

Power Grid Company of Bangladesh

Power Cell, Power Division

Ministry of Power, Energy and Mineral Resources

Government of the People's Republic of Bangladesh

**Environmental Impact Assessment (EIA) for the Feasibility
Study of Enhancement and Strengthening of Power Network
in Eastern Region (ESPNER) of Bangladesh**



Draft Final Report



Power Grid Corporation of Bangladesh

Ministry of Power, Energy and Mineral Resources

Government of the People's Republic of Bangladesh

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ABBREVIATIONS

AIS	Air Insulated Switchgear
BMD	Bangladesh Meteorological Department
BWDB	Bangladesh Water Development Board
BNBC	Bangladesh National Building Code
BRTA	Bangladesh Road Transport Authority
BIWTA	Bangladesh Inland Water Transport Authority
CHT	Chittagong Hill Tracts
CCORRP	Chitagong City Outer Ring Road Project
DC	Double Circuits
DOE	Department of Environment
DPHE	Department of Public Health Engineering
DOF	Department of Fisheries
ECC	Environmental Clearance Certificate
ECR	Environmental Conservation Rules
ECOP	Environmental Code of Practice
EHS	Environmental Health & Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ESMF	Environmental and Social Management Framework
ESPNER	Enhancement and Strengthening of Power Network in Eastern Region
EQS	Environmental Quality Standards
EPA	Environmental Protected Area
ESU	Environmental & Social Unit
FD	Forest Department
FGD	Focus Group Discussions
GOB	Government of Bangladesh
IDA	International Development Association
IEE	Initial Environmental Examination
IEF	Important Environmental Features
JICA	Japan International Cooperation Agency
kV	Kilo Volt
KMG	Kanchpur Meghna Gumti Project
LGED	Local Government of Engineering Department
LL	LiLo Line
LILO	Loop-In- Loop-Out
MOEF	Ministry of Environment and Forest
MOPEMR	Ministry of Power, Energy and Mineral Resources
OP	Operational Policy
OHS	Occupational Health & Safety
PAPs	Project Affected Persons
PDB	Power Development Board
PC	Power Cell
PCB	Polychlorinated Biphenyl
PBS	Palli Bidduyt Shamiti
PGCB	Power Grid Company of Bangladesh
PIU	Project Implementation Unit
PWD	Public Works Datum
REB	Rural Electrification Board
RHD	Roads and Highways Department
RAP	Resettlement Action Plan
SMP	Social Management Plan

SPIA	Subproject Influence Area
SS	Substation
TL	Transmission Line
TOR	Terms of Reference
WB	World Bank

EXECUTIVE SUMMARY

1. INTRODUCTION

The Government of Bangladesh (GOB) has set long term goals for the power sector in the country. Providing access to affordable, reliable and quality supply of electricity to the majority of the people of Bangladesh by 2020 are the goals of the GOB to users the next millennium. In line with the above stated goals, the GOB is expected to obtain financial support from the International Development Association (IDA) for the proposed Enhancement and Strengthening of Power Network in Eastern Region (ESPNER) project to ensure reliable and quality supply of electricity to the rural and urban consumers in Bangladesh through improvements in technical efficiency of the distribution system. The proposed project is expected to construct sub-stations (SS), transmission lines (TL) and LILO lines of the PGCB under the Power Cell, Power Division, Ministry of Power, Energy and Mineral Resources (MOPEMR) of the GOB. Main components of the project include:

- Construction of new 230/132 kV two substations and new 132/33 kV 10 substations;
- Construction of new 283.642km long 132 kV , 230kV and 400kV transmission lines (TL);and
- Construction of new LILO lines (LL);

The present power network in Greater Comilla, Noakhali and Chittagong areas of Bangladesh is aged and suffering numerous problems as system demand is growing rapidly. The greater Comilla and Noakhali areas are the second largest demand areas after the capital city of Dhaka. The greater Chittagong area is on the verge of massive industrialization as the government is taking initiatives to set up multiple economic zones, upgrade port facility and transportation network. Hence, the project was conceptualized with a rationale to expand the 230 kV transmission systems and to strengthen the 132 kV transmission systems in the project area, in order to, eliminate the operational bottlenecks caused due to inadequacy of the existing system. The project will also provide an adequate infrastructure for the future power sector development of the area.

The TOR has prepared to carryout detailed EIA for the project in accordance with the relevant laws and regulations of the GOB and the WB. The specific environmental guideline for the power sector is not available in Bangladesh. However the DOE environmental guidelines for the industries provide a general framework for conducting environmental study for the entire sector. Therefore the proposed EIA will be conducted following the DOE environmental guidelines. In addition, it is suggested to follow the Environmental & Social Management Framework (ESMF) of Rural Electricity Transmission and Distribution Project of PGCB and BREB as well as WB environmental guidelines for the power sector.

The scope of work of the EIA includes: (a) Review of relevant all documents/information/data from secondary sources, and identify gaps to be filled, relevant to the environmental screening needs from primary surveys. (b) Provide a description of the environment (such as baseline data on physical, biological and socio-economic characteristics of the subproject sites along with sub-project influence area (SPIA). (c) Represent the primary surveys where include baseline (air, water, noise, and riverbed) environmental quality monitoring at representative and sensitive locations, and identification of all macro-level environmental issues within the SPIA. (d)Survey the environmentally sensitive locations on and along the sub-projects and within the SPIA. (e)Arrange stakeholder consultation with the local people from all profession to find out their opinion within the subproject. (f) Analysis of alternatives to the proposed subproject. (g) Identify and assessment of potential

environmental impacts due to implementation of the subproject. (h) Formulation of Environmental Management Plan (EMP)

2. ENVIRONMENTAL POLICIES, RULES, REGULATIONS AND STANDARDS

Both the GOB and WB have formulated environmental regulatory framework and made provisions to implement them towards the protection and conservation of the environmental components from negative impacts of the project activities. Major GOB and WB environmental policies, rules, regulations and standards are as follows:

Relevant GOB Policies, Acts, Rules, Strategies and Guidelines: (1)Environmental Conservation Act (ECA), 1995 and Amendments; (2)Environment Conservation Rules (ECR), 1997 and Amendments; (3)Environmental Policy, 1992; (4)Environmental Action Plan, 1992 ; (5)National Environmental Management Plan (NEMAP), 1995; (6)Bangladesh Wildlife (Preservation) Order, 1973 (Amended in 1994) ;(7)National Water Policy, 1999; (8)National Water Management Plan, 2001 (Approved in 2004); (9)The National Fisheries Policy, 1999; (10)The Protection and Conservation of Fish Rules, 1985 (11)National Agricultural Policy, 1999; (12)The Embankment and Drainage Act, 1952; (13)Bangladesh Climate Change Strategy and Action Plan; (14)DOE's IEE/EIA including EMP Guidelines for Industry, 1997; (15) Environmental Code of Practices,; and (16) Electricity Act 1910 and Amendments.

World Bank's Relevant Environmental Safeguard Policy: (1) OP/BP 4.01 Environmental Assessment; (2) OP/BP 4.04 Natural Habitats; (3) OP/BP 4.11 Physical Cultural Resources; (4) OP/BP 4.36 Forestry; (5) OP/BP 4.12 Involuntary Resettlement; & (5) WB Group Environmental Health and Safety (EHS) Guidelines.

Applicable National/International Standards: There are environmental standards in operation in Bangladesh also promulgated under ECR of 1997 and these are for: water; ambient air; noise; odor; industrial effluent and emission discharges; and vehicular emissions, etc. The standards, commonly known as Environmental Quality Standards (EQS), are legally binding. The international standard for heavy metals of soil of USA, EPA, 2000 has also been used.

Categories of Projects: Under the ECR, 1997, a classification system was established for development projects and industries on the basis of location, size and severity of potential environmental pollutions. There are four categories of projects: green, orange A, orange B and Red with respectively no, minor, medium and severe environmental impacts. According to the guidelines, illustrated in ECR, 1997 of DOE , this project falls under the red category of projects. Therefore, for this project, it needs to prepare an Environmental Impact Assessment (EIA) in due course following prescribed format and be submitted to the DOE for getting the Environmental Clearance Certificate (ECC) of the project. According to WB and impact assessment as mentioned in ESMF, this project falls under category B and therefore needs to carry out the Initial Environmental Examination (IEE).

3. PROJECT DESCRIPTION

The project components such as 12 substations, 8 transmission lines (total 210.76 km)and 8 LILO lines (total 25.73 km) are located in the seven districts (such as Chittagong, Feni, Noakhali, Laxmipur, Comilla, Chandpur districts of Chittagong division and Munshiganj district (small part which is in Dhaka division) of the eastern region of PBCB's jurisdiction .

Main components of the project include:

- Construction of new 230/132 kV two substations and new 132/33 kV .10 substations;
- Construction of new total 210.76 km long 132 kV , 230kV and 400kV transmission lines (TL);and
- Construction of new total 25.731 km Lilo lines (LL);

Initially three sites have been selected for the proposed each substation and 3 routes for the proposed each transmission line which are located at different seven districts in Bangladesh. From these three sites, environmentally friendly one site for each substation and one route for each TL have been finally selected (Chapter 4) which is given in the following tabular form:

Sl. No.	*Name of the New Substation (SS)	Name of the New Transmission Line (TL)
1	230/132 kV GIS Substation at Chowmuhoni	Chowmuhoni – Kachua 230 kV M/C Line- 49.05 km
2	230/132 kV GIS Substation at Kachua	Gazaria – Kachua 230 kV M/C Line - 45.09 km (Four Circuit Tower with Twin Mallard Conductor)
3	132/33 kV GIS Substation at Muradnagar	LILO of Comilla (N) – Daukandi 132 kV D/C Line at Muradnagar – 0.5 km
4	132/33 kV GIS Substation at Laksham	Kachua- Laksham 132 kV D/C Line - 30.93 km
5	132/33 kV GIS Substation at Maijdee	Chowmuhoni – Maijdee 230 kV D/C Line- 20.55 km
6	132/33 kV GIS Substation at Patiya	LILO of Dohazari – Sikalbaha 132 kV D/C Line at Patiya – 1.16 Km
7	132/33 kV GIS Substation at Chandina	Comilla (N) – Chandina 132 kV D/C Line - 9.85 km
8	132/33 kV GIS Substation at New Mooring (Anand Bazaar)	LILO of Haliashahar- Khulsi 132 kV S/C (ckt-1, 2&3) Line at New Mooring-0.630 km
9	132/33 kV GIS Substation at Basurhat	Two Ckt LILO from Feni – Chowmuhoni 132 kV D/C line at Basurhat – 2.74 km
10	132/33 kV GIS Substation at Laxmipur	Chowmuhoni – Laxmipur 132 kV D/C Line - 27.38 km
11	132/33 kV GIS Substation at Kosba	Muradnagar – Kosba 132 kV D/C Line- 22.79 km
12	400/230 kV GIS Substation at Korerhat	Korerhat- Chowmuhoni 230 kV M/C Line- 52.73 km (Four Circuit Tower with Twin Mallard Conductor)
		LILO of Modunghat – Meghnaghat 400 kV D/C Line at Korerhat – 0.4 Km
		LILO of Comilla (N)/ Feni – BSRM/ Hathazari 230 kV D/C Line – 5.728 Km
		LILO of Feni/ Baroihat – Hathazari 132 kV D/C Line – 2.8 Km
		Extension of Mirsharai – BSRM 400 kV D/C Line to Korerhat – 11.314 Km

Note: *Initial capacity of 132/33kV substation was 50/75MVA but now it is 80/120MVA.

4. Analyses of Alternative for TL/Lilo Route and Substation Site Selection

For the selection of optimum route, the following points are taken into considerations: (i) The route of the proposed TL/Lilo does not involve any human rehabilitation. (ii) Any monument of cultural or historical importance is not affected by the route of the TL/Lilo. (iii) The proposed route of TL/Lilo does not create any threat to the survival of any community with special reference to Tribal

Community. (iv)The proposed route of TL/Lilo does not affect any public utility services like playgrounds, schools, other establishments etc. (v)The line route does not pass through any sanctuaries, national park etc. (vi) The line route does not infringe with area of natural resources.

In order to achieve this, different alternatives were studied for all the major transmission lines with understanding that minor alterations often added to avoid environmentally sensitive areas and settlements at execution stage.

As a rule, alignments are generally cited 10-15 km away from major towns, whenever possible, to account for future urban expansion. Similarly, forests are avoided to the extent possible, and when it is not possible, a route is selected in consultation with the local Divisional Forest Officer, that causes minimum damage to existing forest resources. Alignments are selected to avoid wetlands and unstable areas for both financial and environmental reasons.

In addition, care is also taken to avoid Environmental Protective Areas (EPA), critical areas, forest area, homesteads, cultural sites etc. Keeping above in mind the routes of proposed lines under the project has been so aligned that it takes care of above factors. As such different alternatives were studied with the help of Google Earth and Survey of Bangladesh (SOB) topographical survey sheets etc. to arrive at most optimum route which can be taken up for detailed survey and assessment of environmental & social impacts for their proper management.

Three different route alignments were studied for the selection of TL/Lilo with the help of published data/Google maps and walkover survey to arrive at most optimum route for detailed survey.

