastur Indus</i>
Tia	টিয়া	<i>Psittacula krameri</i>
Tuntuni	টুনটুনি	<i>Orthotomus sutorius</i>

Mammals

The project areas of Laxmipur Sadar, Ramgoti, and Raipur host a variety of common mammalian species, reflecting the ecological richness of both natural and semi-urban landscapes. Notable small mammals include *Callosciurus pygerythrus* (Irrawaddy Squirrel) and *Mus musculus* (House Mouse), frequently observed in homestead zones and along forest-edges. Several bat species, such as *Pipistrellus* spp. (Small Bats) and *Pteropus* spp. (Flying Foxes), are abundant and play essential ecological roles in pollination and seed dispersal. Predatory mammals, including *Felis chaus* (Jungle Cat) and *Herpestes auropunctatus* (Small Indian Mongoose) are occasionally encountered in forest patches and wetland areas. The presence of both *Vulpes bengalensis* (Bengal Fox) and *Caris aureus* (Golden Jackal) suggests a relatively intact trophic structure, while insectivores such as *Suncus etruscus* (Pygmy Shrew) highlight the diversity of ground-dwelling fauna. Following table presents the mammalian species recorded in the project area, based on primary baseline ecological surveys.

Table. Mammalian species recorded in the project area.

Local Name	Local Name	Scientific Name
Badami Kathbirali	বাদামি কাঠবিড়ালি	<i>Callosciurus pygerythrus</i>
Rangchita Badur	রংচিত্রা বাদুর	<i>Pipistrellus</i> sp.
Flying fox	ফায়িং ফক্স	<i>Pteropus</i> sp.
Ban Biral/Jungle Cat	বন বিড়াল	<i>Felis chaus</i>
Mecho Biral	মেছো বিড়াল	
Bara Beji	বেড়া বেজি	<i>H. edwardsi</i>
Beji	বেজি	<i>Herpestes auropunctatus</i>
Bara Indur	বড় ইদুর	<i>Bandicota bengalensis</i>
Chamchika	চামচিকা	<i>Megadernma lyra</i>
Chika	চিকা	<i>Suncus etruscus</i>
Khek Shial	খেক শিয়াল	<i>Vulpes bengalensis</i>
Pati Shial	পাতি শিয়াল	<i>Caris aureus</i>
Nengti Indur	নেংটি ইদুর	<i>Mus musculus</i>

Aquatic Plants

The aquatic ecosystems of the project areas of Laxmipur Sadar, Ramgoti and Raipur exhibit a rich diversity of aquatic plant species that play a vital role in maintaining fish habitats, enhancing water quality, and supporting overall ecological balance. Prominent among these is *Eichhornia crassipes* (Water Hyacinth), an invasive species that nonetheless provides temporary shelter for fish during breeding periods. *Ipomoea carnea* and *Ipomoea fistulosa* (Dhol Kolmi), along with *Ipomoea reptans* (Water Spinach), are frequently found along margins of canals and ponds. *Alternanthera philoxeroides* (Alligator Weed) and *Lemna minor* (Duckweed) often form dense mats in stagnant waters, offering critical cover and foraging

habitats for aquatic fauna. Additionally, floating and emergent species such as *Trapa bispinosa* (Water Chestnut), *Nymphaea nouchali* (Shalook), and *Nymphaea nucifera* (Shapla/Lotus) contribute to the floral diversity and enhance the ecological and aesthetic value of wetlands and seasonal waterbodies. Following table presents the aquatic plant species recorded in the project area, based on primary baseline ecological surveys.

Table. Aquatic plant species recorded in the project area

Local Name	Common Name	Scientific Name
Choto pana	Common water hyacinth	<i>Echhornia crassipes</i>
Dhol Kolmi	<i>Ipomoea carnea</i>	<i>Ipomoea fistulosa</i>
Helencha	Alligator weed	<i>Alternanthera philoxeroides</i>
Kalmi	Water spinach	<i>Ipomoea reptans</i>
Khudi pana	Common duckweed	<i>Lemna minor</i>
Pani Singara	Water chestnut	<i>Trapa bispinosa</i>
Shalook	Water lily	<i>Nymphaea nouchali</i>
Shapla	Water lily/ Lotus	<i>Nymphaea nucifera</i>

Creepers

The project areas of Laxmipur Sadar, Ramgoti, and Raipur) host a variety of common creeper plants species that contribute significant to local ecosystems, traditional medicine, and household uses. *Quisqualis indica* (Madhabi lata) is a widely recognized ornamental creeper, often found adorning fences and home gardens. *Cuscuta reflexa* (Swarnalata), though parasitic, is noted for its applications in traditional healing practices. Edible creepers such as *Monordica charantia* (Teet Karela) are cultivated for their nutritional and medicinal value. Medicinal species like *Vitis quadrangularis* (Harjora) are commonly used in folk remedies, particularly for bone-related ailments. Wild varieties including *Piper peepuloides* (Pipul) and *Abrus precatorius* (Kuch) hold cultural and herbal significance, though the latter is highly toxic and must be handled with caution. *Calamus viminalis* (Bet) is also present and is valued for its strong canes, widely used in traditional crafts. Together, these creepers species enhance the botanical diversity of the region and support local livelihoods and traditional knowledge systems. Following table presents the creepers species recorded in the project area, based on primary baseline ecological surveys.

Table. Creepers species recorded in the project area.

Local Name	Common name	Scientific Name
Assamlata	Jack in the Bush	<i>Eupatorium odoratum</i>
Bet	Bitter Rattan palm	<i>Calamus viminalis</i>
Harjora	Veld grape	<i>Vitis quadrangularis</i>
Kuch	Rosary pea	<i>Abrus precatorius</i>
Madhabi lata	Rangoon creeper or Burma creeper	<i>Quisqualis indica</i> / <i>Combretum indicum</i>
Pipul	Wild pepper	<i>Piper peepuloides</i>

Swarnalata	Dodder or Amarbel	<i>Cuscuta reflexa</i>
Teet Karela	Bitter melon or bitter gourd	<i>Monordica charantia</i>

Herbs

The project areas (Laxmipur Sadar, Ramgoti and Raipur) are home to a diverse range of common herbaceous plants that serve both ecological and practical functions. Edible herbs like *Oxalis corniculata* (Amrul Shak) and *Eryngium foetidum* (Bon Dhonia) are widely used in local cuisine and traditional medicine. Several banana varieties, including *Musa paradisiaca* (Anaji Kala), *Musa sp.* (Bangla, Sabri, and Sagar Kala), are cultivated for their fruit and leaves. Medicinal herbs such as *Aloe barbadensis* (Ghrit Kumari) and *Leucas aspera* (Shetdrone) are valued for their healing properties. Wild species like *Polygonum hydropiper* (Bish Katali) and *Datura metel* (Dhutura) thrive in moist areas and are often used in folk remedies, albeit with caution due to toxicity. Additionally, ground-covering herbs like *Cynodon dactylon* (Durba) are essential in erosion control and religious rituals. These herbs reflect the rich ethnobotanical knowledge and biodiversity of the region. Following table presents the Herbs species recorded in the project area, based on primary baseline ecological surveys.

Table. Herbs species recorded in the project area.

Local Name	Common name	Scientific Name
Amrul Shak	Creeping woodsorrel	<i>Oxalis corniculata</i>
Anaji Kala	Musa paradisiacal	<i>Musa x paradisiaca</i>
Bangla Kala	Banana plant	<i>Musa sp.</i>
Bish Katali	Water pepper	<i>Polygonum hydropiper</i>
Bon Dhonia	Culantro	<i>Eryngium foetidum</i>
Dhutura	Devil's trumpet	<i>Datura metel</i>
Durba	Scutch grass	<i>Cynodon dactylon</i>
Gandharaj	Cape jasmine	<i>Gardenia jasminoides</i>
Ghrit Kumari	Aloe vera	<i>Aloe barbadensis</i>
Mankachu	Indian Taro	<i>Alocasia indica</i>
Jangli kachu	Water lily taro	<i>Colocasia nymphaeifolia</i>
Sabri Kala	Banana plant	<i>Musa sp.</i>
Sagar Kala	Banana plant	<i>Musa sp.</i>
Shetdrone	Thumbai	<i>Leucas aspera</i>

Shrubs

The project areas of Laxmipur Sadar, Ramgoti, and Raipur support a diverse array of common shrub species that play important roles in local ecosystems, homestead gardens, and cultural traditions. Aromatic and flowering shrubs such as *Jasminum sambac* (Beli), *Jasminum auriculatum* (Jui), and *Hibiscus rosa-sinensis* (Jaba) are widely grown for their

ornamental appeal and aesthetic value. Medicinal plants like *Lawsonia inermis* (Mehedi), used for traditional body art and cooling remedies, and *Justica adhatoda* (Bashok), known for its respiratory healing properties, are also prevalent. *Ocimum americanum* (Tulshi) is revered for its religious and medicinal uses. Shrubs like *Citrus aurentifolia* (Lebu) provide culinary and nutritional benefits, while *Murraya paniculata* (Kamini) is commonly planted as a hedge for its fragrant flowers and dense foliage. These shrubs contribute significantly to the biodiversity, health, and cultural heritage of the communities in the project areas. Following table presents the Shrubs species recorded in the project area, based on primary baseline ecological surveys.

Table. Shrubs species recorded in the project area

Local Name		Scientific Name
Mehedi/ Mendi	Henna	<i>Lawsonia inermis</i>
Bashok	Malabar nut	<i>Justica adhatoda/ Adhatoda vasica</i>
Beli	Jasmine	<i>Jasminum sambac</i>
Jaba	Chinese hibiscus	<i>Hibiscus rosa-sinensis</i>
Lebu	Key lime	<i>Citrus aurentifolia</i>
Tulshi	Hoary Basil	<i>Ocimum americanum</i>
Jui	Juhi – Flowers of India	<i>Jasminum auriculum</i>
Kamini	Orange jessamine	<i>Murraya paniculata</i>

Trees

The project areas of Laxmipur Sadar, Ramgoti, and Raipur support a diverse assemblage of common tree species that contribute substantially to local biodiversity, ecological stability, and community livelihoods. Fruit-bearing trees such as *Mangifera indica* (Mango), *Syzygium cumini* (Java Plum), *Psidium guajava* (Guava), *Artocarpus heterophyllus* (Jackfruit), and *Litchi chinensis* (Lychee) are extensively cultivated for their nutritional value and economic importance. Shade and timber-providing trees like *Ficus benghalensis* (Banyan), *Samanea saman* (Rain Tree), *Swietenia mahagoni* (Mahogany), and *Tectona grandis* (Teak) are commonly observed along homesteads, roadways, and institutional compounds. Several medicinal and culturally significant trees such as *Phyllanthus emblica* (Amlaki), *Aegle marmelos* (Bael), and *Terminalia arjuna* (Arjun) are also prevalent. Additionally, bamboo varieties like *Bambusa balcooa*, *Bambusa tulda*, and *Bambusa longispiculata* serve as vital resources for construction and daily use. The presence of both indigenous and exotic species reflects the ecological richness and agroforestry potential of the region. Following table presents the tree species recorded in the project area based on primary baseline ecological surveys.