For substation site selection also analysis of three alternatives sites has been carried out based on environment and social aspects and technical requirements. Such analysis considers various site specific parameters that include availability of infrastructure facilities such as access roads, water routes, distance from railway lines, type of land (Government/private land/landuse); social impacts such as number of families getting affected; Common Property Resources (CPR) including feasibility of acquisition etc.. The finalization of substation land is done based on above analyses and site visit/verification. The social aspects are provided due weightage after technical requirement in decision making for selection/finalization of land for substation.

5. DESCRIPTION OF ENVIRONMENTAL BASELINE

The subproject areas of the substation and TL/Lilo lines of the project are located in a typical monsoon climate with three main seasons, summer (February to May), monsoon (June to September) and winter (October to January). The environmental baseline conditions and Important Environmental Features (IEFs) of each substation (SS) subproject, Transmission Line (TL) subproject and Lilo Lines are summarized in the following Table 1.

Table 1: Environmental Baseline Data of the Subprojects of the Substations (SS) and Transmission Line (TL) and Lilo Lines

Sl. No.	Subproject Site/Route	Location	Type of Land	Inundation during HFL	Topography	Earthquake Zone	Air	Av. Noise Level (dB)	Water Bodies in & crossing ROW	Trees in ROW	Major Fauna (mainly in SPIA)	EPA in ROW / SPIA	Affected Land in ROW (acre)	Family (Nos)	CS in ROW of SS	Cultural Sites in SPIA	Traffic Condition on nearby Roads
Substation Subprojects:																	
1	230/132 kV GIS at Chowmuhoni	Begumganj, Noakhali.	Partially 2 cropped agricultural land & partially fellow land	Yes	Flat Terrain	Zone-3	Dusty	65.32	No		sparrow, kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, bengal monitor, common house lizard, snakes, frog etc.	No	5	0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
2	230/132 kV GIS at Kachua	Kachua, Chandpur	3 cropped agricultural land	Yes	Flat Terrain	Zone-2	Good	62.84	No		sparrow, kingstork, dove, crow, fox, mouse, grew musk, common house lizard, snakes, frog etc.	No	5	0	0	Mosque at about 200m east	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
3	132/33 kV GIS at Muradnagar	Muradnagar, Comilla	3 cropped agricultural land	Yes	Flat Terrain	Zone-2	Good	57.93	No		shalik, sparrow, kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, bengal monitor, common house lizard, snakes, frog	No	5	0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.

Sl. No.	Subproject Site/Route	Location	Type of Land	Inundation during HFL	Topography	Earthquake Zone	Air	Av. Noise Level (dB)	Water Bodies in & crossing ROW	Trees in ROW	Major Fauna (mainly in SPIA)	EPA in ROW / SPIA	Affected Land in ROW (acre)	Family (Nos)	CS in ROW of SS	Cultural Sites in SPIA	Traffic Condition on nearby Roads
4	132/33 kV GIS at Laksham	Laksham, Comilla	3 cropped agricultural land	Yes	Flat Terrain	Zone-2	Good	56.34	No		shalik, sparrow, kingstork, dove, crow, fox, mouse, shrew, squirrel, , bengal monitor, common house lizard, snakes, frog etc.	No	2	0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
5	132/33 kV GIS at Maijdee	Maijdee, Noakhali	2 cropped agricultural land	Not	Flat Terrain	Zone-3	Good	66.88	No		sparrow, kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, common house lizard, snakes, frog etc.	No	5	0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
6	132/33 kV GIS at Patiya	Patiya, Chittagong	2 cropped agricultural land	Not	Flat Terrain	Zone-2	Dusty	67.23	No		shalik, sparrow, kingstork, dove, crow, fox, mouse, shrew, back, bengal monitor, snakes, frog	No	5	0	.0	Mosque at 200m east of the SS	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
7	132/33 kV GIS at Chandina	Debidwar, Comilla	3 cropped agricultural land	Yes	Plain lands	Zone-2	Dusty	71.51	No	420	shalik, sparrow, kingstork, dove, crow, fox, mouse, grew musk, squirrel, stripped keel	No	2	0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.

Sl. No.	Subproject Site/Route	Location	Type of Land	Inundation during HFL	Topography	Earthquake Zone	Air	Av. Noise Level (dB)	Water Bodies in & crossing ROW	Trees in ROW	Major Fauna (mainly in SPIA)	EPA in ROW / SPIA	Affected Land in ROW (acre)	Family (Nos)	CS in ROW of SS	Cultural Sites in SPIA	Traffic Condition on nearby Roads
											back, common house lizard, snakes, frog etc.						
8	132/33 kV GIS at New Mooring/Anand Bazar	JL. 1, Mouza: Madha Halishahar, Thana: Bandar, District: Chittagong	2 cropped agricultural land	Not	Undulation	Zone-2	Dusty	57.55	No		shalik, sparrow, kingstork, dove, crow, fox, mouse, , squirrel, common house lizard, snakes, frog	No	20	0	0	2 Mosques , and a School at ch 400	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
9	132/33 kV GIS at Bashurhat	Bashurhat, Daganbhuiyan, Noakhali	3 cropped agri. land	Not	Flat terrain	Zone-2	Good	57.55	No	136	shalik, sparrow, dove, crow, fox, mouse, , squirrel, bengal monitor, common house lizard, snakes, frog etc.	No	2	0	0	Mosque at 100m east.	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
10	132/33 kV GIS at Laksmipur	Laksmipur Sadar, Laksmipur	2 cropped agricultural land	Yes	Flat Terrain	Zone-2	Dusty	68.35	No		shalik, sparrow, , fox, mouse, grew musk shrew, Bengal monitor, common house lizard, snakes, frog	No	5	0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
11	132/33 kV GIS at Kosba	Kosba, Brahmanbaria	2 cropped agricultural land	Yes	Flat Terrain	Zone-2	Dusty	59.64	No		sparrow, kingstork, dove, crow, fox, mouse, grew musk shrew,	No	5	0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.

Sl. No.	Subproject Site/Route	Location	Type of Land	Inundation during HFL	Topography	Earthquake Zone	Air	Av. Noise Level (dB)	Water Bodies in & crossing ROW	Trees in ROW	Major Fauna (mainly in SPIA)	EPA in ROW / SPIA	Affected Land in ROW (acre)	Family (Nos)	CS in ROW of SS	Cultural Sites in SPIA	Traffic Condition on nearby Roads
											squirrel, snakes, frog						
12	400/230 kV GIS at Korerhat	Korerhat, Mirsarai, Chittagong	2 cropped agricultural land	Not	Flat terrain	Zone-2	Good	70.57	Small seasonal Khal	2945	shalik, sparrow, crow, fox, mouse, shrew, squirrel, common house lizard, snakes, frog etc.	No	25	0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
Transmission Line Subprojects:																	
1	Chowmuhoni – Kachua 230 kV Double Circuit TL	Started at Chowmohuni substation, UZ: Chowmohuni, Dt: Noakhali and ended at Kachua substation, UZ: Kachua, Dist.: Chandpur	Two to three cropped agricultural lands	Yes	Flat	Zone-3	Good	-	30 Khals & 10 Ponds	2836	kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, stripped keel back, common house lizard, snakes, frog	No	149.42	0	0	A mosque at distance about 0+030	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
2	Kachua-Gazaria 230 kV TL	Started at Kachua substation, UZ: Kachua, Dt: Chandpur and ended at Gazaria substation, UZ: Gazaria, Dist.: Munshiganj	- Two to three cropped agricultural lands	Yes	Flat	Zone-2	Good	-	12 Khals & 7 Ponds	2544	kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, stripped keel back, common house lizard, snakes, frog	No	132.00	0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
3	Kachua-Laksham 132 kV TL	Started at Kachua substation, UZ: Kachua Dt: Chandpur	- Two to three cropped agricultural lands	Yes	Flat	Zone-2	Good	-	Khals & Ponds	2990	kingstork, dove, crow, fox, mouse, grew musk shrew,	No	101.46	0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes

Sl. No.	Subproject Site/Route	Location	Type of Land	Inundation during HFL	Topography	Earthquake Zone	Air	Av. Noise Level (dB)	Water Bodies in & crossing ROW	Trees in ROW	Major Fauna (mainly in SPIA)	EPA in ROW / SPIA	Affected Land in ROW (acre)	Family (Nos)	CS in ROW of SS	Cultural Sites in SPIA	Traffic Condition on nearby Roads
		and ended at Laksham substation, UZ: Laksham, Dist.: Comilla									squirrel, stripped keel back, common house lizard, snakes, frog						etc.
4	Chowmuhoni – Maijdee 230 kV Double Circuit TL	Started at Chowmohuni substation, UZ: Chowmohuni, Dt:Noakhali and ended at Maidee substation, UZ: Chowmohuni, Dt:Noakhali	- Two to three cropped agricultural lands	Yes	Flat	Zone-3	Good	-	6Khals & 5Ponds	1795	kingstork, crow, fox, mouse, grew musk shrew, squirrel, common house lizard, snakes, frog.	No	63.04	0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
5	Comilla – Chandina 132 KV DC TL	Started at Comilla (North) substation Dt:Comilla and ended at Chandina substation, UZ: Chandina, Dist.: Comilla	- Two to three cropped agricultural lands	Yes	Flat	Zone-2	Good	-	1 khal	No	kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, stripped keel back, bengal monitor, snakes, frog	No	33.49	0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
6	Chowmuhoni – Laxmipur 132 kV Double Circuit TL	Started at Chowmohuni substation, UZ: Chowmohuni, Dt:Noakhali and ended at Laxmipur substation, Dist.: Laxmipur	- Two to three cropped agricultural lands	Yes	Flat	Zone-3	Good	-	12Khals & 7Ponds	1740	kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, bengal monitor, common house lizard, snakes, frog	No	94.56	0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
7	Muradnagar –	Started at	Two to	Yes	Flat	Zone-2	Good	-	14Khals	337	kingstork,	No	68.95	0	0	0	trucks, buses,

Sl. No.	Subproject Site/Route	Location	Type of Land	Inundation during HFL	Topography	Earthquake Zone	Air	Av. Noise Level (dB)	Water Bodies in & crossing ROW	Trees in ROW	Major Fauna (mainly in SPIA)	EPA in ROW / SPIA	Affected Land in ROW (acre)	Family (Nos)	CS in ROW of SS	Cultural Sites in SPIA	Traffic Condition on nearby Roads
	Kosba 132 KV DC TL	Muradnagar substation, UZ: Muradnagar, Dt: Comilla and ended at Kosba substation, UZ: Kosba, Dist.: B. Baria.	three cropped agricultural lands -						&4Ponds		dove, crow, fox, mouse, grew musk shrew, squirrel, stripped keel back, bengal monitor, common house lizard, snakes, frog						microbus, sedan cars, taxi, vans, motorbikes etc.
8	Korerhat-Chowmuhoni 230KV MC TL	Started at Korerhat substation, UZ: Mirersorai, Dt: CTG and ended at Chowmuhoni substation, UZ: Chowmuhoni, Dist.: Noakhali.	Two to three cropped agricultural lands -	Not	Flat	Zone-2 & 3	Good	-	30Khals &10Ponds	8010	kingstork, dove, crow, fox, mouse, shrew, squirrel, stripped keel back, bengal monitor, , snakes, frog	No	160.56	0	0	A mosque at 40m distance at ch 49+250 at R/S and a graveyard at 25 m distance at L/S at Ch 10+000.	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
Lilo Lines:																	
1	LILo of 132 KV DC Feni-Chowmuhani, L=2.915km,	0+000-2+915	Two to three cropped agricultural lands	Yes	Flat	Zone- 2	Good	-	30 Khals &10 Ponds	No	dove, crow, fox, mouse, grew musk shrew, squirrel, stripped keel back, common house lizard, snakes, frog	No		0	0	A mosque at distance a ch 0+030	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
2	LILo of 230 KV DC Korerhat – Comilla,	0+000-5+191	- Two to three cropped agricultural lands	Yes	Flat	Zone-2	Good	-	12Khals & 7Ponds	No	kingstork, dove, crow, fox, mouse, grew musk shrew,	No		0	0	o	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes

Sl. No.	Subproject Site/Route	Location	Type of Land	Inundation during HFL	Topography	Earthquake Zone	Air	Av. Noise Level (dB)	Water Bodies in & crossing ROW	Trees in ROW	Major Fauna (mainly in SPIA)	EPA in ROW / SPIA	Affected Land in ROW (acre)	Family (Nos)	CS in ROW of SS	Cultural Sites in SPIA	Traffic Condition on nearby Roads
	L=5.735										squirrel, common house lizard, snakes, frog						etc.
3	LILO of 132 KV DC Karerhat-Hathazari-F5eni 6	0+000-3+327	- Two to three cropped agricultural lands	Yes	Flat	Zone-1	Good	-	Khals & Ponds	No	dove, crow, fox, mouse, grew musk shrew, squirrel, stripped keel back, common house lizard, snakes, frog	No		0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
4	.LILLO of 8132 KV DC Dohazari-Shikalbaha	0+000-0+750	- Two to three cropped agricultural lands	Yes	Flat	Zone-1	Good	-	Seasonal ponds/khals	No	crow, fox, mouse, grew musk shrew, squirrel, , common house lizard, snakes, frog .	No		0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
5	LILLO of 132 KV DC Halishahar-Kulshi	0+000-1+105	- Two to three cropped agricultural lands	Yes	Flat	Zone-1	Good	-	Seasonal ponds/khals	No	kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, stripped keel back, bengal monitor, snakes, frog	No		0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
6	LILLO of 400 KV DC Korerhat-BSRM	0+000-11+850	- Two to three cropped agricultural lands	Yes	Undulated	Zone-2	Good	-	Seasonal ponds/khals	, small to medium size forest	kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, common house lizard, snakes, frog	No		0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.

Sl. No.	Subproject Site/Route	Location	Type of Land	Inundation during HFL	Topography	Earthquake Zone	Air	Av. Noise Level (dB)	Water Bodies in & crossing ROW	Trees in ROW	Major Fauna (mainly in SPIA)	EPA in ROW / SPIA	Affected Land in ROW (acre)	Family (Nos)	CS in ROW of SS	Cultural Sites in SPIA	Traffic Condition on nearby Roads
										trees (not densely) from ch 3+450 – 11+700							
7	.LILO of 132 KV DC Modhunaghat-Meghnaghat	000-0+775	Two to three cropped agricultural lands -	Yes	Flat	Zone-2	Good	-	Seasonal ponds/khals		kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, stripped keel back, bengal monitor, common house lizard, snakes, frog	No		0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
8	LILO of 400 KV DC Comilla(N)-Daudkandi)	0+000-0+424	Two to three cropped agricultural lands -	Not	Flat	Zone-2 & 3	Good	-	Seasonal ponds/khals		kingstork, dove, crow, fox, mouse, shrew, squirrel, stripped keel back, bengal monitor, , snakes, frog	No		0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.

Source: Literature review, Topo Survey, SES & Environmental Survey in 2017.

6. ENVIRONMENTAL SCREENING/IMPACT ASSESSMENT OF THE SUBPROJECTS

The environmental impacts due to implementation of the subproject of Substations and Transmission Lines/LILO Lines during construction and operation stages have been identified through baseline environmental survey including environmental quality survey, public consultations and literature review. During the field visits, Environmental Screening/Assessment Checklist (Appendix-B: Substation, Form 2a and Transmission Line, Form 2b, illustrated in the ESMF Guidelines, 2013) has been filled up for the initially selected 3 sites of each proposed substation and 3 routes of Transmission Line to identify the potential environmental impacts. From these 3 sites (for substation) and routes (for TL), environmentally suitable site (for substation) and route (TL) have been finally selected.

Based on the environmental baseline data (Appendix-B: Form 1a: Substation and Form 1b: Power line) and environmental screening (Appendix-C: Form 2a: Substation and Form 2b: TL & LILO Lines), potential environmental impacts assessment for the finally selected subprojects (Substations, Transmission Lines & LILO lines) have been done. Potential environmental impacts of the finally selected subproject of substation and TL have been categorized into: (i) general/common impacts, which are typical common impacts to be experienced in most subprojects and (ii) subproject specific impacts which are given below:

General/Common and subproject specific Impacts due to finally selected all 12 Substation Subprojects are as follows (Table 2):

Table 2: Environmental Impacts of the Selected Substation Subprojects

Sl. No.	Subproject Site/Route	Selected Site	Common Environmental Impacts	Subproject Specific Impacts
1	230/132 kV GIS at Chowmuhoni, Noakhali	Site-1	Pre-construction/Construction Phase: <ul style="list-style-type: none"> i. Land Acquisition ii. Clearing of Vegetation iii. Disturbance of Fauna (wildlife) iv. Loss of Top Soil v. Hydrology/Drainage Congestion vi. Ground Water Pollution vii. Noise Pollution viii. Air and Dust Pollution ix. Soil Pollution x. Pollution due to Wastes xi. Traffic Congestion/Road Accident xii. Siting of Construction Camps xiii. Occupational Health and Safety xiv. Community Health and Safety xv. Employment Generation/Income 	
2	230/132 kV GIS at Kachua, Chandpur	Site-1		
3	132/33 kV GIS at Muradnagar, Comilla	Site-1		
4	132/33 kV GIS at Laksham, Comilla	Site-1		
5	132/33 kV GIS at Maijdee, Noakhali	Site-1		Surface water (perennial pond at about 50m far away)
6	132/33 kV GIS at Patiya, Chittagong	Site-1		
7	132/33 kV GIS at Chandina, Comilla	Site-1	Operation Stage: <ul style="list-style-type: none"> i. Hydrology/Drainage Congestion ii. Landscape iii. Community Health and Safety iv. Occupational Health and Safety v. Improvement of Social & Economic Life 	Construction Stage: <ul style="list-style-type: none"> i. 420 Trees Cutting ii. Loss of terrestrial Habitat iii Surface water (Perennial Pond at about 150m faraway)

Sl. No.	Subproject Site/Route	Selected Site	Common Environmental Impacts	Subproject Specific Impacts
8	132/33 kV GIS at New Mooring/Anand Bazar, Chittagong	Site-1	vi. Short Circuit/Accident	
9	132/33 kV GIS at Bashurhat, Feni	Site-1		Construction Stage: i. 136 Trees Cutting ii. Loss of terrestrial habitat iii. Surface water (Perennial Pond at about 30m far away) pollution iii. A mosque at 100m faraway at east side of the SS.
10	132/33 kV GIS at Laxmipur, Laksmipur	Site-1		
11	132/33 kV GIS at Kosba, Brahmanbaria	Site-1		
12	400/230 kV GIS at Korerhat, Chittagong	Site-1		Construction Stage: i. 2945 Trees Cutting ii. Loss of terrestrial habitat

General/Common and subproject specific Impacts due to finally selected 8 TL Subprojects are as follows (Table 3):

Table 3 : Environmental Impacts of the Selected TL Subprojects

Sl. No.	kv	Subproject Site/Route	Selected Route	Environmental Impacts	Subproject Specific Impacts
1	230	Chowmuhoni – Kachua 230 kV Double Circuit TL	Route-01	Pre-construction/Construction Phase: i. Clearing of Vegetation ii. Disturbance of Fauna (wildlife) iii. Loss of Top Soil due to tower iv. Noise Pollution v. Air and Dust Pollution vi. Soil Pollution vii. Pollution due to Wastes viii. Aquatic Habitat ix. Traffic Congestion/Road Accident	Preconstruction/Construction Stage: i. Surface water Pollution ii. 2806 Trees may be partially affected by trimming. ii. Loss of terrestrial habitat Construction Stage: i. Surface Water Pollution ii. 1740 Trees may be partially affected by trimming. ii. Loss of terrestrial habitat v. Disrurbation of boat movement and water pollution in the Meghna-Gumti River during construction of the TL along with tower at both
2	230	Kachua-Gazaria 230 kV TL	Route-01		

Sl. No.	kv	Subproject Site/Route	Selected Route	Environmental Impacts	Subproject Specific Impacts
				x. Siting of Construction Camps	river banks.
3	132	Kachua-Laksham 132 kV TL	Route-01	xi. Occupational Health and Safety	Construction Stage: i. Surface water Pollution
				xii. Community Health and Safety	ii. 299 Trees may be partially affected by trimming.
				xiii. Employment Generation/Income	ii. Loss of terrestrial habitat
4	230	Chowmuhoni – Maijdee 230 kV Double Circuit TL	Route-01	Operation Stage: i. Landscape	Construction Stage: i. Surface water Pollution
				ii. Community Health and Safety	ii. 1795 Trees may be partially affected by trimming.
				iii. Occupational Health and Safety	ii. Loss of terrestrial habitat
5	132	Comilla (North) –Chandina 132 KV DC TL	Route-01	iv. Improvement of Social & Economic Life	
				v. Short Circuit/Accident	Construction Stage: i. Surface water Pollution
6	132	Chowmuhoni – Laxmipur 132 kV Double Circuit TL	Route-01	vi. Electro-Magnetic Field (EMF)	ii. 2544 Trees may be partially affected by trimming.
					ii. ii Loss of terrestrial habitat
7	132	Muradnagar – Kosba 132 KV DC TL	Route-01		Construction Stage: i. Surface water Pollution
					ii. 377 Trees may be partially affected by trimming.
					ii. Loss of terrestrial habitat
8	230	Korerhat- Chowmuhoni 230KV MC TL	Route-01		Construction Stage: i. Surface water Pollution
					ii. 8010 Trees may be partially affected by trimming
					ii. Loss of terrestrial habitat
					v. Disrubtion of boat movement in the Feni River (perennial 3water body) during construction of the TL along with tower at both river banks.
					v. A mosque at 20m far away at R/S of the TL.
					vi. A grave yard at 25m far away at L/S of the TL.

All Lilo lines (as mentioned in Appendix-D) have more or less same environmental impacts except Lilo line of 400 KV DC Korerhat-BSRM and therefore screening of impacts has been done for the 8 Lilo lines in the following same table except the Lilo of 400 KV DC Korerhat-BSRM and given in the following Table 4.

Table 4: Common/General & Subproject Specific Environmental Impacts of the Selected Lilo Line Subprojects

Sl. No.	kv	Subproject Site/Route	Common Environmental Impacts
1			Pre-construction/Construction Phase: i. Clearing of Vegetation ii. Disturbance of Fauna (Wildlife)

Sl. No.	kv	Subproject Site/Route	Common Environmental Impacts
			iii. Loss of Top Soil due to Tower iv. Noise Pollution v. Air and Dust Pollution vi. Soil Pollution vii. Pollution due to Wastes viii. Loss of Terrestrial Habitat ix. Traffic Congestion/Road Accident x. Siting of Construction Camps xi. Occupational Health and Safety xii. Community Health and Safety xiii. Employment Generation/Income Operation Stage: i. Landscape ii. Community Health and Safety iii. Occupational Health and Safety iv. Improvement of Social & Economic Life v. Short Circuit/Accident vi. EMF
Sl. No.	kv	Subproject Site/Route	Subproject Specific Environmental Impact
1	400	LILO of 400 KV DC Korerhat-BSRM*	Construction Phase: i. Trimming of Trees (pocket hills with small to medium size forest trees (not densely) from ch 3+450 – 11+700; and ii. Disturbance of wildlife (specially birds)

Note: *Prior to start construction, permission from FD of Bangladesh is to be required.

7. ENVIRONMENTAL MANAGEMENT PLAN

Based on all the identified environmental impacts during preconstruction/construction and operation stages due to implementation of various subproject (Substation & TL) components/activities and associated development, Environmental Management Plan (EMP) has been prepared for the subprojects of the substation and TL.

Environmental Mitigation Plan: Environmental mitigation measures have been proposed for each of the identified impact of the subproject of the substations and TL/Lilo lines. Responsible institutions/departments for the implementation and supervision of each of the environmental issues have also been illustrated. Mitigation measures have been suggested based on the knowledge of the environmental specialist, suggestions of the stakeholders, collected during public consultation, and opinions from other relevant specialists (Table 4) .

Table 4: Mitigation Measures for the General/Common Impacts of the Substation Subprojects

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
(a) Preconstruction/Construction Stage				
Land acquisition/requisition	<ul style="list-style-type: none"> Loss of 86 acres land (mainly agricultural) permanently for twelve substation sites. 	<ul style="list-style-type: none"> Prior to commence construction activities, the owner of the affected land must be noticed and provided proper compensation in time as per GOB and WB guidelines; As per GOB & WB guidelines, RAP should be prepared 	DC	DSC/PGCB

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
	<ul style="list-style-type: none"> Temporarily loss of land (requisition) for construction camps etc. 	<ul style="list-style-type: none"> for land acquisition/requisition/compensation and follow it. Use GIS instead of AIS in order to reduce land requirement. 		
Top soil	<ul style="list-style-type: none"> Top soil loss (about 0.5m thick) due to construction of substation sites 	<ul style="list-style-type: none"> Prior to start filling the site, collect and storage top soils (minimum 0.5m thick) for using on the surface of the site boundary and access road side slopes for protection from side slope erosion. The topsoil, excavated from the proposed construction sites should be re-spread in areas to be landscaped. Follow ECOP-8 	Contractor	DSC/PGCB
Clearing of vegetation	<ul style="list-style-type: none"> Loss of standing crops (if any), grass and bushes of substation sites and construction camp sites 	<ul style="list-style-type: none"> Prior to start clearing of vegetation; provide adequate compensation to the owners in time. Follow ECOP-18 	Contractor	DSC/PGCB
Fauna (Wildlife)	<ul style="list-style-type: none"> Disturbance of wildlife specially birds due to project activities such as earthworks, moving of project equipment & transports especially during night time. 	<ul style="list-style-type: none"> Prepare construction management plan (CMP) by the contractor and follow it properly. Follow GOB rules and regulations on noise. Project workers should not disturb or kill any wildlife. Follow ECOP-18 	Contractor	DSC/PGCB
Construction Waste	<ul style="list-style-type: none"> Generation of construction wastes from the construction materials. 	<ul style="list-style-type: none"> Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time Provision of facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements Purchase of perishable construction materials such as paints incrementally to ensure reduced spoilage of unused materials Use of building materials that have minimal packaging to avoid the generation of excessive packaging waste Use of construction materials containing recycled content when possible and in accordance with accepted standards. Adequate collection and storage of waste on site and safe transportation to the disposal sites and disposal methods at designated area shall be provided. 	Contractor	DSC/PGCB
Drainage congestion and flooding	<ul style="list-style-type: none"> Reducing floodplain storage area and increase local flooding Due to earth filling of substation sites and 	<ul style="list-style-type: none"> Provide culvert in the access road of the substation; Ensure adequate monitoring, especially if construction works are carried out during the monsoon period. Provision for pumping of congested water, if needed; 	Contractor	DSC/PGCB