Table. Tree species recorded in the project area

Local Name	Common name	Scientific Name
Aam	Mango	<i>Mangifera indica</i>
Acacia/ Babla	Gum Arabic tree	<i>Acacia nilotica</i>
Amlaki	Indian gooseberry or amla	<i>Phyllanthus emblica</i>
Arjun	Arjun tree	<i>Terminalia arjuna</i>
Ata fal	Sugar apple	<i>Annona squamosa</i>
Barak Bansh	Clumping bamboo	<i>Bambusa balcooa</i>
Bael	Golden apple	<i>Aegle marmelos</i>
Borro	Indian jujube	<i>Zizipus mauritiana</i>
Bot	Banyan	<i>Ficus benghalensis</i>
Chalta	Elephant apple	<i>Dillenia indica</i>
Deshi Nim	Chinaberry	<i>Melia azadirachta</i>

Local Name	Common name	Scientific Name
Dumur Khoska)	Opposite leaf	<i>Ficus hispida</i>
Jalpai	Robust Olive	<i>Elaeocarpus robustus</i>
Jam	Java Plum	<i>Syzygium cumini</i>
Jambura	Pomelo	<i>Cytus grandis</i>
Jamrul	Java apple	<i>Syzygium samarangense</i>
Talla Bansh	Tulda bamboo	<i>Bambusa. tulda</i>
Kadam	Burflower tree	<i>Anthocephalus chinensis</i>
Kalo Karoi	Lebbeck	<i>Albizia lebbek</i>
Kathal	Jackfruit	<i>Artocarpus heterophyllus</i>
Kad Bel	Wood apple	<i>Feronia limonia</i>
Khejur	Silver date palm	<i>Phoenix sylvestris</i>
Krishnachura	Royal poinciana	<i>Delonix regia</i>
Lichu	Lychee	<i>Litchi Chinensis</i>
Mahogani	American mahogany	<i>Swietenia mahogoni</i>
Mandar	Indian Coral Tree	<i>Erythrina variegata</i>
Sajna	Moringa	<i>Moringa oleifera.</i>
Narikel	Coconut	<i>Cocos nucifera</i>
Tal	Asian Palmyra palm	<i>Borassus flabellifer</i>
Peara	Common guava	<i>Psidium guajava</i>
Raintree Koroi	Rain tree	<i>Samanea saman</i>
Segun	Teak	<i>Tectonia grandis</i>
Shal	Sal tree	<i>Shorea rubusta</i>
Shawra	Nyireh batu	<i>Xylocarpus moluccensis (Lam) or Carapa moluccensis</i>
Shimul	Cotton tree	<i>Bombax ceiba</i>
Supari	Areca palm	<i>Areca catechu</i>
Tarla Bansh	Mahal bamboo	<i>Bambusa longispiculata</i>
Tetul	Tamarind	<i>Tamarind indica</i>

Aquatic and Terrestrial Biodiversity of Cumilla: Fish, Reptiles, Birds, Mammals, and Plant Species

Visited Sites:

- Bank protection and slope protection locations and surrounding area on banks of Gumati River
- On the banks of re-excavation location in Ruhita Khal

Identified Species:

The project sites in Cumilla district continue to exhibit rich freshwater biodiversity, representing diverse fish populations that play a vital role in sustaining local livelihoods, ensuring food security, and maintaining essential ecosystem services.

Fish

Aquaculture in Cumilla is predominantly based on indigenous species such as Rohu (*Labeo rohita*), Catla (*Catla catla*), Mrigal (*Cirrhinus mrigala*), Kalibaus (*Labeo calbasu*) and Pangas (*Pangasius suchi*), which are widely cultured in ponds, canals, and other freshwater systems. In recent years, a clear shift toward polyculture has emerged, marked by the growing inclusion of introduced species like Nile Tilapia (*Oreochromis niloticus*), Common Carp (*Cyprinus carpio*), and Thai Sorputi (*Barbonymus gonionotus*). This transition highlights an evolving aquaculture practice in the region, focused on increasing productivity and diversification production.

Seasonal monsoon floods and pond overflows facilitate the migration of cultured species into nearby canals and floodplain wetlands, which serve as important habitats for resident and migratory fish species.

Common native fish found in these riverine and canal systems include:

- Small indigenous species (SIS) such as Puti (*Puntius* spp.), Tengra (*Mystus vittatus*, *Mystus tengra*, *Mustus bleekeri*), Chapila (*Gudusia chapra*), Chanda (*Parambassis* sp.), Shing (*Heteropneustes fossilis*), Magur (*Clarias batrachus*), Taki (*Channa punctate*), Biam (*Mastacembelus* spp.), and Mola (*Amblypharyngodon mola*)
- Predatory species like Shol (*Channa striata*), Boal (*Wallago attu*), and Gajar (*Channa marulius*).
- Seasonally introduced aquaculture species, such as Thai pangas (*Pangasianodon hypophthalmus*) and Thai sarputi (*Barbonymus gonionotus*), along with various native aquaculture species, often escape into natural water systems, contributing to the dynamic interaction between cultured and wild fish populations.

The river and canal fisheries in the project area sustain both subsistence and commercial needs of local fishing communities, while also demonstrate the ecological productivity and resilience of these aquatic systems.

Following table presents a comprehensive inventory of cultured and wild-caught fish species observed in Cumilla district. This inventory provides a critical baseline for resource management and supports the project's efforts to uphold traditional knowledge and promote sustainable environmental and social management practices.

Table. Fish species observed covering project areas in the Cumilla district

Local Name	English Name	Local Name	Scientific Name	Aquaculture/ Natural
Rui	Roho labeo	রুই	<i>Labeo rohita</i>	Aquaculture and Natural
Katla	Catla	কাতলা	<i>Labeo catla</i>	Aquaculture and Natural
Mrigel	Mrigal carp	মৃগাল	<i>Cirrhinus mrigala</i>	Aquaculture and Natural
Kalibaus	Black Rohu	কালিবাউস	<i>Labeo calbasu</i>	Aquaculture and Natural
Tilapia	Tilapia	নাইলটিকা	<i>Oreochromis niloticus</i>	Aquaculture
Commonr Carp	Common Carp	কার্পিও	<i>Cyprinus caprio</i>	Aquaculture
Thai sorputi	Silver barb	থাই সরপুটি	<i>Barbonymus gonionotus</i>	Aquaculture
Grass Carp	Grass Carp	গ্রাস কার্প	<i>Ctenopharyngodon idella</i>	Aquaculture
Silver Carp	Silver Carp	সিলভার কার্প	<i>Hypophthalmichthys nobilis</i>	Aquaculture
Thai pangus	Striped catfish	থাই পান্ডাস	<i>Pangasianodon hypophthalmus</i>	Aquaculture
Piranha	Piranhas	পিরহানা	<i>Pygocentrus sp.</i>	Aquaculture
Ayre/Aor	Longwhiskered Catfish	আইড়	<i>Aorichthys aor</i>	Natural
Bele/Bailla	Tank Goby	বেলে	<i>Glossogobius giuris</i>	Natural
Boal	Freshwater Shark	বোয়াল	<i>Wallago attu</i>	Natural
Chela	Large razorbelly minnow	চেলা	<i>Salmophasia bacaila</i>	Natural
Chela	Silver Razorbelly Minnow	চেলা	<i>Salmophasia acinaces</i>	Natural
Chep chela	Barbs & Minnows	চেপ-চেলা	<i>Chela cachius</i>	Natural
Gajar/Gajal	Giant Snakehead	গজার মাছ	<i>Channa marulius</i>	Natural
Guizza Ayer	Giant Rivercatfish	আইড়	<i>Sperate seenghala</i>	Natural
Kaikla	Freshwatr Garfish	কাকিলা	<i>Xenentodon cancila</i>	Natural
Koi	Climbing Perch	কৈ	<i>Anabas testudineus</i>	Natural and aquaculture
Cuchia	Gangetic Mudeel	কুচিয়া	<i>Monopterusuchia</i>	Natural
Magur/Jagur	Walking catfish	মাগুর	<i>Clarias batrachus</i>	Natural
Mola	Mola Carplet	মলা	<i>Amblypharyngodon mola</i>	Natural
Pholoi	Featherbacks	কানলা	<i>Notopterus notopterus</i>	Natural
Chitol	Knifefish	চিতল	<i>Chitala chitala</i>	Natural

Local Name	English Name	Local Name	Scientific Name	Aquaculture/ Natural
Jatputi	Pool barb	জাতপুটি	<i>Puntius sophore</i>	Natural
Teri puti	Onespot barb	টেরি পুটি	<i>Puntius terio</i>	Natural
Rita	Rita	রিটা	<i>Rita rita</i>	Natural
Ghaura	Ghaura	গাওড়া	<i>Clupisoma garua</i>	Natural
Meni	Perches	মেনি	<i>Nandus nandus</i>	Natural
Pangus	Pangus catfish	পাঙ্গাস	<i>Pangasius pangasius</i>	Natural
Shol mach	Striped snakehead	শোল মাছ	<i>Channa striata</i>	Natural
Shing	Stinging Catfish	শিং মাছ	<i>Heteropneustes fossilis</i>	Natural and aquaculture
Deshi Sarputi	Olive Barb	সরপুটি	<i>Systomus sarana</i>	Natural
Taki	Spotted Snakehead	টাকি	<i>Channa punctatus</i>	Natural
Tel Taki	Asiatic Snakehead	গাছুয়া	<i>Channa orientalis</i>	Natural
Tit Punti	Ticto barb	তিত পুটি	<i>Puntis ticto</i>	Natural
Kata chanda	Glassy perchlet	কাঁটা চান্দা	<i>Parambassis sp.</i>	Natural
Tengra/Guls ha-tengra	Day's Mystus	টেংরা	<i>Mystus bleekeri</i>	Natural
Tengara	Striped dwarf catfish	টেংরা	<i>Mystus vittatus</i>	Natural
Tengara	Tengara catfish	ডোরা টেংরা	<i>Mystus tengara</i>	Natural
Golda Chingri (Large)	Prawn	গলদা চিংড়ি	<i>Macrobrachium rosenbergii</i>	Natural and aquaculture
Chingri (Small)	Prawn	ছোট বা গুড়া চিংড়ি	<i>Macrobrachium sp.</i>	Natural
Kakra	Crab	কাঁকড়া	<i>Austrotelphusa sp</i>	Natural
Other aquatic animals				
Shushuk	River dolphin	শুশুক বা ডলফিন	<i>Platanista gangetica gangetica</i>	Natural



Photos: Available aquatic ecosystem at Kongsonagar Bazar, Cumilla (Embankment repair location km 28+700 to km 29+166: (A) Cultured Tengra; (B) Shrimp (marine source); (C) Cultured Grass Carp; (D) Cultured Shing (local source); (E) Cultured Pangas; (F) Mola fish (early harvest, cultured).