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
	<p>access roads above highest flood level (HFL).</p> <ul style="list-style-type: none"> Drainage congestion if the surrounding the sites are blocked by the earth embankment. 	<ul style="list-style-type: none"> Consider of HFL during design of substations to avoid inundation. Follow ECOP-1. 		
Noise level	<ul style="list-style-type: none"> Noise pollution due to construction activities, generators and construction vehicle movement. 	<ul style="list-style-type: none"> Use of noise plug in heavy construction equipment; It is recommended that no construction should be allowed during night time (9 PM to 6 AM) Avoid using of construction equipment producing excessive noise at night; Construction activities should not be during night time Avoid prolonged exposure to noise (produced by equipment) by workers; and Regulate use of horns and avoid use of hydraulic horns in project vehicles. Generator should be placed within room (concrete walls with roof). Monitoring of noise level at construction site, construction camp as and when required. 	Contractor	DSC/PGCB
Air quality & dust	<ul style="list-style-type: none"> Air pollution and dust generation due to construction activities, generators and construction vehicle movement. 	<ul style="list-style-type: none"> All vehicles (e.g., trucks, equipment, and other vehicles that support construction works) shall be well maintained and not emit dark or smoky emissions in excess of the limits described in the EQS. Specific training will be focused on minimizing dust and exhaust gas emissions from heavy construction vehicles. Drivers of vehicles used during construction will be under strict instructions to minimize unnecessary trips and minimize idling of engines. Dust suppression facilities (back pack water sprayer) shall be available where earth and cement works are required. Spray water on dry & loose surface of the construction sites regularly; Maintain adequate moisture content of soil during transportation, compaction and handling; Construction materials (sand, gravel, and rocks) and spoil materials will be transported trucks covered with tarpaulins. Sprinkle and cover stockpiles of loose construction materials (e.g., fine aggregates, sand); Avoid use of equipment such as stone crushers at site, which produce significant amount of particulate matter. 	Contractor	DSC/PGCB

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
		<ul style="list-style-type: none"> Dust masks should be provided to all personnel in areas prone to dust emissions throughout the period of construction. 		
Soil quality	<ul style="list-style-type: none"> Soil pollution 	<ul style="list-style-type: none"> Laboratory analysis of the river bed materials to be confirmed prior to start collection from the river; and Prevention of spillage and leakage of hazardous liquid at construction site & camp. Ensure not to use transformer containing PCB to avoid soil & air pollution. 	Contractor	DSC/PGCB
Sitting of construction camps	<ul style="list-style-type: none"> Removal of vegetation such as grass, standing crops (if any) and bushes. Environmental pollutions (such as air/dust, noise, water, wastes & soil) affecting nearby the settlements, 	<ul style="list-style-type: none"> Prior to start clearing of vegetation; provide adequate compensation to the owners in time. Locate construction camp away from residential settlements, cultural sites, water bodies etc (minimum 0.5km). Try to use fallow land to avoid crops damage Just after completion of the construction, hand over the camp sites to the owners as in earlier condition . Follow ECOP-7 	Contractor/ DSC	PGCB
Traffic congestion/road accident	<ul style="list-style-type: none"> Traffic congestion and road accident due to movement of construction vehicles. 	<ul style="list-style-type: none"> Follow Bangladesh Road Traffic Authority (BRTA) traffic rules and regulations; Schedule deliveries of materials/ equipment during off-peak hours Engage flagman specially at the entry of the substation sites and construction camps for traffic control Engage experienced drivers to drive project vehicles Arrange for signal light at night Prepare and follow proper traffic management; and Avoid stockpiling of materials specially at the road sides that could disturb traffic movement. Follow ECOP-14 	Contractor	DSC/PGCB
Pollution due to wastes	<ul style="list-style-type: none"> Pollution due to wastes (construction wastes from construction activities & general wastes from workers' camps) 	<ul style="list-style-type: none"> Solid wastes collection system will be essential, which should include separation and collection of solid wastes in the dustbins/waste containers throughout the work site, construction yard/labour camp. The wastes such as piece of rods and woods, newspapers, containers etc. can be sold to the vendors and rest wastes can be dumped into the nearby road side waste containers/ waste bins from where will send these wastes to the nearest land fill dumping site by the Contractors. A log of the disposal of toxic and other waste materials is to be kept by the Contractors. Prior to start construction, contractor should prepare 	Contractor	DSC/PGCB

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
		waste management plan (WMP) based on the EMP ▪ Follow ECOP-10		
Community health and safety (H&S)	▪ Community H&S nearby the substation site	▪ Safety barrier and warning sign surrounding the construction site; ▪ Generators should be placed in the closed room ▪ Formulate and implement emergency risk management plan by the contractor ▪ Follow ECOP-20.	Contractor	DSC/PGCB
Occupational health and safety (H&S)	▪ Health & safety risks of construction workers.	▪ An experienced Health & Safety (H&S) Manager must be engaged by the contractor prior to start construction ▪ Only permitting trained and certified workers to work with any electrical equipment. ▪ Safety induction by the H&S Manager should be provided for the workers ▪ Prior to start work, tool box meeting should be arranged by the H&S Manager for the workers ▪ First Aid Box and personal protective equipment, PPE (such as safety helmets, safety shoes, eye protection glasses, ear plugs/muffs, waist belts, masks, hand gloves, body protective aprons and insulating boots) must be provided to the workers and ensure to use these PPE by the workers; ▪ Safety signs, health signs, prohibition sign, warning sign, mandatory sign, emergency escape sign, first-aid sign, information sign, signboard, supplementary signboard, safety collar, symbol, pictogram, illuminated sign, acoustic signal, verbal communication and hand signal must be fitted at the designated sites of the subproject areas. ▪ Follow ECOP-19.	Contractor	DSC/PGCB
Employment generation/income	▪ Employment opportunities for the local people especially for PAPs.	▪ Employ local people specially PAPs for the project activities as much as possible.	Contractor	DSC/PGCB
(b) Operation Stage:				
Tree replantation	▪ A total of 7000 various local tree species can be replanted at the access road side slope @ 2.50m interval. ▪ Among the planted saplings, some (about 10%) may be dead.	▪ Plantation of 7000 saplings to replace felled trees on the side slopes of the access roads during monsoon period. ▪ The dead saplings should be replaced by new saplings ▪ Nursing period of planted sapling should not less than 2 years. ▪ Follow ECOP-17.	FD	PGCB
Drainage congestion	▪ Drainage congestion will be occurred in the	▪ Clean the drains, specially during monsoon regularly; ▪ Ensure adequate monitoring.	PGCB	PGCB

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
	surface drains within the substation area if O&M is not done regularly.			
Community health and safety	<ul style="list-style-type: none"> Community H&S nearby the substation site 	<ul style="list-style-type: none"> Safety barrier and warning sign surrounding the construction site; Generators should be placed in the closed room; Follow ECOP-20 	PGCB	PGCB
Safety & Security of workers	<ul style="list-style-type: none"> Risk to continuous power supply and even damage of substation 	<ul style="list-style-type: none"> Ensure security of substation in collaboration with law enforcing agencies. Keep complain book in the substation for recording of people's complains. Ensure availability of adequate safety gears for substation operations 	PGCB	PGCB
Power Supply	<ul style="list-style-type: none"> Due to adequate reliability of power supply, social life and economic condition of the people will be improved 	<ul style="list-style-type: none"> O&M of the substations should be done in time for adequate power generation. Follow ECOP-7 	PGCB	PGCB
Short Circuit/Accident	<ul style="list-style-type: none"> Due to short circuit of the substation, disruption of power and accident will be occurred. 	<ul style="list-style-type: none"> O&M of substations should be done in time by experienced personnel. 	PGCB	PGCB

Table 5: Mitigation Measures for the Specific Impacts of the Substation Subprojects

Substations	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
(a) Preconstruction/Construction Stage				
400 kV Korerhat Substation, Mirsarai, Chittagong	<ul style="list-style-type: none"> Site clearance will be required and 2945 trees will need to be felled. 	<ul style="list-style-type: none"> Try to avoid tree cutting as many as possible; Replantation of minimum 5900 numbers of various local saplings along the access road slopes and other private land during monsoon period of operation stage Follow ECOP-18 & 19 	Contractors	DSC/PGCB
132/33 kV: Basurhat GIS 2x50/75 MVA Substation, Daganbhuiya n, Feni	<ul style="list-style-type: none"> Site clearance will be required and 136 trees will need to be felled. Water of nearby pond will be polluted in case of dumping 	<ul style="list-style-type: none"> Try to avoid tree cutting as many as possible; Replantation of minimum 272 numbers of various local saplings along the access road slopes during monsoon period of the operation stage Follow ECOP-18 & 19 Need to prepare waste management plan & follow it. All project vehicles must be washed in the designated project garage but not in the nearby pond. Dust should be controlled by watering regularly. 	Contractors	DSC/PGCB

Substations	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
	<p>of project wastes into pond and washing of project vehicles.</p> <p>▪ Due to earth work, a mosque at about 100m far away will be affected specially by dust and noise.</p>	<p>▪ Noise level should be minimised by noise barrier (by tin/polythene fence).</p>		
132/33 kV: Chandina GIS 2x50/75 MVA Substation, Debidwar, Comilla	<p>▪ Site clearance will be required and 420 trees will need to be felled.</p> <p>▪ Nearby pond water will be polluted in case of dumping of project wastes into the pond and washing of project vehicles</p>	<p>▪ Try to avoid tree cutting as many as possible;</p> <p>▪ Replantation of minimum 840 numbers of various local saplings along the access road slopes during monsoon period of operation stage .</p> <p>▪ Follow ECOP-18 & 19</p> <p>▪ Need to prepare waste management plan & follow it.</p> <p>▪ All project vehicles must be washed in the designated project garage.</p>	Contractors	DSC/PGCB
Maijdee Substation, Noakhali	<p>▪ Nearby khal water will be polluted in case of dumping of project wastes into the khal and washing of project vehicles</p>	<p>▪ Need to prepare waste management plan & follow it.</p> <p>▪ All project vehicles must be washed in the designated project garage.</p>	Contractors	DSC/PGCB
(b) Operation Stage:				
400 kV Korerhat Substation, Mirsarai, Chittagong	<p>▪ A total of 2945 various local tree species can be replanted at the access road side slope @ 2.50m interval.</p> <p>▪ Among the planted saplings, some (about 10%) may be dead.</p>	<p>▪ Plantation of minimum 5900 saplings to replace felled trees on the side slopes of the access roads during monsoon period.</p> <p>▪ The dead saplings should be replaced by new saplings</p> <p>▪ Nursing period of planted sapling should not less than 2 years.</p> <p>▪ Follow ECOP-17.</p>	FD	PGCB
132/33 kV:	<p>▪ A total of 136</p>	<p>▪ Plantation of minimum 272 saplings to replace felled</p>	FD	PGCB

Substations	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
Basurhat GIS 2x50/75 MVA Substation, Daganbhuiyan, Feni	various local tree species can be replanted at the access road side slope @ 2.50m interval. ▪ Among the planted saplings, some (about 10%) may be dead.	trees on the side slopes of the access roads during monsoon period. ▪ The dead saplings should be replaced by new saplings ▪ Nursing period of planted sapling should not less than 2 years. ▪ Follow ECOP-17.		
132/33 kV: Chandina GIS 2x50/75 MVA Substation, Debidwar, Comilla	▪ A total of 420 various local tree species can be replanted at the access road side slope @ 2.50m interval. ▪ Among the planted saplings, some (about 10%) may be dead.	▪ Plantation of minimum 840 saplings to replace felled trees on the side slopes of the access roads during monsoon period. ▪ The dead saplings should be replaced by new saplings ▪ Nursing period of planted sapling should not less than 2 years. ▪ Follow ECOP-17.	FD	PGCB

Table 6: Mitigation Measures for the General/Common Impacts of TL/Lilo Line Subprojects

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
(a) Preconstruction/Construction Stage				
Clearing of vegetation	▪ 20252 trees will be partially affected by trimming as well as standing crops (if any) and bushes along the ROW also will be affected.	▪ Prior to start clearing of vegetation; provide adequate compensation to the owners. ▪ Follow ECOP-17	Contractor	DSC/PGCB
Land Requisition (Temporary loss of 804 acres land for the	▪ Loss of 804 acres land temporarily for the 884 nos. of tower bases of the TL/LILO lines	▪ Prior to commence construction activities, the owner of the temporarily affected land must be noticed and provided proper compensation as per GOB and WB guidelines; ▪ As per GOB & WB guidelines, RAP should be prepared for land acquisition/requisition/compensation and	DC	DSC/PGCB

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
construction period of about 3 years)		follow it. ▪ Use GIS instead of AIS in order to reduce land requirement.		
Fauna (Wildlife)	▪ Disturbance of wildlife specially birds due to project activities such as moving of project equipment & transports especially during night time.	▪ Prepare construction management plan by the contractor and follow it. ▪ Follow GoB rules and regulations on noise. ▪ Project workers should not disturb or kill the birds. ▪ Follow ECOP-18	Contractor	DSC/PGCB
Construction Waste	▪ Generation of construction wastes from the construction materials.	▪ Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time ▪ Provision of facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements ▪ Purchase of perishable construction materials such as paints incrementally to ensure reduced spoilage of unused materials ▪ Use of building materials that have minimal packaging to avoid the generation of excessive packaging waste ▪ Use of construction materials containing recycled content when possible and in accordance with accepted standards. ▪ Adequate collection and storage of waste on site and safe transportation to the disposal sites and disposal methods at designated area shall be provided.	Contractor	DSC/PGCB
Noise level	▪ Noise pollution due to construction activities, generators and construction vehicle movement.	▪ Use of noise plug in heavy construction equipment; ▪ It is recommended that no construction should be allowed during night time (9 PM to 6 AM) ▪ Avoid using of construction equipment producing excessive noise at night; ▪ Construction activities should not be during night time ▪ Avoid prolonged exposure to noise (produced by equipment) by workers; and ▪ Regulate use of horns and avoid use of hydraulic horns in project vehicles. ▪ Generator should be placed within room (concrete walls with roof).	Contractor	DSC/PGCB

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
		<ul style="list-style-type: none"> Monitoring of noise level at construction site, construction camp as and when required. 		
Air quality & dust	<ul style="list-style-type: none"> Air pollution and dust generation due to construction activities, generators and construction vehicle movement. 	<ul style="list-style-type: none"> All vehicles (e.g., trucks, equipment, and other vehicles that support construction works) shall be well maintained and not emit dark or smoky emissions in excess of the limits described in the EQS. Specific training will be focused on minimizing dust and exhaust gas emissions from heavy construction vehicles. Drivers of vehicles used during construction will be under strict instructions to minimize unnecessary trips and minimize idling of engines. Dust suppression facilities (back pack water sprayer) shall be available where earth and cement works are required. Spray water on dry & loose surface of the construction sites regularly; Maintain adequate moisture content of soil during transportation, compaction and handling; Construction materials (sand, gravel, and rocks) and spoil materials will be transported trucks covered with tarpaulins. Sprinkle and cover stockpiles of loose construction materials (e.g., fine aggregates, sand); and Avoid use of equipment such as stone crushers at site, which produce significant amount of particulate matter. Dust masks should be provided to all personnel in areas prone to dust emissions throughout the period of construction. 	Contractor	DSC/PGCB
Soil quality	<ul style="list-style-type: none"> Soil pollution 	<ul style="list-style-type: none"> Prevention of spillage and leakage of hazardous liquid at construction site & camp. Ensure not to use transformer containing PCB to avoid soil & air pollution. 	Contractor	DSC/PGCB
Sitting of construction camps	<ul style="list-style-type: none"> Temporarily loss of land for the construction camps etc. Clearing of standing crops if (any), grass and bushes Environmental pollutions (such as air, noise, water, wastes & 	<ul style="list-style-type: none"> Prior to commence construction activities, the owner of the temporarily affected land must be noticed and provided proper compensation as per GOB and WB guidelines; As per GOB & WB guidelines, RAP should be prepared for land acquisition/requisition/compensation. Prior to start clearing of vegetation; provide adequate compensation to the owners in time. Locate construction camp away from residential settlements, cultural sites, water bodies etc (minimum 0.5km) . Try to use fallow land Just after completion of construction, hand over this 	Contractor/ DSC	PGCB

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
	soil) affecting nearby the settlements,	camp site to the owners as in earlier condition. ▪ Follow ECOP-7.		
Traffic congestion/road accident	▪ Traffic congestion and road accident due to movement of construction vehicles.	▪ Follow BRTA traffic rules and regulations; ▪ Schedule deliveries of material/ equipment during off-peak hours ▪ Engage flagman specially at the entry of the substation site and construction camps for traffic control ▪ Engage experienced drivers to drive project vehicles ▪ Arrange for signal light at night ▪ Proper traffic management; and ▪ Avoiding stockpiling of materials specially at the road sides that could hamper traffic movement.. ▪ Follow ECOP-14	Contractor	DSC/PGCB
Pollution due to wastes	▪ Pollution due to wastes (construction wastes from construction activities & general wastes from workers' camps)	▪ Solid wastes collection system will be essential, which should include separation and collection of solid wastes in the dustbins/waste containers throughout the work site, construction yard/labour camp. ▪ The wastes such as piece of rods and woods, newspapers, containers etc. can be sold to the vendors and rest wastes can be dumped into the nearby road side waste containers/ waste bins from where will send these wastes to the nearest land fill dumping site by the Contractors. ▪ A log of the disposal of toxic and other waste materials is to be kept by the Contractors. ▪ Contractor should prepare waste management plan based on the EMP ▪ Follow ECOP-10	Contractor	DSC/PGCB
Community health and safety (H&S)	▪ Community H&S along the distribution line	▪ Safety barrier and warning sign surrounding the construction site; ▪ Generators should be placed in the closed room ▪ Formulate and implement emergency risk management plan by the contractor ▪ Follow ECOP-20	Contractor	DSC/PGCB
Occupational health and safety (H&S)	▪ Health & safety risks of construction workers.	▪ An experienced H&S Manager must be engaged by the contractor prior to start construction ▪ Only permitting trained and certified workers to work with any electrical equipment. ▪ First aid box and personal protective equipment, PPE (such as helmet, safety shoes, eye protection glass, ear plugs, waist belt, mask, hand gloves, body protective apron, ear muff and insulating boots) must be provided to the workers and ensure to use these PPE	Contractor	DSC/PGCB

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
		by the workers; ■ Safety signs, health signs, prohibition sign, warning sign, mandatory sign, emergency escape sign, first-aid sign, information sign, signboard, supplementary signboard, safety collar, symbol, pictogram, illuminated sign, acoustic signal, verbal communication and hand signal must be fitted at the designated sites of the subproject area. ■ Follow ECOP-19		
Employment generation/income	■ Employment opportunities for the local people especially for PAPs.	■ Employ local people specially PAPs for the project activities as much as possible.	Contractor	DSC/PGCB
(b) Operation Stage:				
Community health and safety	■ Community H&S along the distribution lines	■ Safety barrier and warning sign surrounding the construction site; ■ Generators should be placed in the closed room. ■ Follow ECOP-20	PGCB	PGCB
Safety & Security of workers	■ Risk to continuous power supply	■ Ensure security of substation in collaboration with law enforcing agencies. ■ Keep complain book in the substation for recording of people's complains. ■ Ensure availability of adequate safety gears for substation operations	PGCB	PGCB
Power Supply	■ Due to inadequate reliability of power supply, social life and economic condition of the people will be improved	■ O&M of substations should be done in time for adequate power generation.	PGCB	PGCB
Short Circuit/Accident	■ Due to short circuit of the substation, disruption of power and accident will be occurred.	■ O&M of substations should be done in time by experienced personnel.	PGCB	PGCB
EMF	■ Due to EMF, human health may be affected	■ To be checked and accordingly take n/a.	PGCB	PGCB

Table 7: Mitigation Measures for the Specific Impacts of the TL/Lilo line Subprojects

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
Preconstruction /Construction Stage:				
Subproject Name: 230kV D/C Korerhat – Chowmuhoni Transmission Line				
Requirement of land	Crop production at the 163 tower sites will be disrupted.	Adequate compensation will be provided to the affected people in time following RAP.	DC	DSC/PGCB
Disruption of boat movement; and Disruption of 2 cultural sites (such as a mosque at about 20m far away from TL at ch 48+300 at R/S, and a graveyard at ch 10+000 at L/S (witin SPIA). .	Disruptions of water transport movement during construction of transmission line over the Feni River at Ch 2+850. A mosque at about 20m far away from TL at ch 48+300 at R/S, and a graveyard at ch 10+000 at L/S (witin SPIA) may be affected .	<ul style="list-style-type: none"> Follow BITWA rules and regulations on navigation. Transmission line should be about 15m above the HWL. Close monitor the river crossing site of the TL during construction to avoid accident. Try to construct the TL at the river crossing during night to avoid disruption of boat movement. Any waste should not be disposed into the river. River water should be tested quarterly during construction. Mosque and graveyard should not be affected by the project activities (such as by wastes, noise, dust etc.). Adequate size noise barrier/screen should be install at the mosque and graveyard site for protecting noise and dust. No activities should be done during night (6:00 AM – 9:00PM). 	Contractors	DSC/PGCB
Water pollution	Construction of transmission line across rivers, canals and other water bodies (total 15) could pollute water during construction stage;	<ul style="list-style-type: none"> Discharge of fuel, lubricants, chemicals, and wastes into adjacent rivers/ponds will be prevented; and During construction, washing of clothes, bathing and cleaning of project vehicle & equipment in the aquatic habitat (e.g. river, pond) will be prohibited; Surface water quality will be monitored twice in a year (during dry and wet seasons); and ECOP -12 for water bodies and water qualities respectively will be followed. 	Contractor	DSC/PGCB
Aquatic Fauna	Due to water pollution by the construction of TL across the water bodies , aquatic fauna (fishes, frogs, snakes etc.) will be	<ul style="list-style-type: none"> Discharge of fuel, lubricants, chemicals, and wastes into adjacent rivers/ponds will be prevented; and During construction, washing of clothes, bathing and cleaning of project vehicle & equipment in the aquatic habitat (e.g. river, pond) will be prohibited; 	Contractor	DSC/PGCB

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
	affected	<ul style="list-style-type: none"> Project workers should not kill fishes & other fauna from the water bodies. ECOP- 11 and 12 for water bodies and water qualities respectively will be followed. 		
Subproject Name: 230kV D/C Kachua-Gazaria Transmission Line:				
Requirement of land	Crop production at the 134 tower sites will be disrupted.	Adequate compensation will be provided to the affected people in time following RAP.	DC	DSC/PGCB
Disruption of boat communication	Disruptions of water transport movement during construction of transmission line over the Meghna-Gumti River at ch 33+500.	<ul style="list-style-type: none"> Follow BITWA rules and regulations on navigation. Transmission line should be about 15m above the HWL. Close monitor the river crossing site of the TL during construction to avoid accident. Any waste should not be disposed into the river. Try to construct the TL at the river crossing during night to avoid disruption of boat movement. River water should be tested quarterly during construction 	Contractors	DSC/PGCB
Water pollution	Construction of TL (along with tower on both river banks) across the Meghna – Gumti River at ch 33+500 will pollute river water;	<ul style="list-style-type: none"> Discharge of fuel, lubricants, chemicals, and wastes into adjacent rivers/ponds will be prevented; and During construction, washing of clothes, bathing and cleaning of project vehicle & equipment in the aquatic habitat (e.g. river, pond) will be prohibited; Surface water quality will be monitored twice in a year (during dry and wet seasons); and ECOP- 12 for water bodies and water qualities respectively will be followed. 	Contractor	DSC/PGCB
Aquatic Fauna	Due to water pollution by the construction of TL across the water bodies, aquatic	<ul style="list-style-type: none"> Discharge of fuel, lubricants, chemicals, and wastes into adjacent rivers/ponds will be prevented; and During construction, washing 	Contractor	DSC/PGCB

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
	fauna (fishes, frogs, snakes etc.) will be affected	of clothes, bathing and cleaning of project vehicle & equipment in the aquatic habitat (e.g. river, pond) will be prohibited; ▪ Project workers should not kill fishes & other fauna from the water bodies. ▪ ECOP-11 and 12 for water bodies and water qualities respectively will be followed.		
Subproject Name: Korerhat-BSRM LILO Line:				
Forest tress in the poket hilly area from ch 3+450-11+700	▪ Forest trees may be affected by trimming of trees along the ROW ▪ Wildlife specially birds will be disturbed	▪ Prior to start construction, written permission should be taken from the FD i(In case of trimming of forest trees), ▪ Follow ECOP- 16, 17 and 18.	Contractor	DSC/PGCB/FD

Environmental Monitoring Plan: The aim of the Environmental Monitoring Plan during the preconstruction/construction and operation stages of the subproject of substations & TL/Lilo is to compare the monitored data against the baseline condition collected during the study period to assess the effectiveness of the mitigation measures and the protection of environmental components (e.g. water, soil, noise etc.) based on the national standards. A monitoring schedule has been drawn up based on the environmental components that may be affected during the preconstruction/construction and operation stages of the project. Since the project is likely to have impact on various components of the environment, a comprehensive monitoring plan: (i) for the substation subprojects covering land acquisition, vegetation clearance, tree felling/replantation, drainage congestion/flooding, air quality, water quality, soil quality, noise quality, fauna and health & safety as well as (ii) for the TL/Lilo subprojects covering temporary land requirement, vegetation clearance, tree trimming, disturbance of fauna, soil pollution, noise pollution and health & safety has been provided in the Monitoring Plan. Details of Monitoring Plan is given in the following Table 8.