Reptiles

The project areas of Cumilla currently support a notable diversity of reptilian fauna, reflecting the region's ecologically rich and varied habitats. Commonly observed species include lizards such as Garden Lizard (*Calotes versicolor*) and Spotted House Gecko (*Hemidactylus brookii*), which thrive in both natural and human-modified environments. Several species of monitor lizards, including Bengali Monitor (*Varanus bengalensis*) and Yellow Monitor (*Varanus flavescens*), are also present. However, the occasional sightings of freshwater turtles such as Spotted Pond Turtle (*Geoclemys hamiltonii*) and Red-crowned roofed turtle (*Batagur kachuga*) highlight the ecological significance and conservation value of these habitats in supporting reptilian biodiversity. A detailed list of reptile species currently recorded in the project areas is provided in following table.

Table. Reptile species recorded within the project area

Local Name	Local Name	Scientific Name
Striped grass skink	স্ট্রিপ গ্রাস সাইনক/আচিল	<i>Mabuya dissimilis</i>
Dora shap/ Buff Striped keel back	ডোরা সাপ	<i>Amphiesma stolatum</i>
Painna Shap, Common-Smooth-scaled Water Snake	পাইন্না সাপ	<i>Enhydris enhydris</i>
Gui shap/Clouded monitor	গুই সাপ	<i>Varanus nebulosus</i>
Holdey Gui Shap/yellow monitor	হলদে গুই সাপ	<i>Varanus flavescens</i>
Maitta Shap/Split keelback	মাইট্টা সাপ	<i>Atretium schistosum</i>
Original garden lizard	বাগানের গিরগিটি	<i>Calotes versicolor</i>
Tiktiki/spotted house gecko	টিকটিকি	<i>Hemidactylus brookii</i>
Bengal monitor, Gui shap	গুইসাপ	<i>Varanus bengalensis</i>
Spotted Pond Turtle	কালো কাছিম	<i>Geoclemys hamiltonii</i>
Red-crowned roofed turtle	কড়ি কাইট্টা	<i>Batagur kachuga</i>

Birds

The project areas of Cumilla currently support a wide variety of common bird species, highlighting the continued presence of vibrant and ecologically diverse avian habitats. Key species include Doel (*Copsychus saularis*) and House Sparrow (*Passer domesticus*), which remain prevalent around human settlements. **Following table** presents the bird species currently documented in these areas, based on updated baseline ecological surveys and verified secondary sources.

Predatory birds such as Black Kite (*Milvus migrans*) and Jerdon's Baza (*Aviceda jerdoni*) are frequently observed soaring above, while waterbirds like Large Egret (*Ardea insignis*), Indian Pond Heron (*Ardeola grayii*), and White-throated Kingfisher (*Halcyon smyrnensis*) are commonly seen in and around wetland habitats. The continued presence of species such as Asian Koel (*Eudynamis scolopacea*), Common Myna (*Acridotheres tristis*), and Asian Pied Starling (*Sturnus contra*), along with woodpeckers like Black-rumped flameback (*Dinopium benghalense*) and various Drongos (*Dicrurus macrocercus*) and Doves (*Spilopelia chinensis*), underscores the ecological richness of the region and the critical need to conserve these habitats to support sustained bird populations.

Table. Bird species documented within the project area

Local Name	Local Name	Scientific Name
Babui	বাবুই	<i>Ploceus philippinus</i>
Baj	বাজ	<i>Aviceda jerdoni</i>
Bhat Shalik/Common myna	ভাত শালিক	<i>Acridotheres tristis</i>
Gobrey Shalik	গোবরে শালিক	<i>Sturnus contra</i>
Bhutum Pencha	ভুতুম পেচা	<i>B. bengalensis</i>
Bulbuli/Red-vented Bulbul	বুলবুলি	<i>Pycnonotus cafer</i>
Charui/House sparrow	চড়ুই	<i>Passer domesticus</i>

Local Name	Local Name	Scientific Name
Chil	চিল	<i>Milvus migrans</i>
Choto Fingey	ছোট ফিংগে	<i>D. aeneus</i>
Dahuk	ডাউক	<i>Amaurornis akool</i>
Dar Kak/Jungle crow	দাড়কাক	<i>Corvus macrorhynchos</i>
Pati Kak/House crow	পাতিকাক	<i>Carvus splendens</i>
Dar Kak/Jungle crow	দাড়কাক	<i>Corvus macrorhynchos</i>
Doel/Robin	দোয়েল	<i>Copsychus saularis</i>
Fingey/Black drongo	ফিংগে	<i>Dicrurus macrocercus</i>
Ghughu/Dove (Spotted)	তিলা ঘুঘু	<i>Spilopelia chinensis</i>
Holdey Pakhi	হলদে পাখি	<i>Oriolus xanthornus</i>
Kutum bird	কুটুম পাখি	<i>Oriclus sp.</i>
Jalali Kobutar	জালালি কবুতর	<i>Columba livia</i>
Kalo Shalik	কালো শালিক	<i>Aplonis panayensis</i>
Kana Bok	কানা বক	<i>Ardeola gragii</i>
Kaththokra	কাঠঠোকরা	<i>Dinopium benghalense</i>
Kokil	কোকিল	<i>Eudynamys scolopacea</i>
Kura	কুড়া	<i>Gallicrex cinerea</i>
Common kingfisher	মাছরাঙ্গা	<i>Alcedo atthis</i>
Maachranga/Kingfisher	মাছরাঙ্গা	<i>Halcyon smyrnensis</i>
Pan Kauri	পান কৈরী	<i>Rynchops albicollis</i>
Pati Kak	পাতিকাক	<i>Carvus splendens</i>
Pencha/Owl	পেচা	<i>Bubo nipalensis</i>
Sada Bok	সাদা বক	<i>Ardea insignis</i>
Shankho Chil	শঙ্খ চিল	<i>Haliastur Indus</i>
Tia	টিয়া	<i>Psittacula krameri</i>
Tuntuni/Common tailorbird	টুনটুনি	<i>Orthotomus sutorius</i>

Mammals

The project areas of Cumilla currently support a variety of common mammalian species, reflecting the ecological richness of their natural and semi-urban landscapes. Frequently observed small mammals include Irrawaddy Squirrel (*Callosciurus pygerythrus*) and House Mouse (*Mus musculus*), particularly in homestead areas and along forest edges. Multiple bat species, such as Small Bata (*Pipistrellus* spp.) and Chamchika (*Megaderma lyra*), remain abundant and continue to play vital ecological roles in pollination and seed dispersal.

Predatory mammals like Jungle Cat (*Felis chaus*) and Small Indian Mongoose (*Herpestes auropunctatus*) are occasionally sighted in forest patches and wetland zones. The presence of Bengal Fox (*Vulpes bengalensis*) and Golden Jackal (*Canis aureus*) indicates a relatively intact trophic structure in the landscape. Additionally, the continued occurrence of insectivores such as Pygmy Shrew (*Suncus etruscus*) highlights the diversity of ground-dwelling fauna in the area. Following table provides a current list of mammalian species documented in the project areas, based on recent baseline ecological surveys.

Table. Mammalian species recorded in the project area

Local Name	Local Name	Scientific Name
Badami Kathbirali	বাদামি কাঠবিড়ালি	<i>Callosciurus pygerythrus</i>
Rangchita Badur	রংচিত্রা বাদুর	<i>Pipistrellus sp.</i>
Small Bat	ছোট বাদুর	<i>Pipistrellus sp.</i>
Ban Biral/Jungle Cat	বন বিড়াল	<i>Felis chaus</i>
Mecho Biral	মেছো বিড়াল	
Beji/Mongoose	বেজি	<i>Herpestes sp.</i>
Bara Indur	বড় ইদুর	<i>Bandicota bengalensis</i>
Chamchika	চামচিকা	<i>Megadernma lya</i>
Chika	চিকা	<i>Suncus etruscus</i>
Khek Shial	খেক শিয়াল	<i>Vulpes bengalensis</i>
Pati Shial	পাতি শিয়াল	<i>Caris aureus</i>
House Rat	ঘরের ইদুর	<i>Rattus rattus</i>
Nengti Indur	নেংটি ইদুর	<i>Mus musculus</i>
Aquatic mammals		
Shushuk/ River dolphin	Shushuk/ River dolphin	Shushuk/ River dolphin

Aquatic Plants

The aquatic ecosystems of the project areas in Cumilla currently exhibit a rich diversity of aquatic plant species, which continue to play a vital role in sustaining fish habitats, improving water quality, and supporting overall ecological balance. Water Hyacinth (*Eichhornia crassipes*), though invasive, remains widespread and provides temporary shelter for fish during breeding seasons. Species such as Pink Morning Glory (*Ipomoea carnea*) and Kolmi (*Ipomoea aquatica*) are commonly found along the edges of canals and ponds.

Alligator Weed (*Alternanthera philoxeroides*) and Duckweed (*Lemna minor*) frequently form dense mats in stagnant waters, offering essential cover and foraging grounds for aquatic organisms. Floating and emergent plants like Shapla (*Nymphaea nouchali*), Sada-Shapla (*Nymphaea pubescens*), and Lal-Shapla (*Nymphaea rubra*) continue to enrich the floral diversity and enhance both the ecological function and visual appeal of wetlands and seasonal waterbodies. Following table presents the aquatic plant species currently recorded in the project areas, based on recent baseline ecological surveys.

Table. Aquatic plant species recorded in the project area,

Local Name	English name	Scientific Name
Kachuri pana	Common water hyacinth	<i>Eichhornia crassipes</i>
Dhol Kolmi	Pink morning glory	<i>Ipomoea carnea</i>
Kolmi	Water Spinach	<i>Ipomoea aquatica</i>
Hogla	Cattail	<i>Typha angustifolia</i>
Nol-Khagra	Common Reed	<i>Phragmites karka</i>

Helencha, Malancha	Alligator weed	<i>Alternanthera philoxeroides</i>
Khudi pana	Common duckweed	<i>Lemna minor</i>
Shapla/Water Lily	Water lily	<i>Nymphaea nouchali</i>
Sada-Shapla	Water lily	<i>Nymphaea pubescens</i>
Lal-Shapla	Red water lily	<i>Nymphaea rubra</i>
Shawla	Azolla	<i>Azolla sp.</i>

Creepers

The project areas of Cumilla currently support a diverse range of common creeper plant species that contribute significantly to local ecosystems, traditional medicine, and household uses. Madhabi Lata (*Quisqualis indica*) remains a popular ornamental creeper, frequently seen adorning fences and home gardens. Swarnalata (*Cuscuta reflexa*), although parasitic, continues to be valued for its role in traditional healing practices.

Edible creepers such as Teet Karela (*Momordica charantia*) are actively cultivated for their nutritional and medicinal properties. Medicinal species like Harjora (*Vitis quadrangularis*) are commonly used in folk remedies, especially for treating bone-related conditions. Wild creepers such as Pipul (*Piper peepuloides*) and Kuch (*Abrus precatorius*) also persist in the area, holding cultural and herbal importance, though caution is advised when handling the highly toxic Rosary pea (*Abrus precatorius*). Bet (*Calamus viminalis*) continues to be found locally and is prized for its durable canes, commonly used in traditional crafts.

Collectively, these creeper species contribute to the botanical diversity of the region and support local livelihoods and traditional knowledge systems. Following table presents the current list of creeper species recorded in the project areas, based on recent baseline ecological surveys.

Table. Creepers species recorded in the project area

Local Name	Common name	Scientific Name
Assamlata	Jack in the Bush	<i>Eupatorium odoratum</i>
Bet	Bitter Rattan palm	<i>Calamus viminalis</i>
Harjora	Veld grape	<i>Vitis quadrangularis</i>
Kuch	Rosary pea	<i>Abrus precatorius</i>
Madhabi lata	Rangoon creeper or Burma creeper	<i>Quisqualis indica</i> / <i>Combretum indicum</i>
Pipul	Wild pepper	<i>Piper peepuloides</i>
Swarnalata	Dodder or Amarbel	<i>Cuscuta reflexa</i>
Teet Karela	Bitter melon or bitter gourd	<i>Momordica charantia</i>
Pui-Sak	Indian Spinach	<i>Basella alba</i>
Libuji lota	Perennial creeping climber	<i>Mikania cordata</i>
Guloncho	Heart-leaved moonseed	<i>Tinospora cordifolia</i>
Lota futki	Balloon vine	<i>Cardiospermum halicacabum</i>

Herbs

The project areas of Cumilla currently host a diverse range of common herbaceous plant species that continue to play important ecological and practical roles. Edible herbs such as

Amrul Shak (*Oxalis corniculata*) and Bon Dhonia (*Eryngium foetidum*) remain widely used in local diets and traditional medicine. Various banana cultivars, including Anaji Kala (*Musa paradisiaca*) and Bangla, Sabri and Sagar Kala (*Musa* spp.), are actively grown for both their fruits and multipurpose leaves.

Medicinal herbs like Ghrit Kumari (*Aloe barbadensis*) and Shetdrone (*Leucas aspera*) continue to be valued for their therapeutic uses. Wild herbaceous species such as Bish Katali (*Polygonum hydropiper*) and Dhutura (*Datura metel*) thrive in moist habitats and are still used in folk remedies, though *Datura* requires careful handling due to its toxic nature. Additionally, ground-covering species like Durba (*Cynodon dactylon*) play a vital role in soil stabilization and are integral to local religious practices.

These herbaceous plants underscore the region's rich ethnobotanical knowledge and biological diversity. Following table presents the current list of herb species recorded in the project areas, based on recent baseline ecological surveys.

Table. Herbs species recorded in the project area.

Local Name	Common name	Scientific Name
Amrul Shak	Creeping woodsorrel	<i>Oxalis corniculata</i>
Dhona-Pata	Coriander	<i>Coriandrum sativum</i>
Palong Shak	Spinach	<i>Spinacia oleracea</i>
Pudina	Mint	<i>Mentha orvensis</i>
Thankuni pata	Centella	<i>Centella asiatica</i>
Gash-full	Goatweed	<i>Ageratum</i> sp.
Lozzaboti	Touch-me-not	<i>Mimosa pudica</i>
Anaji Kala	Musa paradisiacal	<i>Musa x paradisiaca</i>
Bangla Kala	Banana plant	<i>Musa</i> sp.
Bish Katali	Water pepper	<i>Polygonum hydropiper</i>
Bon Dhonia	Culantro	<i>Eryngium foetidum</i>
Dhutura	Devil's trumpet	<i>Datura metel</i>
Durba	Scutch grass	<i>Cynodon dactylon</i>
Gandharaj	Cape jasmine	<i>Gardenia jasminoides</i>
Ghrit Kumari	Aloe vera	<i>Aloe barbadensis</i>
Mankachu	Indian Taro	<i>Alocasia indica</i>
Kachu	Taro	<i>Alocasis</i> sp.
Jangli kachu	Water lily taro	<i>Colocasia nymphaeifolia</i>
Sabri Kala	Banana plant	<i>Musa</i> sp.
Sagar Kala	Banana plant	<i>Musa</i> sp.
Shetdrone	Thumbai	<i>Leucas aspera</i>
Kalmegh	Creast or Green chiretta,	<i>Andrographis paniculata</i>
Ada	Ginger	<i>Zingiber officinale</i>
Holud	Turmeric	<i>Curcuma longa</i>
Grito-kumari	Aloe vera	<i>Aloe vera</i>

Shrubs

The project areas of Cumilla currently support a rich variety of common shrub species that continue to play vital roles in local ecosystems, homestead gardens, and cultural practices. Aromatic and flowering shrubs such as Beli (*Jasminum sambac*), Jui (*Jasminum auriculatum*), and Jaba (*Hibiscus rosa-sinensis*) are widely cultivated for their ornamental beauty and aesthetic appeal.

Medicinal shrubs like Mehedi (*Lawsonia inermis*), traditionally used for body art and cooling treatments, and Bashok (*Justicia adhatoda*), valued for its respiratory benefits, remain common in household gardens. Tulshi (*Ocimum americanum*) continues to hold religious significance and is widely utilized in herbal remedies. Shrubs such as Lebu (*Citrus aurantifolia*) provide essential culinary and nutritional value, while Kamini (*Murraya paniculata*) is frequently planted as a natural hedge, appreciated for its dense foliage and fragrant blossoms.

These shrub species collectively enhance the biodiversity, environmental quality, and cultural richness of the project communities. Following table presents the currently documented shrub species in the project areas, based on recent baseline ecological surveys.

Table. Shrubs species recorded in the project area.

Local Name	Common name	Scientific Name
Mehedi/ Mendi	Henna	<i>Lawsonia inermis</i>
Bashok	Malabar nut	<i>Justica adhatoda/ Adhatoda vasica</i>
Beli	Jasmine	<i>Jasminum sambac</i>
Jaba	Chinese hibiscus	<i>Hibiscus rosa-sinensis</i>
Lebu	Key lime	<i>Citrus aurentifolia</i>
Tulshi	Hoary Basil	<i>Ocimum americanum</i>
Jui	Juhi – Flowers of India	<i>Jasminum auriculatum</i>
Kamini	Orange jessamine	<i>Murraya paniculata</i>
Gondhoraj	Gardenia	<i>Gardenia jasminoides</i>
Veranda	Castor oil plant	<i>Ricinus communis</i>

Trees

The project areas of Cumilla presently support a diverse assemblage of common tree species that play a critical role in maintaining local biodiversity, promoting ecological resilience, and supporting community livelihoods. Fruit-bearing trees such as Mango (*Mangifera indica*), Java Plum (*Syzygium cumini*), Guava (*Psidium guajava*), Jackfruit (*Artocarpus heterophyllus*), and Lychee (*Litchi chinensis*) are widely cultivated for their nutritional benefits and economic value.

Shade- and timber-producing species like Banyan (*Ficus benghalensis*), Rain Tree (*Samanea saman*), Mahogany (*Swietenia mahagoni*), and Teak (*Tectona grandis*) are commonly found along homesteads, roadsides, and within institutional premises. Trees of medicinal and cultural importance, including Amlaki (*Phyllanthus emblica*), Bael (*Aegle marmelos*), and Arjun (*Terminalia arjuna*), remain prevalent across the landscape.

In addition, bamboo species such as Clumping bamboo (*Bambusa balcooa*), Indian timber Bamboo (*Bambusa tulda*), and Mahal bamboo (*Bambusa longispiculata*) continue to serve as key resources for construction, household applications, and handicrafts. The coexistence of indigenous and exotic species highlights the region's ecological diversity and its strong potential for agroforestry development. Following table presents the currently recorded tree species in the project areas, based on recent baseline ecological assessments.

Table. Tree species recorded in the project area.

Local Name	Common name	Scientific Name
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Local Name	Common name	Scientific Name
Aam	Mango	<i>Mangifera indica</i>
Acacia/ Babla	Gum Arabic tree	<i>Acacia nilotica</i>
Amloki	Indian gooseberry or amla	<i>Phyllanthus emblica</i>
Arjun	Arjun tree	<i>Terminalia arjuna</i>
Ata fal	Sugar apple	<i>Annona squamosa</i>
Barak Bansh	Clumping bamboo	<i>Bambusa balcooa</i>
Bael	Golden apple	<i>Aegle marmelos</i>
Borroi	Indian jujube	<i>Zizipus mauritiana</i>
Bot	Banyan	<i>Ficus benghalensis</i>
Chalta	Elephant apple	<i>Dillenia indica</i>
Deshi Nim	Chinaberry	<i>Melia azadirachta</i>
Dumur Khoska)	Opposite leaf	<i>Ficus hispida</i>
Jam	Java Plum	<i>Syzygium cumini</i>
Jambura	Pomelo	<i>Cytus grandis</i>
Jamrul	Java apple	<i>Syzygium samarangense</i>
Talla Bansh	Tulda bamboo	<i>Bambusa. tulda</i>
Kadam	Burflower tree	<i>Anthocephalus chinensis</i>
Kalo Karoi	Lebbeck	<i>Albizia lebbek</i>
Kathal	Jackfruit	<i>Artocarpus heterophyllus</i>
Khejur	Silver date palm	<i>Phoenix sylvestris</i>
Krishnachura	Royal poinciana	<i>Delonix regia</i>
Lichu	Lychee	<i>Litchi Chinensis</i>
Mahogani	American mahogany	<i>Swietenia mahogoni</i>
Mandar	Indian Coral Tree	<i>Erythrina variegata</i>
Sajna	Moringa	<i>Moringa oleifera.</i>
Narikel	Coconut	<i>Cocos nucifera</i>
Tal	Asian Palmyra palm	<i>Borassus flabellifer</i>
Peara	Common guava	<i>Psidium guajava</i>
Raintree Koroi	Rain tree	<i>Samanea saman</i>
Segun	Teak	<i>Tectonia grandis</i>
Shal	Sal tree	<i>Shorea rubusta</i>
Shawra	Nyireh batu	<i>Xylocarpus moluccensis (Lam)</i>
Shimul	Cotton tree	<i>Bombax ceiba</i>
Supari	Areca palm	<i>Areca catechu</i>
Tarla Bansh	Mahal bamboo	<i>Bambusa longispiculata</i>
Borta/Dahua	Lakoocha	<i>Artocarpus lacucha</i>
Pitali/Medda	False white teak	<i>Mallotus nudiflorus</i>
Tetul	Tamarind	<i>Tamarind indica</i>