Table 0: Environmental Monitoring Plan for Substation Subprojects

Environmental Issues/Parameters	Monitoring Parameters	Standards/Guidelines	Means of Monitoring	Frequency	Location	Implementation Agency	Supervision Agency
Preconstruction/Construction Stage							
Felling of trees and clearing of vegetation	▪ Checking whether proper compensation as mentioned in RP is received by PAPs.	DOE/FD	Inspection	Regular during tree felling and site	Within ROW of substation & access road sites	Contractor /FD	DSC/PGCB

Environmental Issues/Parameters	Monitoring Parameters	Standards/Guidelines	Means of Monitoring	Frequency	Location	Implementation Agency	Supervision Agency
				clearing operations			
Fauna (Wildlife)	Checking whether wildlife is disturbing/killing by the workers	DOE/FD	Inspection	Weekly	ROW of Route	Contractor /FD	DSC/PGCB
Drainage Congestion /Flooding	<ul style="list-style-type: none"> Checking drainage congestion & top of substation site above HFL 	Hydrological/Drainage study	Inspection	Regular during earthworks	Substation site	Contractor	DSC/PGCB
Noise Pollution	Ambient noise level	DOE Noise Pollution Control Rules, 2006	Measurement	As & when required	At construction sites & camps	Contractor	DSC/PGCB
Dust Pollution	<ul style="list-style-type: none"> Dust should be controlled by water spraying regularly specially during dry period. 	DOE guidelines	Inspection	Regular	SS sites	Contractor	DSC/PGCB
Surface Water Quality	pH, BOD ₅ , COD, NH ₃ -N, PO ₄	DOE Standards	Sampling and Laboratory Analysis	Quarterly	Nearby 3 Water bodies	Contractor	DSC/PGCB
Ground Water/Drinking Water Quality	pH, Mn, Fe, As, TC, FC	DOE Standards	Sampling and Laboratory Analysis	Quarterly	At 3 construction camps (in Chittagong, Comilla & Noakhali)	Contractor	DSC/PGCB
Dredge Materials	Pb, Cd, Cr, Cu, Zn, Mn, As, Se, Hg	US EPA, 2000	Sampling and Laboratory Analysis	Once before dredging and once after dredging	Dredging sites (such as Meghna – Gumti River, Bay of Bengal etc.)	Contractor	DSC/PGCB
Pollution due to Wastes	<ul style="list-style-type: none"> Checking collection, storage, transportation, and disposal of hazardous waste; Waste from construction site to be collected and disposed safely to the designated sites; and Wastes from labour camp to be disposed properly at the designated sites. 	DOE guidelines	Inspection	Regular	Construction camps	Contractor	DSC/PGCB
Traffic Congestion / Road	<ul style="list-style-type: none"> Checking meeting point of existing road & access road 	BRTA	Inspection	Regular	Meeting point of existing road & access	Contractor	DSC/PGCB

Environmental Issues/Parameters	Monitoring Parameters	Standards/Guidelines	Means of Monitoring	Frequency	Location	Implementation Agency	Supervision Agency
Accident					road		
Occupational health and safety	Checking health, use of PPE & 1 st aid facilities, DWQ, sanitation and accommodation	DOE/IFC guidelines	Inspection & testing of DWQ	Regular & twice	At construction sites and camps	Contractor	DSC/PGCB
Community health and safety	Awareness of local people and staying safely from the project activities	DOE/IFC guidelines	Inspection	Regular	At construction site and camps	Contractor	DSC/PGCB
Operation Stage							
Tree replantation	Replanting of saplings and checking replacement of dead saplings & nursing (watering & fertilizer) of saplings for 2 years	FD	Inspection	As & when required	Access road side slopes	FD	PGCB
Drainage congestion	Checking drainage congestion in the substation sites during monsoon	Hydrological/Drainage study	Inspection	As & when required during monsoon	Substation sites	PGCB	PGCB
Community health and safety	Community H&S nearby the substation site	DOE/IFC guidelines	Inspection	Regular	Substation sites	PGCB	PGCB
Safety & Security of Substation & workers	Checking use of PPE & duty of security force	DOE/IFC guidelines	Inspection	Regular	Substation sites	PGCB	PGCB

Table 9: Environmental Monitoring Plan for TL/Lilo lines Subprojects

Environmental Issues/Parameters	Monitoring Parameters	Standards/Guidelines	Means of Monitoring	Frequency	Location	Implementation Agency	Supervision Agency
Preconstruction/Construction Stage							
Requirement of land (Temporary requisition for 3 years)	<ul style="list-style-type: none"> Ensure that PAPs get compensation as per RAP which needs to be prepared. 	As per RAP	Inspection	As per RAP	ROW of the TL/LILO lines	DC	DSC/PGCB
Trimming of trees within ROW and clearing vegetation from the tower bases of the TL/LILO lines.	<ul style="list-style-type: none"> Checking whether proper compensation as mentioned in RAP is received by PAPs. 	DOE/FD	Inspection	Regular during tree felling and site clearing operations	Trimming of trees within ROW and clearing vegetation from the tower bases of the TL/LILO lines.	FD	DSC/PGCB
Noise	Ambient noise level	DOE	Measure	As & when	At adjacent	Contractor	DSC/PGCB

Environmental Issues/Parameters	Monitoring Parameters	Standards/Guidelines	Means of Monitoring	Frequency	Location	Implementation Agency	Supervision Agency
Pollution		standards	ment	rwquired	subproject cultural sites & construction camps		
Pollution due to Wastes	<ul style="list-style-type: none"> Checking storage, transportation, handling, and disposal of wastes; Wastes from construction sites and camps to be disposed properly at the designated waste dumping sites. 	DOE guidelines	Inspection	Regular	Construction sites and camps	Contractor	DSC/PGCB
Surface Water Quality	pH, BOD ₅ , COD, NH ₃ , PO ₄	DOE Standards	Sampling and Laboratory Analysis	Quarterly	River Crossing Site of Meghna-Gumti & Feni River by TL	Contractor	DSC/PGCB
Ground Water /Drinking Water Quality	pH, Mn, Fe, As, TC, FC	DOE Standards	Sampling and Laboratory Analysis	Quarterly	3 Construction camps (in Chittagong, Commilla & Noakhali)	Contractor	DSC/PGCB
Traffic congestion /Road Accident	Checking road crossing points, road adjacent to towers etc.	BRTA	Inspection	Regular	At road/Rly. crossing points & road adjacent to towers	Contractor	DSC/PGCB
Cutural sites in SPIA (such as a mosque at R/S at about 20m distance at ch 48+300 and a graveyard at L/S at about 25m distance from Korerhat-Choumohini TL.	Checking whether these two cultural sites are affected by the project activities such as by noise, wastes etc.	DOE guidelines	Inspection	As & when rwquired	A mosque at R/S at about 20m distance at ch 48+300 and a graveyard at L/S at about 25m distance from Korerhat-Choumohini TL.	Contractor	DSC/PGCB
Occupational health and safety	Use of PPE, general health, water supply and sanitation	DOE/IFC guidelines	Inspection	Regular	At construction sites and camps	Contractor	DSC/PGCB
Community	Awareness of local	DOE/IFC	Inspection	Regular	At	Contractor	DSC/PGCB

Environmental Issues/Parameters	Monitoring Parameters	Standards/Guidelines	Means of Monitoring	Frequency	Location	Implementation Agency	Supervision Agency
health and safety	people	guidelines			construction site and crossing of roads		
Operation Stage							
Tall trees	Trimming of tall trees under the TL	ESMF	Inspection	Once every year and as directed by the relevant engineer of PGCB	Along the TL/LILO Lines	PGCB	PGCB
EMF	EMF level	ESMF	On site measurement	Twice a year	At populated area where TL/Lilio lines passes over	PGCB	PGCB
Short circuit/accident	Safety	DOE guidelines	Inspection	Regular	Along the TL/Lines	PGCB	PGCB
Occupational Health and Safety (OHS)	Use of PPE	As required	Inspection	Regular	Along the TL/LILO lines	PGCB	PGCB
Power Supply	Access to electricity in the rural area on priority basis.	DOE/PDB guidelines	Inspection	Whole project period	Along the TL/LILO lines	PGCB	PGCB

The EMP Implementation Schedule and Implementation Cost: The schedule of implementing the EMP has been prepared based on the environmental issues/parameters illustrated in the EMP which will be followed at the certain period of the project. However, this implementation schedule is subject to change depending on the existing situation. The estimated duration of the construction work is approximately 3 years. Approximate cost for the implementation of the EMP is about BDT 5.6 millions (approx. 70,000 USD).

Environmental Code of Practises (ECOP): The ECOP is prepared as a guideline for environment management of different components of the substation and TL subprojects. The ECOP has designed to address all potential impacts during the construction of the substations, rehabilitation of the transmission lines, and construction of the new transmission lines. The ECOP will provide guidelines for best operating practices and environmental management guidelines to be followed by the contractors for sustainable management of all environmental issues. The list of ECOP, prepared for the subprojects of ESPNER is given below: Project Planning and Design, Route Selection, Tower/Pole Erection, Overhead Power Cable Installation, Installation of Transformer on H-Pole, Substation Site Preparation, Construction Camps, Topsoil Salvage, Storage and Replacement, Borrow Areas, Land Reclamation, Waste Management, Water Bodies, Water Quality, Public Health and Safety, Material Storage, Transport & Handling, Cutting/triming of Trees, Vegetation Natural Habitats, Occupational Health and safety, Community Health and Safety.

8. INSTITUTIONAL ARRANGEMENT AND CAPACITY BUILDING

Institutional arrangements are essential to implement the suggested mitigation measures properly and to execute Monitoring Plan at different project stages. The implementation of the EMP also requires capacity building of the EMP implementation agency through training needs and plan. The structured institutional settings facilitate proper implementation of the environment safeguard requirements for the development of the project. The PGCB is the key authority to follow up all the relevant environmental safeguard requirements following institutional arrangement. In addition, the relevant organizations such as consultant, contractor, DOE and FD are also included. Enhancement of the capacity of the PGCB's ESU is required for the effective implementation of proposed mitigation measures and monitoring the resultant effect, some training programs and awareness workshop are also essential.

Grievance Redress Mechanism: The concern/grievances may come from the local/affected people related to inappropriate implementation of various components of EMP or the overall road upgrading itself. These issues will be addressed through acknowledgement, evaluation and corrective action and response approach. A grievance redress mechanism will be established to receive, evaluate, and facilitate the resolution of affected people's concerns, complaints, and grievances about the social and environmental performance of the project. The GRM aims to provide a trusted way to voice and resolve concerns linked to the project, and to be an effective way to address affected people's concerns.

9. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

The aim of public consultation is to ensure that the people and the stakeholders living in the SPIA become aware about the project activities and the aim is also to ensure the acceptance of the subprojects of Substation & TL/Lilo activities. Public consultation is important to collect baseline

information and to identify potential impacts and mitigation measures. After conducting public consultation, it is also important to disclose information to the public in their own language regarding the decision and measures planned to be taken against different project activities. As a part of the environmental study, the environmental team conducted several stakeholders meeting with local administrative authority, businessmen, farmers, service holders, workers, drivers, shopkeepers, women as well as PAPs. A total of five stakeholders have been carried out during the preparation of the EIA of the project. The findings of the consultations are as follows: (i) main positive issues are: employment opportunities; improvement of local and national economy; improvement of security and improvement of power generation etc. and main negative issues are: permanent (due to construction of SS) and temporary land loss (due to construction of TL/Lilo lines); losses/trimming of vegetation, air/dust pollution mainly due to construction of SS, noise pollution due to movement of project vehicles/equipment and accidents/injuries may be occurred during construction and operation stages of the project etc. The participants of the consultations also have suggested to enhance the positive issues/impacts and possible mitigation measures to minimize the negative impacts. The participants of the consultations are in favour of the project implementation.

The implementation of the EMP for the proper management of mitigation/enhancement measures of the project as document or report, should be publicly available in readable format to the local people. The project proponent (e.g. PGCB) should ensure information disclosure to the local people. and to the respective stakeholders of the respective subproject under the proposed project.

10. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The Government of Bangladesh (GOB) has set long term goals for the power sector in the country. Providing access to affordable, reliable and quality supply of electricity to the majority of the people of Bangladesh by 2020 are the goals of the GOB to users the next millennium. In line with the above stated goals, the GOB is expected to obtain financial support from the International Development Association (IDA) for the proposed Enhancement and Strengthening of Power Network in Eastern Region (ESPNER) project to ensure reliable and quality supply of electricity to the rural and urban consumers in Bangladesh through improvements in technical efficiency of the distribution system. The proposed project is expected to provide support for augmentation and rehabilitation of the transmission network of the Power Grid Company of Bangladesh (PGCB) under the Power Cell, Power Division, Ministry of Power, Energy and Mineral Resources (MOPEMR) of the GOB. Main components of the project include:

- Construction of new 230/132 kV two substations and new 132/33 kV 10 substations;
- Construction of new 283.642km long 132 kV, 230kV and 400kV transmission lines (TL); and
- Construction of new 8 LILLO lines;

The present power network in Greater Comilla, Noakhali and Chittagong areas of Bangladesh is aged and suffering numerous problems as system demand is growing rapidly. The greater Comilla and Noakhali areas are the second largest demand areas after the capital city of Dhaka. The greater Chittagong area is on the verge of massive industrialization as the government is taking initiatives to set up multiple economic zones, upgrade port facility and transportation network. Hence, the project was conceptualized with a rationale to expand the 230 kV transmission systems and to strengthen the 132 kV transmission systems in the project area, in order to, eliminate the

operational bottlenecks caused due to inadequacy of the existing system. The project will also provide an adequate infrastructure for the future power sector development of the area.

The TOR has prepared to carryout detailed EIA for the project in accordance with the relevant laws and regulations of the GOB and the WB. The specific environmental guideline for the power sector is not available in Bangladesh. However the DOE environmental guidelines for the industries provide a general framework for conducting environmental study for the entire sector. Therefore the proposed EIA will be conducted following the DOE environmental guidelines. In addition, it is suggested to follow the Environmental & Social Management Framework (ESMF) of Rural Electricity Transmission and Distribution Project of PGCB and BREB as well as WB environmental guidelines for the power sector.

The scope of work of the EIA includes: (a) Review of existing information (relevant all documents) from secondary sources, and identify gaps to be filled, relevant to the environmental screening needs from primary surveys. (b) Provide a description of the environment (such as baseline data on physical, biological and socioeconomic characteristics of the subproject site along with area of influence). (c) Represent the primary surveys where include baseline (air, water, noise, and riverbed) environmental quality monitoring at representative and sensitive locations, and identification of all macro-level environmental issues within the Sub-project's influence area. (d) Survey the environmentally sensitive locations on and along the Sub-projects as well as within the Sub-project's influence area. (e) Arrange stakeholders' consultations within the local people from all professions to find out their opinion within the subproject. (f) Analysis of alternatives to the proposed subproject. (g) Identify and assessment of potential environmental impacts due to implementation of the subproject. (h) Formulation of Environmental Management Plan (EMP)

Initially, 3 sites for each proposed substation and 3 routes for each proposed TL have been selected and environmental screening and assessment for these 3 substation sites and TL routes have been done for identifying the potential impacts based on the collected baseline information/data by the environmental specialist and survey team according to Appendix-B (Substation subproject) and Appendix-C (TL subproject). From these 3 sites/routes, environmentally suitable substation site and TL have been finally selected. The potential impacts for the selected subprojects of the substation and TL/LILO Lines during pre-construction/ construction and operation stages of the subprojects are:

(a) For Substation Subprojects:

(i) General/Common Potential Impacts:

During Preconstruction/Construction: A total of 86.62 acres land acquisition, clearing of vegetation including 3501 trees, hydrology/ drainage congestion, top soils, and dust pollution, noise pollution, waste pollution, soil pollution, traffic congestion, occupational HS, community HS, and employment generation; and

During Operation: Drainage congestion, tree replantation (a total 7000 various trees), landscape, occupational HS, community HS, and improvement of social and economical life of the people.

(ii) Specific Impacts of Substations

During Preconstruction/Construction: 2945 trees, 136 trees & 420 trees need to be cut due to construction of Korerhat, Basurhat & Chandina substation respectfully. SW pollution of pond will be occurred due to construction of Maijdee, Basurhat & Chandina substation respectfully.

(b) For TL & LILO Lines Subprojects

(i) General/Common Impacts:

Pre-construction/Construction Phase: Trimming of 20252 trees, Disturbance of Fauna (wildlife), Loss of Top Soil due to tower, Noise Pollution, Air and Dust Pollution, Soil Pollution, Pollution due to Wastes, Aquatic Habitat, Traffic Congestion/Road Accident, Siting of Construction Camps, Occupational Health and Safety Community Health and Safety, Employment Generation/Income
Operation Stage: Landscape, Community Health and Safety, Occupational Health and Safety Improvement of Social & Economic Life, Short Circuit/Accident, EMF (Electro-Magnetic Fields (EMF)).

(ii) Specific Impacts

Preconstruction/Construction Phase: Disruption of boat movement in the Meghna- Gumti River during construction of the Kachua-Laksham TL and Disruption of boat movement in the Feni River; a mosque due at 20m far away at R/S of the TL at ch 48+300 and a graveyard at 25m faraway at L/S of the TL due to construction of the Korerhat Choumohini TL. Pocket hilly areas with forest small to medium trees will be affected (trimming) due construction of Korerhat-BSRM LILO line.

The potential impacts during construction phase are short-term that can be avoided or eliminated or reduced by adopting the mitigation measures properly. Therefore, the anticipated negative construction related impacts could be mostly controlled/minimized or eliminated by taking suggested mitigation measures and manage the implementation of the mitigation measures through the EMP including effective monitoring plan during pre-construction/construction and operation phases of the project.

The potential impacts during operation are long term and PGCB should ensure to mitigate these impacts through implementation of the EMP including monitoring plan properly. Approx. total budget for EMP is about BDT 7,124,000.

Recommendations

Based on the findings of the EIA study, the following can be recommended:

- Based on the EMP of the EIA, Construction Environmental Management Plan (CEMP) should be prepared by the contractor prior to start construction of the project and act accordingly during construction;
- The EMP will be included in the bid document of the civil works along with the EMP budget and eventually become part of the civil works contract (s);
- The mitigation measures for the negative impacts and enhancement measures for the positive impacts of the project as mentioned in the EMP must be implemented by the contractor (s) properly in schedule time; and
- The main tool for the successful implementation of the EMP is the environmental monitoring during various stages of the project, which must be carried out properly in time by the client/DSC/other relevant organisations.

INTRODUCTION

1.1 Background

The economy of Bangladesh has performed well over the past decade. Its Gross Domestic Product (GDP) has grown at an average of 6% per annum since 2010. In Fiscal Year 2014 (FY 14), the country moved up to a lower-middle income country (LMIC) status as per capita Gross National Income (GNI) of US\$ 1,080 crossed the LMIC threshold of US\$ 1,046. The country's per capita income soared to US\$1,430 at the end of FY 2016. This sustained growth was achieved despite the negative impacts of the global recession, oil price rise, unrest in the Middle East and local natural disasters as well as political disturbance and has largely been dependent on a reliable and affordable supply of electricity. Bangladesh's economy could have performed better if the energy infrastructure had developed in line with the economic demands.

The supply of power in Bangladesh has not been able to keep pace with the rapid growth in demand and consumers experience frequent power outages. Current installed generation capacity in Bangladesh is 13,000 mega-Watts (MW), while available capacity is only 9,000 MW. The highest demand served in the country until November 2016 was 9,036 MW. On average, over 1,000 MW of load shedding occurs in the summer. Electricity demand is projected to grow by more than 10 percent per annum over the medium term. The Power Sector Master Plan 2016 has projected that demand will rise to more than 50,000 MW by 2041.

The shortage of electricity and poor quality of supply (aged and low capacity grid network) not only affect households, but also industry and services, which account for a major share of growth in the economy. According to the 2013 World Bank (WB) Enterprise Survey, Bangladeshi businesses on average suffered power outages for 840 hours per year, resulting in an output loss of approximately 3 % of GDP. The availability and reliability of power is hence a key constraint to job creation and poverty reduction.

The Government of Bangladesh (GOB) has set long term goals for the power sector in the country. Providing access to affordable, reliable and quality supply of electricity to the majority of the people of Bangladesh by 2020 are the goals of the GOB to users the next millennium. In line with the above stated goals, the GOB is expected to obtain financial support from the International Development Association (IDA) for the proposed Enhancement and Strengthening of Power Network in Eastern Region (ESPNER) project to ensure reliable and quality supply of electricity to the rural and urban consumers in Bangladesh through improvements in technical efficiency of the distribution system. The proposed project is expected to provide support for augmentation and rehabilitation of the transmission network of the Power Grid Company of Bangladesh (PGCB) under the Power Cell, Power Division, Ministry of Power, Energy and Mineral Resources (MOPEMR) of the GOB.

Main components of the project include:

- Construction of new 132 kV substations;
- Construction of new 132 kV transmission lines;
- Construction of new 230 kV transmission lines; and
- Construction of new LILLO Lines.

The present power network in Greater Comilla, Noakhali and Chittagong areas of Bangladesh is aged and suffering numerous problems as system demand is growing rapidly. The greater Comilla and Noakhali areas are the second largest demand areas after the capital city of Dhaka. The greater Chittagong area is on the verge of massive industrialization as the government is taking initiatives to set up multiple economic zones, upgrade port facility and transportation network. Hence, the project was conceptualized with a rationale to expand the 230 kV transmission systems and to strengthen the 132 kV transmission systems in the project area, in order to, eliminate the operational bottlenecks caused due to inadequacy of the existing system. The project will also provide an adequate infrastructure for the future power sector development of the area.

The TOR has prepared to carryout detailed EIA for the project in accordance with the relevant laws and regulations of the GOB and the WB. The specific environmental guideline for the power sector is not available in Bangladesh. However the Department of Environment's (DOE) environmental guidelines for the industries/projects provide a general framework for conducting environmental study for the entire sector. Therefore the proposed EIA will be conducted following the DOE environmental guidelines. In addition, it is suggested to follow the Environmental & Social Management Framework (ESMF) of Rural Electricity Transmission and Distribution Project of PGCB and BREB as well as WB environmental guidelines for the power sector.

1.2 Expected Benefits of the Project

The project is expected to positively influence the environmental, social and economic profile of the project area. The expected benefits are described below:

- I. **Environmental Benefits:** Replacing the electricity from Diesel Generator (DG) sets with Grid power will result in saving of millions of liters of fossil fuel and reduction in pollution level of the Project area. Expected environmental benefits include reduction in the level of Particulate Matters, SO_x, NO_x and Green House Gases (GHG).
- II. **Social Benefits:** It is expected that about 194,000 new residential consumers and about 11,500 new agricultural consumers would be supplied power through the systems proposed under the project. Additionally, about 4,200 small scale industries and 2 large scale industries could be supplied power through the schemes proposed under the project, which in turn, is expected to generate direct employment for about 85,000 people and a significant number of indirect employment. Further, the new agricultural connections will boost the agricultural output of the area.
- III. **Economic Benefits:** Considering the fact that the difference between charges of electricity from off-Grid sources and that from grid is around 15 Taka (Tk), there will be significant cost saving to end users. It is expected that the initial value of savings will be 4760 Million Taka, which will gradually increase to 7070 Million Taka.

Power being an enabler sector often results in the overall growth and development of the area. Income level of the general population tends to generally increase in the areas where electricity makes an inroad or where the existing power infrastructure is improved.

1.3 Legislative Requirements

The main components of the Environment Conservation Act(ECA), 1995 are (GOB, 1995, pages 613–621):

- a) “Declaration of ecologically critical areas, and restriction on the operation and process, which can be carried or cannot be initiated in the ecologically critical area.
- b) Regulation in respect of vehicle emitting smoke harmful for the environment.
- c) Environmental clearance for all industrial units and projects.
- d) Regulation on the industries and other development activities — discharge permit.
- e) Promulgation of standards for quality of air, water, noise and soil for different purposes.
- f) Promulgation of standard limit for discharging and emitting waste.
- g) Formulation and declaration of environmental guidelines.
- h) Penal measures for non-compliance.”

The major requirements of the Environment Conservation Rules (ECR), 1997 are (GOB, 1997, pages 1303–2346):

- a. “National Environmental Quality Standards for ambient air, various types of water, industrial effluent, emission, noise, vehicular exhaust etc.
- b. Requirements and procedures to obtain environmental clearance.
- c. Requirement for Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) according to categories of industrial and other development interventions.”

For preparation of the EIA report, therefore, the following legislative procedure will be followed:

- Collection and review of relevant information regarding environmental legislation, statutory orders, by-laws, etc. connected to preparation and approval of the EIA report by the Department of Environment (DOE), and draft the memo. The memo will also consider the requirements of WB Guidelines.
- Conduction of meetings with the DOE, the Ministry of Environment and Forest (MOEF), and the Local Government Engineering Department (LGED). During these meetings appropriate legal and administrative procedures will be discussed. Review of other relevant environmental laws, regulations, Norms, and Standards on Air, Noise, Water, Waste, Wildlife, and etc.
- Conduction of discussion meeting with the DOE particularly for “Environmental Clearance Certificate” in accordance with the ECA, 1995 and ECR, 1997 of Bangladesh.

Besides this, WB has its own environmental and social safeguard policies. According to the policies set by WB “an Environmental Impact Assessment (EIA) level study” is a study that includes the analysis of alternative plans, the prediction and assessment of environmental impacts, and the preparation of mitigation measures and monitoring plans based on detailed field surveys.” Also basic principles of considering environmental and social impacts, the following WB guidelines will be followed:

1. “A wide range of impacts must be addressed. The types of impacts addressed by WB cover a wide range of environmental and social issues.
2. Measures for environmental and social considerations must be implemented from an early stage to a monitoring stage.
3. WB asks stakeholders for their participation. WB incorporates stakeholder opinions into decision-making processes regarding environmental and social considerations by ensuring the meaningful participation of stakeholders in order to have consideration for environmental and social factors and to reach a consensus accordingly. WB replies to

stakeholders' questions. Stakeholders who participate in meetings are responsible for what they say.

4. WB discloses information. WB itself discloses information on environmental and social considerations in collaboration with project proponents etc., in order to ensure accountability and to promote the participation of various stakeholders."

1.4 Main Objectives of the EIA

The implementation of the subprojects' activities has both negative and positive impacts on the surrounding environment. These impacts will be on the physic-chemical, biological/ecological and socio-economic environment. Hence, to prevent and/or to reduce the negative environmental impacts at an acceptable level and to enhance the positive environmental impacts linked with the implementation of the subproject activities of the project; an EIA is to be required.

Based on the above requirement, the environmental consultant employed for this project will carry out the EIA and contribute to bidding document for incorporation of EMP cost.

1.5 Extent of the Study

This EIA is carried out based on the approved terms of reference (TOR) (Annex A) against the EIA Study TOR (Annex B) submitted to the Department of Environment for approval. The influence of impact has been defined as 1 Km on each side from the substation subprojects location and along the rights of way (ROW) for transmission lines. However, the study area has been extended beyond 5 Km area if any major environmental significant area is found and might have impact due to the project. Geographical Information System (GIS) techniques have also been used based on recent satellite imageries of the project area for above purposes. Assessment is carried out on the following environment components: terrestrial and aquatic ecology, soil, water, air, noise, and socio economic aspects. The impacts on ecologically sensitive areas (e.g. wildlife sanctuaries, biosphere reserve, and protected places) within 5 Km of the project areas have been assessed.