Photos: Available Terrestrial ecosystem at Jaforganj Bazar in Cumilla (Left embankment repair location km 33+000 to km 33+400:
(A) Discussion with local community,
(B) Fruit trees and taro vegetables,
(C) Raintree along with castor oil plant and other herbs & creepers





Photos: Fisheries sites at Companiganj, Cumilla (Right embankment repair location: km 45+000 to km 55+000): (A) Fish culture adjacent to the main river, (B) Capture fisheries within the main river





Photos: Available Terrestrial ecosystem at Km 00+170 in Cumilla (Right Bank protection at km 00+000 to 00+200). (A) Date palm tree at eroded Bank, (B) Series of fruit trees (Banana, Date palm, Asian Palmyra palm, etc.,) (C) Series of fruit trees (Mango, Jackfruits, Palm, etc. along with Raintree, Sal tree, Herbs and Creepers.



Aquatic and Terrestrial Biodiversity of Brahmanbaria: Fish, Reptiles, Birds, Mammals, and Plant Species

Visited Sites:

- Bank protection, slope protection and resectioning locations and surrounding area on banks of Hawra River

Identified Species:

The project sites in Brahmanbaria district continue to demonstrate rich aquatic biodiversity, representing freshwater ecosystems with extensive floodplains along both banks of the Hawra River originated from Tripura, India and enters Bangladesh through Akhaura Upazila in Brahmanbaria. These areas support diverse fish assemblages, agriculture, transportation, and cultural practices that are vital for sustaining local livelihoods, food security, and essential ecosystem services.

Fish

Aquaculture practices in Brahmanbaria are primarily based on indigenous riverine species such as Rohu (*Labeo rohita*), Catla (*Catla catla*), Mrigal (*Cirrhinus mrigala*), Kalibaus (*Labeo calbasu*) and Pangas (*Pangasius suchi*), which widely cultivated in ponds, canals, and other freshwater systems. In recent years, a distinct shift towards polyculture has been observed, with the increasing inclusion of introduced species like *Oreochromis niloticus* (Nile Tilapia), *Cyprinus carpio* (Common Carp), and *Barbonymus gonionotus* (Thai Sorputi). This transition highlights the adaptive evolution of local aquafarming practices, aimed at enhancing productivity, meeting local consumption needs, supporting exports to Tripura, India, and diversifying aquaculture systems in the region.

The study area also supports a wide variety of wild-capture fish species. Seasonal monsoon floods and pond overflows enable the migration of cultured fish into nearby canals, floodplains, and river systems, which provide critical habitats for both resident and migratory species. The river is connected to the Meghna River system through the Titas River, creating pathways for the movement of riverine fish as well as river dolphins (locally known as *Shushuk*). Tourists can often observe river dolphin activity in these waters, while local communities benefit from the availability of larger riverine species such as Pangas, Rohu, Catla, Mrigal, Kalibaus, Rita, and Air.

A variety of native riverine species contribute to subsistence and commercial fisheries. Common examples include Jatputi (*Puntius sophore*), Tengra (*Mystus bleekeri*, *Mystus tengara*, *Mystus vittatus*), Ayre (*Aorichthys aor*), Bele (*Glossogobius giuris*), Rita (*Rita rita*), Boal (*Wallago attu*), Koi (*Anabas testudineus*), Shol (*Channa striata*), Taki (*Channa punctatus*), Tel Taki (*Channa orientalis*), Glassy Perchlet (*Parambassis* sp.), Golda Chingri (*Macrobrachium rosenbergii*), and small freshwater prawns. In addition, other aquatic organisms such as crabs (*Austrotelphusa* sp.) contribute to the ecological and livelihood diversity of the area.

The dynamic interaction between aquaculture and capture fisheries highlights the ecological productivity and resilience of local aquatic systems. Escaped farmed species, such as Thai Pangas and Thai Sarputi, intermingle with native stocks, reinforcing the ecological connectivity between natural and cultured populations.

Following table provides a detailed inventory of both cultured and wild-caught fish species observed in the project area of Akhaura Upazila, Brahmanbaria. This serves as a critical baseline for fisheries resource management, supporting efforts to uphold traditional knowledge while promoting sustainable environmental and social practices.

Table. Fish species observed in the project areas of Akhaura Upazila, Brahmanbaria District

Local Name	English Name	Local Name	Scientific Name	Aquaculture/ Natural
Rui	Roho labeo	iaB	<i>Labeo rohita</i>	Aquaculture and Natural
Katla	Catla	KvZjv	<i>Labeo catla</i>	Aquaculture and Natural
Mrigel	Mrigal carp	g,,Mvj	<i>Cirrhinus mrigala</i>	Aquaculture and Natural
Kalibaus	Black Rohu or Orangefin labeo	KvwjeDm	<i>Labeo calbasu</i>	Aquaculture and Natural
Tilapia	Tilapia	bvBjwUKv	<i>Oreochromis niloticus</i>	Aquaculture
Commonr Carp	Common Carp	Kvwc©I	<i>Cyprinus caprio</i>	Aquaculture
Thai sorputi	Silver barb	_vB micywU	<i>Barbonymus gonionotus</i>	Aquaculture
Grass Carp	Grass Carp	MÖvm Kvc©	<i>Ctenopharyngodon idella</i>	Aquaculture
Silver Carp	Silver Carp	wmjfvi Kvc©	<i>Hypophthalmichthys molitrix</i>	Aquaculture
Big head Carp	Big-head Carp	weM†nW Kvc©	<i>Hypophthalmichthys nobilis</i>	Aquaculture
Thai pangus	Striped catfish	_vB cv½vm	<i>Pangasianodon hypophthalmus</i>	Aquaculture
Piranha	Piranhas	wcinvbv	<i>Pygocentrus sp.</i>	Aquaculture
Ayre/Aor	Longwhiskered Carfish	AvBo	<i>Aorichthys aor</i>	Natural
Bele/Baila	Tank Goby	†e†j	<i>Glossogobius giuris</i>	Natural
Boal	Freshwater Shark	†evqvj	<i>Wallago attu</i>	Natural
Chela	Large razorbelly minnow	†Pjv	<i>Salmophasia bacaila</i>	Natural
Chela	Silver Razorbelly Minnow	†Pjv	<i>Salmophasia sp.</i>	Natural
Guizza Ayer	Giant Rivercatfish	AvBo	<i>Sperate seenghala</i>	Natural
Kaikla	Freshwatr Garfish	KvwKjv	<i>Xenentodon cancila</i>	Natural
Koi	Climbing Perch	%oK	<i>Anabas testudineus</i>	Natural and aquaculture
Cuchia	Gangetic Mudeel	KzwPqv	<i>Monopterusuchia</i>	Natural
Tengra/Golsha-tengra	Day's Mystus	†Usiv	<i>Mystus bleekeri</i>	Natural
Pholoi	Grey Featherback	Kvbjv	<i>Notopterus notopterus</i>	Natural
Jatputi	Pool barb	RvZcywU	<i>Puntius sophore</i>	Natural
Teri puti	Onespot barb	†Uwi cuywU	<i>Puntius terio</i>	Natural
Rita	Rita	wiUv	<i>Rita rita</i>	Natural

Local Name	English Name	Local Name	Scientific Name	Aquaculture/ Natural
Pangus	Pangus catfish	cv½vm	<i>Pangasius pangasius</i>	Natural
Shol mach	Striped snakehead	‡kvj gvQ	<i>Channa striata</i>	Natural
Shing	Stinging Catfish	wks gvQ	<i>Heteropneustes fossilis</i>	Natural and aquaculture
Taki	Spotted Snakehead	UvwK	<i>Channa punctatus</i>	Natural
Tel Taki	Asiatic Snakehead	MvQzqv	<i>Channa orientalis</i>	Natural
Tit Punti	Ticto barb	wZZ cywU	<i>Puntis ticto</i>	Natural
Kata chanda	Glassy perchlet	KvuvUv Pv>`v	<i>Parambassis sp.</i>	Natural
Tengara	Striped dwarf catfish	‡Usiv	<i>Mystus vittatus</i>	Natural
Tengara	Tengara catfish	‡Wviv †Usiv	<i>Mystus tengara</i>	Natural
Golda Chingri (Large)	Prawn	Mj`v wPswO	<i>Macrobrachium rosenbergii</i>	Natural
Chingri (Small)	Prawn	‡QvU ev ,ov wPswO	<i>Macrobrachium sp.</i>	Natural
Kakra	Crab	KuvKov	<i>Austrotelphusa sp</i>	Natural
Other aquatic animals				
Shushuk	River dolphin	ĩK ev Wjwdb	<i>Platanista gangetica gangetica</i>	Natural



Fish Market, Akhaura, B.Baria



Fish sailing, Akhaura



Fish Market, Akhaura



Photos: Available Aquatic ecosystem at Mogra Bazar in Brahmanbaria. (A) Available cultured fish, (B) Culture Grass Carp, (C) Cultured Bighead carp, (D) Catla or Major South Asian carp, (E) Sardine fish (marine source)

Reptiles

The project areas of Brahmanbaria currently support a notable diversity of reptilian fauna, reflecting the region's ecologically rich and varied habitats. Commonly observed species include lizards such as *Calotes versicolor* (Garden Lizard) and *Hemidactylus brookii* (Spotted House Gecko), which thrive in both natural and human-modified environments. Several species of monitor lizards, including *Varanus bengalensis* (Bengal Monitor) and *Varanus flavescens* (Yellow Monitor), are also present. However, the occasional sightings of freshwater turtles such as *Geoclemys hamiltonii* (Spotted Pond Turtle) and *Batagur kachuga* (Red-crowned Roofed Turtle) highlight the ecological significance and conservation value of these habitats in supporting reptilian biodiversity. A detailed list of reptile species currently recorded in the project areas is provided in following table.

Table. Reptile species recorded within the project area in Brahmanbaria.

Local Name	Local Name	Scientific Name
Striped grass skink	ৱঃ ^{ac} MÖvm mvBb&K/AvwPj	<i>Mabuya dissimilis</i>
Dora shap/ Buff Striped keel back	‡Wviv mvc	<i>Amphiesma stolatum</i>

Local Name	Local Name	Scientific Name
Painna Shap, Common-Smooth-scaled Water Snake	cvBbœv mvc	<i>Enhydryis enhydryis</i>
Gui shap/Clouded monitor	,B mvc	<i>Varanus nebulosus</i>
Holdey Gui Shap/yellow monitor	nj‡` ,B mvc	<i>Varanus flavescens</i>
Maitta Shap/Split keelback	gvBÆv mvc	<i>Atretium schistosum</i>
Original garden lizard	evMv‡bi wMiwMwU	<i>Calotes versicolor</i>
Tiktiki/spotted house gecko	wUKwUwK	<i>Hemidactylus brookii</i>
Bengal monitor Lizard, Gui shap	,Bmvc	<i>Varanus bengalensis</i>
Spotted Pond Turtle	Kv‡jv KvWQg	<i>Geoclemys hamiltonii</i>
Red-crowned roofed turtle	Kwo KvBÆv	<i>Batagur kachuga</i>

Birds

The project areas of Brahmanbaria currently support a wide variety of common bird species, highlighting the continued presence of vibrant and ecologically diverse avian habitats. Key species include *Copsychus saularis* (Doel) and *Passer domesticus* (House Sparrow), which remain prevalent around human settlements. Following table presents the bird species currently documented in these areas, based on updated baseline ecological surveys and verified secondary sources.

Predatory birds such as *Milvus migrans* (Black Kite) and *Aviceda jerdoni* (Jerdon's Baza) are frequently observed soaring above, while waterbirds like *Ardea insignis* (Large Egret), *Ardeola grayii* (Indian Pond Heron), and *Halcyon smyrnensis* (White-throated Kingfisher) are commonly seen in and around wetland habitats. The continued presence of species such as *Eudynamis scolopacea* (Asian Koel), *Acridotheres tristis* (Common Myna), and *Sturnus contra* (Asian Pied Starling), along with woodpeckers like *Dinopium benghalense* and various drongos and doves, underscores the ecological richness of the region and the critical need to conserve these habitats to support sustained bird populations.

Table. Bird species documented within the project area

Local Name	Local Name	Scientific Name
Babui	eveyB	<i>Ploceus philippinus</i>
Baj	evR	<i>Aviceda jerdoni</i>
Bhat Shalik/Common myna	fvZ kvwjK	<i>Acridotheres tristis</i>
Gobrey Shalik	‡Mve‡i kvwjL	<i>Sturnus contra</i>
Bhutum Pencha	fzZyg ‡cPv	<i>B. bengalensis</i>
Bulbuli/Red-vented Bulbul	eyjeywj	<i>Pycnonotus cafer</i>
Charui/House sparrow	Po–B	<i>Passer domesticus</i>
Chil	wPj	<i>Milvus migrans</i>
Choto Fingey	‡QvU wds‡M	<i>D. aeneus</i>
Dahuk	WvDK	<i>Amaurornis akool</i>
Pati Kak/House crow	cvwZKvK	<i>Corvus splendens</i>
Dar Kak/Jungle crow	`voKvK	<i>Corvus macrorhynchos</i>
Doel/Robin	‡`v‡qj	<i>Copsychus saularis</i>
Fingey/Black drongo	wds‡M	<i>Dicrurus macrocercus</i>
Ghughu (Spotted)	wZjv NyNy	<i>Spilopelia chinensis</i>

Local Name	Local Name	Scientific Name
Holdey Pakhi (Black hooded oriolus)	nj††' cvwL, Bw÷KzUzg	<i>Oriolus xanthornus</i>
Kutum bird	KzUzg cvwL	<i>Oriolus sp.</i>
Jalali Kobutar	Rvjvwj KeyZi	<i>Columba livia</i>
Kalo Shalik	Kv††jv kvwjK	<i>Aplonis panayensis</i>
Kana Bok/Pond heron	Kvbv eK	<i>Ardeola grayii</i>
Kaththokra	KvV††VvKiv	<i>Dinopium benghalense</i>
Kokil	††KvwKj	<i>Eudynamys scolopacea</i>
Kura	K,ov	<i>Gallicrex cinerea</i>
Common Kingfisher	gvQiv½v	<i>Alcedo atthis</i>
Maachranga/Kingfisher	gvQiv½v	<i>Halcyon smyrnensis</i>
Pan Kauri	cvb †Kix	<i>Rynchops albicollis</i>
Pencha/Owl	††cPv	<i>Bubo nipalensis</i>
Sada Bok	mv'v eK	<i>Ardea insignis</i>
Shankho Chil	k•L wPj	<i>Haliastur Indus</i>
Tia	wUqv	<i>Psittacula krameri</i>
Tuntuni/Common tailorbird	UzbUzwb	<i>Orthotomus sutorius</i>

Mammals

The project areas of Brahmanbaria currently support a variety of common mammalian species, reflecting the ecological richness of their natural and semi-urban landscapes. Frequently observed small mammals include *Callosciurus pygerythrus* (Irrawaddy Squirrel) and *Mus musculus* (House Mouse), particularly in homestead areas and along forest edges. Multiple bat species, such as *Pipistrellus* spp. (Small Bats) and *Megaderma lyra* (Chamchika), remain abundant and continue to play vital ecological roles in pollination and seed dispersal.

Predatory mammals like *Felis chaus* (Jungle Cat) and *Herpestes auropunctatus* (Small Indian Mongoose) are occasionally sighted in forest patches and wetland zones. The presence of *Vulpes bengalensis* (Bengal Fox) and *Canis aureus* (Golden Jackal) indicates a relatively intact trophic structure in the landscape. Additionally, the continued occurrence of insectivores such as *Suncus etruscus* (Pygmy Shrew) highlights the diversity of ground-dwelling fauna in the area. Following table provides a current list of mammalian species documented in the project areas, based on recent baseline ecological surveys.

Table. Mammalian species recorded in the project area.

Local Name	Local Name	Scientific Name
Badami Kathbirali	ev'vwg KvVweovwj	<i>Callosciurus pygerythrus</i>
Rangchita Badur	iswP†v ev'yi	<i>Pipistrellus sp.</i>
Small Bat	††QvU ev'yi	<i>Pipistrellus sp.</i>
Ban Biral/Jungle Cat	eb weovj	<i>Felis chaus</i>
Mecho Biral/Jungle cat	††g††Qv weovj	<i>Felis sp.</i>
Beji/Mongoose	††ewR	<i>Herpestes sp.</i>
Bara Indur/Bandicoot rat	eo B'yyi	<i>Bandicota bengalensis</i>
Chamchika	PvgwPKv	<i>Megaderma lyra</i>
Chika	wPKv	<i>Suncus etruscus</i>

Khek Shial/Bengal Fox	‡LK wkqvj	<i>Vulpes bengalensis</i>
Pati Shial	cvwZ wkqvj	<i>Caris aureus</i>
House Rat	N‡ii B`yi	<i>Rattus rattus</i>
Nengti Indur	‡bswU B`yi	<i>Mus musculus</i>
Aquatic mammals		
Shushuk/ River dolphin	‡iK ev Wjwdb	<i>Platanista gangetica gangetica</i>

Aquatic Plants

The aquatic ecosystems of the project areas in Brahmanbaria currently exhibit a rich diversity of aquatic plant species, which continue to play a vital role in sustaining fish habitats, improving water quality, and supporting overall ecological balance. *Eichhornia crassipes* (Water Hyacinth), though invasive, remains widespread and provides temporary shelter for fish during breeding seasons. Species such as *Ipomoea carnea* (Pink Morning Glory) and *Ipomoea aquatica* (Kolmi) are commonly found along the edges of canals and ponds.

Alternanthera philoxeroides (Alligator Weed) and *Lemna minor* (Duckweed) frequently form dense mats in stagnant waters, offering essential cover and foraging grounds for aquatic organisms. Floating and emergent plants like *Nymphaea nouchali* (Nil-Shapla), *Nymphaea pubescens* (Sada-Shapla), and *Nymphaea rubra* (Lal-Shapla) continue to enrich the floral diversity and enhance both the ecological function and visual appeal of wetlands and seasonal waterbodies. Following table presents the aquatic plant species currently recorded in the project areas, based on recent baseline ecological surveys.

Table. Aquatic plant species recorded in the project area

Local Name	English name	Scientific Name
Kachuri pana	Common water hyacinth	<i>Echhornia crassipes</i>
Dhol Kolmi	Pink morning glory	<i>Ipomoea carnea</i>
Kolmi	Water Spinach	<i>Ipomoea aquatica</i>
Hogla	Cattail	<i>Typha angustifolia</i>
Nol-Khagra	Common Reed	<i>Phragmites karka</i>
Helencha, Malancha	Alligator weed	<i>Alternanthera philoxeroides</i>
Khudi pana	Common duckweed	<i>Lemna minor</i>
Shapla/Water Lily	Water lily	<i>Nymphaea nouchali</i>
Sada-Shapla	Water lily	<i>Nymphaea pubescens</i>
Lal-Shapla	Red water lily	<i>Nymphaea rubra</i>
Shawla	Azolla	<i>Azolla sp.</i>

Creepers

The project areas of Brahmanbaria currently support a diverse range of common creeper plant species that contribute significantly to local ecosystems, traditional medicine, and household uses. *Quisqualis indica* (Madhabi Lata) remains a popular ornamental creeper, frequently seen adorning fences and home gardens. *Cuscuta reflexa* (Swarnalata), although parasitic, continues to be valued for its role in traditional healing practices.

Edible creepers such as *Momordica charantia* (Teet Karela) are actively cultivated for their nutritional and medicinal properties. Medicinal species like *Vitis quadrangularis* (Harjora) are commonly used in folk remedies, especially for treating bone-related conditions. Wild creepers such as *Piper peepuloides* (Pipul) and *Abrus precatorius* (Kuch) also persist in the area, holding cultural and herbal importance,

though caution is advised when handling the highly toxic *Abrus precatorius*. *Calamus viminalis* (Bet) continues to be found locally and is prized for its durable canes, commonly used in traditional crafts.

Collectively, these creeper species contribute to the botanical diversity of the region and support local livelihoods and traditional knowledge systems. Following table presents the current list of creeper species recorded in the project areas, based on recent baseline ecological surveys.

Table. Creepers species recorded in the project area

Local Name	Common name	Scientific Name
Assamlata	Jack in the Bush	<i>Eupatorium odoratum</i>
Bet	Bitter Rattan palm	<i>Calamus viminalis</i>
Harjora	Veld grape	<i>Vitis quadrangularis</i>
Kuch	Rosary pea	<i>Abrus precatorius</i>
Madhabi lata	Rangoon creeper/Burma creeper	<i>Quisqualis indica/Combretum indicum</i>
Pipul	Wild pepper	<i>Piper peepuloides</i>
Swarnalata	Dodder or Amarbel	<i>Cuscuta reflexa</i>
Teet Karela	Bitter melon or bitter gourd	<i>Monordica charantia</i>
Pui-Sak	Indian Spinach	<i>Basella alba</i>
Libuji lota	Perennial creeping climber	<i>Mikania cordata</i>
Guloncho	Heart-leaved moonseed	<i>Tinospora cordifolia</i>
Lota futki	Balloon vine	<i>Cardiospermum halicacabum</i>

Herbs

The project areas of Brahmanbaria currently host a diverse range of common herbaceous plant species that continue to play important ecological and practical roles. Edible herbs such as *Oxalis corniculata* (Amrul Shak) and *Eryngium foetidum* (Bon Dhonia) remain widely used in local diets and traditional medicine. Various banana cultivars, including *Musa paradisiaca* (Anaji Kala) and *Musa* spp. (Bangla, Sabri, and Sagar Kala), are actively grown for both their fruits and multipurpose leaves.

Medicinal herbs like *Aloe barbadensis* (Ghrit Kumari) and *Leucas aspera* (Shetdrone) continue to be valued for their therapeutic uses. Wild herbaceous species such as *Polygonum hydropiper* (Bish Katali) and *Datura metel* (Dhutura) thrive in moist habitats and are still used in folk remedies, though *Datura* requires careful handling due to its toxic nature. Additionally, ground-covering species like *Cynodon dactylon* (Durba) play a vital role in soil stabilization and are integral to local religious practices.

These herbaceous plants underscore the region's rich ethnobotanical knowledge and biological diversity. Following table presents the current list of herb species recorded in the project areas, based on recent baseline ecological surveys.

Table. Herbs species recorded in the project area

Local Name	Common name	Scientific Name
Amrul Shak	Creeping woodsorrel	<i>Oxalis corniculata</i>
Dhona-Pata	Coriander	<i>Coriandrum sativum</i>
Palong Shak	Spinach	<i>Spinacia oleracea</i>
Pudina	Mint	<i>Mentha orvensis</i>
Thankuni pata	Centella	<i>Centella asiatica</i>
Gash-full	Goatweed	<i>Ageratum sp.</i>
Lozzaboti	Touch-me-not	<i>Mimosa pudica</i>

Local Name	Common name	Scientific Name
Anaji Kala	Musa paradisiacal	<i>Musa x paradisiaca</i>
Bangla Kala	Banana plant	<i>Musa sp.</i>
Bish Katali	Water pepper	<i>Polygonum hydropiper</i>
Bon Dhonia	Culantro	<i>Eryngium foetidum</i>
Dhutura	Devil's trumpet	<i>Datura metel</i>
Durba	Scutch grass	<i>Cynodon dactylon</i>
Gandharaj	Cape jasmine	<i>Gardenia jasminoides</i>
Ghrit Kumari	Aloe vera	<i>Aloe barbadensis</i>
Mankachu	Indian Taro	<i>Alocasia indica</i>
Jangli kachu	Water lily taro	<i>Colocasia nymphaeifolia</i>
Sabri Kala	Banana plant	<i>Musa sp.</i>
Sagar Kala	Banana plant	<i>Musa sp.</i>
Shetdrone	Thumbai	<i>Leucas aspera</i>
Kalmegh	Creast or Green chiretta,	<i>Andrographis paniculata</i>
Ada	Ginger	<i>Zingiber officinale</i>
Holud	Turmeric	<i>Curcuma longa</i>
Grito-kumari	Aloe vera	<i>Aloe vera</i>

Shrubs

The project areas of Brahmanbaria currently support a rich variety of common shrub species that continue to play vital roles in local ecosystems, homestead gardens, and cultural practices. Aromatic and flowering shrubs such as *Jasminum sambac* (Beli), *Jasminum auriculatum* (Jui), and *Hibiscus rosa-sinensis* (Jaba) are widely cultivated for their ornamental beauty and aesthetic appeal.

Medicinal shrubs like *Lawsonia inermis* (Mehedi), traditionally used for body art and cooling treatments, and *Justicia adhatoda* (Bashok), valued for its respiratory benefits, remain common in household gardens. *Ocimum americanum* (Tulshi) continues to hold religious significance and is widely utilized in herbal remedies. Shrubs such as *Citrus aurantifolia* (Lebu) provide essential culinary and nutritional value, while *Murraya paniculata* (Kamini) is frequently planted as a natural hedge, appreciated for its dense foliage and fragrant blossoms.

These shrub species collectively enhance the biodiversity, environmental quality, and cultural richness of the project communities. Following table presents the currently documented shrub species in the project areas, based on recent baseline ecological surveys.

Table. Shrubs species recorded in the project area

Local Name	Common name	Scientific Name
Mehedi/ Mendi	Henna	<i>Lawsonia inermis</i>
Bashok	Malabar nut	<i>Justicia adhatoda/Adhatoda vasica</i>
Beli	Jasmine	<i>Jasminum sambac</i>
Jaba	Chinese hibiscus	<i>Hibiscus rosa-sinensis</i>
Lebu	Key lime	<i>Citrus aurentifolia</i>
Tulshi	Hoary Basil	<i>Ocimum tenuiflorum</i>
Jui	Juhi – Flowers of India	<i>Jasminum auriculatum</i>
Kamini	Orange jessamine	<i>Murraya paniculata</i>
Gondhoraj	Gardenia	<i>Gardenia jasminoides</i>

Trees

The project areas of Brahmanbaria presently support a diverse assemblage of common tree species that play a critical role in maintaining local biodiversity, promoting ecological resilience, and supporting community livelihoods. Fruit-bearing trees such as *Mangifera indica* (Mango), *Syzygium cumini* (Java Plum), *Psidium guajava* (Guava), *Artocarpus heterophyllus* (Jackfruit), and *Litchi chinensis* (Lychee) are widely cultivated for their nutritional benefits and economic value.

Shade- and timber-producing species like *Ficus benghalensis* (Banyan), *Samanea saman* (Rain Tree), *Swietenia mahagoni* (Mahogany), and *Tectona grandis* (Teak) are commonly found along homesteads, roadsides, and within institutional premises. Trees of medicinal and cultural importance, including *Phyllanthus emblica* (Amlaki), *Aegle marmelos* (Bael), and *Terminalia arjuna* (Arjun), remain prevalent across the landscape.

In addition, bamboo species such as *Bambusa balcooa*, *Bambusa tulda*, and *Bambusa longispiculata* continue to serve as key resources for construction, household applications, and handicrafts. The coexistence of indigenous and exotic species highlights the region's ecological diversity and its strong potential for agroforestry development. Following table presents the currently recorded tree species in the project areas, based on recent baseline ecological assessments.

Table. Tree species recorded in the project area

Local Name	Common name	Scientific Name
Aam	Mango	<i>Mangifera indica</i>
Acacia/ Babla	Gum Arabic tree	<i>Acacia nilotica</i>
Amlaki	Indian gooseberry or amla	<i>Phyllanthus emblica</i>
Arjun	Arjun tree	<i>Terminalia arjuna</i>
Ata fal	Sugar apple	<i>Annona squamosa</i>
Barak Bansh	Clumping bamboo	<i>Bambusa balcooa</i>
Bael	Golden apple	<i>Aegle marmelos</i>
Borroi	Indian jujube	<i>Zizipus mauritiana</i>
Bot	Banyan	<i>Ficus benghalensis</i>
Chalta	Elephant apple	<i>Dillenia indica</i>
Deshi Nim	Chinaberry	<i>Melia azadirachta</i>
Dumur	Opposite leaf	<i>Ficus hispida</i>
Jam	Java Plum	<i>Syzygium cumini</i>
Jambura	Pomelo	<i>Cytus grandis</i>
Talla Bansh	Tulda bamboo	<i>Bambusa. tulda</i>
Kadam	Burflower tree	<i>Anthocephalus chinensis</i>
Hijal	Indian Putat	<i>Barringtonia acutangula</i>
Kalo Karoi	Lebbeck	<i>Albizia lebbeck</i>
Kathal	Jackfruit	<i>Artocarpus heterophyllus</i>
Khejur	Silver date palm	<i>Phoenix sylvestris</i>
Krishnachura	Royal poinciana	<i>Delonix regia</i>
Lichu	Lychee	<i>Litchi Chinensis</i>
Mahogani	American mahogany	<i>Swietenia mahagoni</i>
Mandar	Indian Coral Tree	<i>Erythrina variegata</i>
Sajna	Moringa	<i>Moringa oleifera.</i>
Narikel	Coconut	<i>Cocos nucifera</i>
Tal	Asian Palmyra palm	<i>Borassus flabellifer</i>
Peara	Common guava	<i>Psidium guajava</i>
Raintree Koroi	Rain tree	<i>Samanea saman</i>

Local Name	Common name	Scientific Name
Segun	Teak	<i>Tectonia grandis</i>
Shal	Sal tree	<i>Shorea rubusta</i>
Shawra	Nyireh batu	<i>Xylocarpus moluccensis (Lam)</i>
Simul	Cotton tree	<i>Bombax ceiba</i>
Supari	Areca palm	<i>Areca catechu</i>
Tarla Bansh	Mahal bamboo	<i>Bambusa longispiculata</i>
Borta/Dahua	Lakoocha	<i>Artocarpus lacucha</i>
Pitali/Medda	False white teak	<i>Mallotus nudiflorus</i>
Tetul	Tamarind	<i>Tamarind indica</i>



: Terrestrial ecosystem along the left embankment and Right embankment. (A) Left embankment at Mogra Bridge, (B) Right embankment near at Chainage km 09+000, (C) Left embankment at Kornel Bazar (near at Km 12+000), (D) Right embankment at Kornel Bazar (near at Km 13+000)



Dumur (*Ficus hispida*)



Banana plant (*Musa sp.*)



Kadam (*Anthocephalus chinensis*)

Annex E:

Comments and Responses

World Bank provided comments and suggestions on the report which have been incorporated during the revision. The responses to the comments are summarised in the following table.

Table E1: Responses to the Comments from World Bank

SI No	Comments	Responses
1.	Lack of Specific Project Locations: The report refers to interventions such as 5.79 km bank protection, 72.55 km embankment repair etc., but no specific subproject locations, alignment, maps, or site references are provided. Without site-level clarity, it is difficult to assess location-specific risks, vulnerabilities, or determine appropriate mitigation.	Specific subproject locations, alignment, maps, etc. have been incorporated in Section 3.1, Page 61-91
2.	Generalized Baseline Data: ES baselines are discussed broadly across five districts rather than along specific alignments.	ES baselines have been re-established along alignments of the proposed project interventions and surrounding influence area. (Page 110-154), Appendix-D (Page D1-D48)
3.	Risk and Impact Analysis Needs Site specific: Impacts are described by project phase but not by exact location, design footprint, or sensitive receptors; also, alternatives analysis is missing.	Locations of project activities and sensitive receptors have been incorporated in Table 6-1: Key risks and impacts of the project interventions on the identified VESCs (Page 160-169) . Alternative analysis is added as Section 6.5 (Page 179-182) .
4.	ESMP Requires Site-Specific Detailing: The proposed ESMP is largely generic. Once the exact locations, alignments and concept designs are finalized, it will be essential to develop detailed site-specific mitigation and monitoring measures as well recommendation on the ES considerations in design as per ESS3.	Detailed site-specific mitigation and monitoring measures, considering ESS3, have been developed. Table 8-1: Mitigation and enhancement measures and Table 8 2: Environmental and Social Monitoring Plan are revised accordingly. (Page 197-227)
		Some changes have been made to the Budget Estimates. (Page 230-231)

Table E2: Responses to the second round Comments from World Bank

SL.	Comments	Responses
	General Comments	
1.	PIU (BWDB) E&S staffing is insufficient; dedicated environmental, social, and OHS specialists with clear TORs must be ensured, and the CSC should be strengthened with independent E&S staff holding stop-work authority.	Agreed and updated. E&S Staffing has been updated as per ESCP of the project.
2.	Contractor E&S capacity has not been assessed; the ESIA should require bidders to submit an E&S organization chart, CVs of qualified staff, records of past performance, and a training plan as part of evaluation.	Agreed and updated. Contractor's E&S Capacity requirements ensuring guidelines has been mentioned in the ESMP, by making the requirements essential in bid documents.
3.	Stockpile and plant site management measures (drainage, bunding, spill containment, restoration) are not detailed; contractors must prepare and submit a comprehensive Stockpile & Plant Site Management Plan with cost provisions.	Agreed, and updated. It has been included in ESMP to make it mandatory for contractor's to submit their site work plan with all these relevant information to be shown in their CESMP.
4.	The monitoring framework is presented but lacks clarity; frequencies and responsibilities should be defined, including post-storm/flood inspections of drains, routine dust/noise monitoring at sensitive receptors, and quarterly independent audits.	Agreed. Frequencies and responsibilities have been updated.
5.	ESMP budget lines are included but need to be ring-fenced to cover implementation, training, monitoring, and independent audits.	Agreed. ESMP budget has been updated as item wise format.

SL.	Comments	Responses
6.	Grievance redress and disclosure mechanisms are noted, but they must ensure local-language disclosure, an accessible GRM, and documented responses to community complaints.	Agreed. Letters, e-mails and website are suggested for accessible GRM in the report. We will suggest disclosure and documented responses to community complaints in Bangla.
	Environmental Observation	
	Project description chapter	
7.	Recommend adding relevant layout plans and typical designs.	Available design sheets have been provided.
8.	The work schedule, currently included in the ESMP chapter, should be relocated to this chapter for better alignment with project description content.	Agreed and updated
	Baseline chapter	
9.	Please provide details on the methodologies of air, noise, surface and ground water tests including method of sample collection and equipment used etc.	Agreed and updated.
10.	Table 5.1 presents ambient air quality data compared only with Bangladesh standards—comparison should also be made with international standards (e.g., WHO).	Agreed and updated
11.	For PM ₁₀ exceedance, reasons provided (e.g., aircraft) are unclear—please verify whether such transportation exists in the area. Avoid informal language like “your lungs (reader!)”; revise to a professional tone.	Agreed and updated
12.	Provide narrative analysis of surface and groundwater quality results, indicating any exceedances and potential causes.	Agreed and updated

SL.	Comments	Responses
13.	Clarify the period of climatic data used; minimum 20 years of data is recommended.	An adequate duration of climate data has been utilized to formulate a usable climate scenario for the project area, as per standard practice.
14.	The project area of influence (AOI) and the areas considered for ecological assessment are not clearly defined. Please specify this in the baseline section considered for overall baseline study too.	Agreed, information regarding AOI has been updated.
15.	In biological section, species listings should include their status according to the IUCN Red List.	Agreed, relevant information has been added.
Environmental and social risks and impacts chapter		
16.	This chapter and subsequent ones fail to assess risks and impacts related to spoil from canal re-excavation, nor is a spoil management plan included.	Agreed and updated. A plan for management of dredged materials with alternative steps have been outlined based on soil test data of canal bed.
17.	Impact assessment is expected to conduct against each of the 10 WB ESS.	Agreed, this impact assessment exercise has been provided.
18.	Though alternative analysis is provided considering only the project and without project scenario- other aspects like selection of technology/equipment, works method, selection of materials, locations as necessary could also be covered.	Only the 2 alternatives have been considered due to majority of scope of works being rehabilitation. We have elaborated these alternatives in the report.
ESMP chapter		
19.	Spoil management plan for canal re-excavation	Agreed and updated. A Spoil management plan has been outlined with alternative options. However, this can be finalized by the Design and

SL.	Comments	Responses
		Supervision Consultants.
20.	Fish pass design through sluices/regulators	The project scope includes regulator repair, no new regulator is proposed. As such, fish pass design is not relevant to the project.
21.	Navigation considerations	Specified project interventions do not hamper prevailing navigability. It will be discussed in the ESMP
22.	Occupational Health and Safety (OHS) of workers.	Agreed and Updated
23.	Community Health and Safety (CHS)	Agreed and Updated
24.	While a subsection on Climate Change and Adaptation Measures is included, it lacks specificity of different aspects like consideration of highest flood levels, infrastructure resilience to climate impacts etc.	This section has been clarified. As majority of the works are rehabilitation of existing infrastructures, there is little room for additional adaptation measures. However, this can be considered for any new or replaced ones.
25.	The ESMoP table suggests some tests to be done only once before construction. Recommend revisiting the monitoring frequency to ensure monitoring of potential degradation during construction.	Agreed, testing frequency has been updated.
26.	The ESMP and ESMoP budgets require further breakdown, clearly covering all identified mitigation and monitoring activities.	Agreed, further detailed breakdown has been provided.
27.	Include an organizational structure section with an organogram, ensuring it aligns with the positions outlined in the project's ESCP.	Agreed and Updated

SL.	Comments	Responses
	Social Observation	
28.	The Executive Summary states that permanent riverbank protection works (5.79 km) will be implemented in Feni, Cumilla, and Brahmanbaria. Please clarify whether these works will be constructed on the existing embankment or road. If no new land acquisition is required, kindly state this explicitly in the document.	Agreed and updated
29.	Please ensure that the term "safeguard" is not used anywhere in the document. This instruction applies to the entire report.	Agreed and updated
30.	The Executive Summary primarily uses BBS data to describe baseline conditions. Please also include data related to landownership, presence of businesses, residential structures, and non-titled properties in the areas where construction will take place.	Agreed, available relevant primary data on this has been provided.
31.	The Executive Summary mentions that the project area includes significant cultural and historical sites such as Mainamati-Lalmai, Shalban Bihar, and war cemetery. Although it notes that interventions will consider the preservation of these areas, the project will actually avoid these sites entirely to ensure their full protection. No construction activities or interventions will occur within or directly affect these culturally and historically important locations.	These historically important locations are within 2 km radius of the construction site, but the works will not directly/indirectly affect the sites. The report will be revised stating this.
32.	The Executive Summary does not address potential social impacts or propose relevant mitigation measures.	Agreed and Updated.
33.	Although the ESMP and its monitoring plan are included in the Executive Summary, there is no discussion of social impacts such as resettlement or effects on non-titled	Agreed, social impacts have now been included in updated report

SL.	Comments	Responses
	residents.	
34.	The budget section includes allocations only for environmental management and monitoring. Please clarify the provisions for social impact management, including mitigation and monitoring.	Agreed and Updated. However, the resettlement impact mitigation budget will be estimated during RAP.
35.	Section 1.6.3 refers to the “proposed Stakeholder Engagement Plan (SEP).” Please revise this to reflect that the project already has an SEP, which will guide consultation processes and grievance redress mechanisms.	Agreed and Updated.
36.	The ESIA states that “The project will follow proper rules and guidelines for private land acquisition and ensure lawful compensation for each PAP.” Please revise this section. Land acquisition is not permitted under this project. However, impacts on non-titled individuals will be addressed following the provisions of the RPF and RAP	Agreed and Updated.
37.	Table 4.2 refers to the presence of Indigenous Peoples in the project area. However, the impacts and mitigation measures related to these communities are not addressed in the impact assessment chapter. This needs to be corrected.	Agreed and Updated.
38.	Table 4.2 states, “The project identifies, following ESS10, stakeholders that are relevant to the cultural heritage that is known to exist or is likely to be encountered during the project life cycle.” Please clarify what is meant by this statement.	Agreed and Updated..
39.	According to Tables 5.20 and 5.24, there are 2,658 individuals from ethnic communities in and around the project area. If this is accurate, please confirm whether they meet the World Bank definition of Indigenous	Agreed and Updated.

SL.	Comments	Responses
	Peoples and whether Free, Prior, and Informed Consent (FPIC) is required. If FPIC is applicable, an Indigenous Peoples Plan (IPP) must be prepared prior to the commencement of construction. In addition, the impact assessment section does not address potential impacts on ethnic communities. Please avoid using the term “Indigenous Peoples” and instead use the terminology adopted in the ESCP, likely “ethnic communities.”	
40	The social baseline section relies primarily on BBS data, which is acceptable. However, if any primary data were collected in the field, please include those findings as well.	Agreed and Updated. Primary social data of affected area has been provided
41.	Chapters 6, 7, and 8 do not address social impacts or propose any mitigation measures. Please ensure that these aspects are included.	Agreed and Updated. Potential social impacts and relevant mitigation measures have been included
42.	Impacts related to labor and occupational health and safety are not clearly presented. Please provide estimates of the number of workers expected to be engaged at different stages of project implementation.	Agreed and Updated. Relevant section has been updated, providing necessary guidelines
43.	There is no discussion of contractor management, including the preparation of the Contractor’s Environmental and Social Management Plan (CESMP), roles and responsibilities of contractors and subcontractors, or requirements to be included in bidding documents. Please incorporate this information into the relevant sections.	Agreed and Updated. Requirements for CESMP has been included.



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