1.6 Scope of Work

The scope of work of the EIA includes:

- a) Review of relevant all documents and data/information from secondary sources, and identify gaps to be filled, relevant to the environmental screening needs from field surveys.
- b) Provide a description of the environmental baseline (such as baseline data on physical, biological/ecological and socio-economic characteristics of the subproject site along with area of influence).
- c) Represent the field surveys where include baseline (air, noise, surface water and ground/drinking water) environmental quality monitoring at representative and sensitive locations, and identification of macro-level environmental issues within the Sub-project's influence area.
- d) Collect information on environmentally sensitive locations on and along the sub-projects as well as within the sub-project's influence area.
- e) Arrange consultation with the local people specially project affected persons (PAPs) to find out their opinions about the sub-projects.
- f) Analysis of alternatives to the proposed sub-projects.

- g) Identify and assessment of potential environmental impacts due to implementation of the sub-projects.
- h) Conduct preliminary analysis of impacts and management measures of the nature, scale and magnitude of the impacts that the sub-project is likely to cause on the environment and classify the same using established methods.
- i) Develop Environmental Management Plan (EMP) including Monitoring Plan for successfully implementing the mitigation/enhancement measures.
- j) Assess PGCB's institutional capacity to execute and monitor the EMP and recommend necessary institutional capacity building including additional professionals for environmental management.
- k) Prepare an EIA report in accordance with the DOE and WB safeguard policies and guidelines.

1.7 EIA Content

The report fulfils the requirements of EIA under ECR, 1997 and has been prepared in accordance with the TOR. This EIA report is also consistent with the GOB guidelines and other relevant international laws and treaties to the project. The report contains ten chapters and the chapter details are discussed below:

Chapter 1: Introduction

This chapter consists of the background of the project along with the objectives, scope of work and the methodology of preparing the EIA report. This chapter also includes the organization of the total EIA report.

Chapter 2: Environmental policies, laws, regulations and standard

In this chapter the national and international laws and policies are described which are relevant to the environmental and social aspects of the project. The relevant guidelines of the DOE, WB and other national and international laws are described.

Chapter 3: Project description

This chapter includes the proposed project and project area description. The location of the project and proposed project interventions are described here. In total, this chapter gives a detailed idea about the project.

Chapter 4: Route selection approach

In this chapter the alternative options of the proposed project are analyzed. It starts from no project alternative and ends at analyzing all the possible alternatives. This chapter concludes with declaring the proposed project as the best solution after analyzing all the other alternatives.

Chapter 5: Description of the environmental baseline

This chapter gives idea about the environmental baseline condition of the subproject areas with its surroundings. It describes the physical, biological/ecological and socio-economic environment.

Chapter 6: Environmental screening/assessment of the subprojects

In this chapter, the impacts likely to be occurred during pre-construction, construction and operational phases are discussed.

Chapter 7: Public Consultation

In this chapter, the consultation process, consultation meetings details and the outcomes are described.

Chapter 8: Environmental management plan

This chapter includes the Environmental Management Plan (EMP) which includes the mitigation measures for the negative impacts/enhancement for the positive impacts and Environmental Monitoring Plan (MP) to implement the mitigation/enhancement measures during pre-construction stage, construction stage and operational stages.

Chapter 9: Institutional arrangement and capacity building

This chapter depicts the institutional arrangements of the executing company for successful implementation of the EMP.

Chapter 10: Conclusions and recommendations

The conclusions and recommendations are suggested here about the proposed project.

1.8 Methodology

1.8.1 Approach

The study has been conducted in accordance with ECR, 1997, GOB EIA Guidelines, 1997, and other relevant international laws and treaties to the proposed project. The route map of this EIA preparation is given in the following Figure 1.1. The EIA study has been prepared based on the secondary and primary data/information. The secondary data includes collection and review of the all relevant documents and data/information of the various relevant government and non government organizations, websites etc.. The primary data/information includes data/information collected from the field surveys, inspections, observations and discussions with stakeholders including community representatives and PAPs at important locations of the project and Project Influence Area (PIA). The main purpose of this approach was to obtain a fair impression on the people's perceptions of the project and its environmental impacts and possible mitigation.

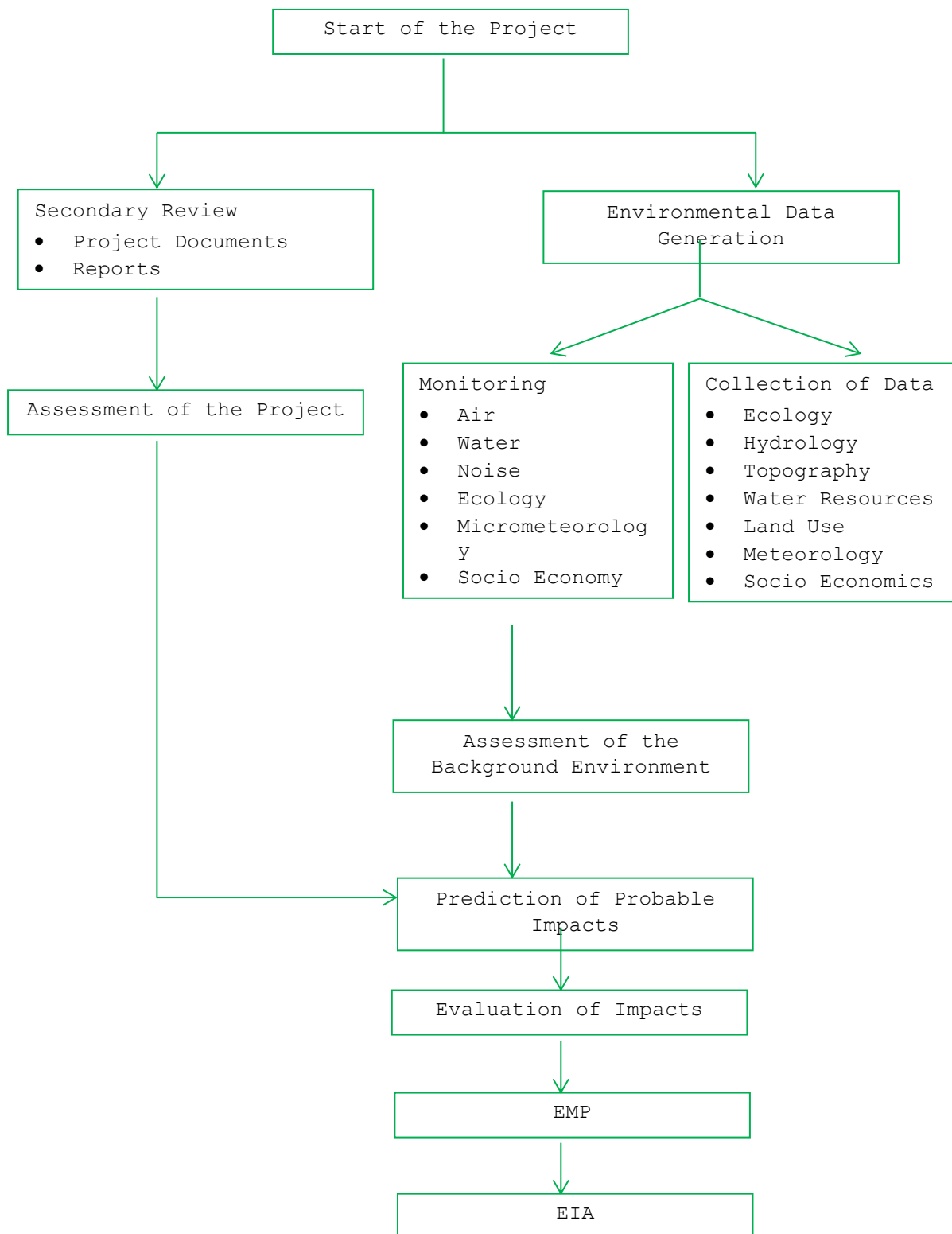


Figure 0.1: Route Map of Environmental Impact Assessment (EIA)

1.8.2 Methodology

The following methodology was adopted for carrying out the EIA of the proposed project:

(i) Orientation

Meetings and discussions were held among the members of the EIA Team. This activity was aimed at achieving a common ground of understanding of various issues of the study.

(ii) Data/Information Collection Plan

Subsequent to the concept clarification and understanding obtained in the preceding step, a detailed data/information collection plan was developed for the internal use of the EIA Team. The plan included identification of specific data requirements and their sources; determined time schedules and responsibilities for their collections and indicated the logistics and other supporting need for the execution of the data/information collection plan.

(iii) Data/Information Collection

In this step, secondary and primary data/information were collected from relevant organizations and published materials, field surveys, inspections and observations to establish environmental baseline profile for physical, ecological/biological and socio-economic environmental conditions. Following activities were performed for data/information collection:

- Site Reconnaissance;
- Analysis of Maps and Plans;
- Literature Review;
- Desk Research;
- Field Surveys, Inspection, Observations and Studies;
- Laboratory Analysis; and
- Public Consultations.

(iv) Secondary Data Collection

Collection and literature review of all available relevant documents, data/information were conducted for the EIA study of the Project. The review of secondary sources and informal initial field investigations were undertaken in order to prepare a preliminary assessment of the physical and social environment, biodiversity, and conservation significance of the identified study area. This preliminary literature review also assisted in identifying data gaps which would require collection of additional primary information through physical field survey. The following secondary data collection activities were carried out for the Project:

- Relevant data/information were collected from the various relevant government/non government organizations specially related to site aspects, climate (weather), topography, earthquake, soils, waterbodies, surface/ground water quality, ecology/biology, socio-economic etc. and assessed;
- Previous environmental site studies, where available, were reviewed as well as relevant scientific journal articles and web sites; and
- Thereafter, an information gap analysis was undertaken to identify the areas where further primary/field data collection would be required to complete the EIA.

Further detail regarding the titles of the relevant literature, policies, acts and other regulations and guidelines reviewed and applied during the course of this process can be found in legal section of this report.

(v) Primary Data Collection

The primary data/information of the following physical, biological/ecological and socio-cultural environment were collected during January- August 2017 by Topo Survey, SES & Environmental Survey Teams to comprehensively evaluate the existing project area environmental baseline conditions.

(a) Physical Environment

Information/data were collected on the existing physical environment, particularly as related to topography/geology/soils, hydrology/drainage, water (surface and ground/drinking) quality, air quality and noise.

Geology, Topography, and Soils

Data related to geology, topography and soil was collected to establish the environmental baseline of the project area and further to find out the impacts of the project mainly during the construction and operational phases.

Hydrology and Drainage

Data related to hydrology and drainage was collected to identify the elements of the flooding and water logging that are likely to have impacts on the project and the possible impacts that the project could have on the regime. Field assessments mainly on inundation and drainage issues of the subproject areas were carried out by interviews with the stakeholders including PAPs.

Environmental Quality Survey (EQS)

The EQS (such measurement of air quality & noise level, sampling of surface water and groundwater/drinking water at the fields) has been carried out at the various locations of the subproject areas during 25-29 August 2017 by EQMS (EQS Organization, Bangladesh).

Air Quality Monitoring

Ambient air quality measurements are essential to provide a description of the existing conditions, to provide a baseline against which changes can be measured and to assist in the determination of potential impacts of the proposed construction on air quality conditions. To monitor ambient air quality; SPM, carbon monoxide (CO), Carbon dioxide (CO₂) Sulphur-di-oxide (SO₂), Oxides of Nitrogen (NO_x) and Particulate Matter (PM₁₀ and PM_{2.5}) have been included for ambient air quality monitoring for two hours. LATA Envirotech APM 250 with Combined PM₁₀/PM_{2.5} Sampler was used for the measurement and monitoring of particulate matters and for gaseous pollutants.

Noise Level Measurement

The noise monitoring was performed by a trained specialist, using a calibrated Sound Level Meter (SLM) set to A-weighting, fast response and statistical analysis settings. The SLM was mounted facing in the direction of the apparent predominant noise source. The SLM was programmed to record statistical noise levels for 15 minutes at each location and was calibrated before and after the

survey; no significant drift was detected. Noise quality measurements were observed various locations of the Project site during day time.

Ground /Drinking Water Quality

Sampling and analysis of ground/drinking water has been carried for the following parameters: pH, Chloride (Cl⁻), Iron (Fe), Manganese (Mn), Arsenic (As), Total Coliforms (TC), and Fecal Coliforms (FC).

Surface Water Quality

Sampling and analysis of surface water quality has been carried out for the following parameters: pH, Dissolved Oxygen (DO), Chemical Oxygen Demand (COD) and Biochemical Oxygen Demand (BOD5), Phosphate (PO₄), and Ammonia Nitrogen (NH₃-N).

Biological/Ecological Environment

The status of the flora and fauna of the project area were determined by the reviewing of the literatures relevant to the area, observations and survey at the subproject areas.

Flora

The tree counting at the subproject sites within the Right of Way (ROW) was carried out by the social survey team. Identification of the dominant tree species, assessment of stage of growth (mature or sapling) and assessment of canopy cover was carried out.

Fauna

Information on fauna was gathered from existing literature on reported species as well as observations in the field.

Socio-Cultural Environment

The Consultants have been utilized a combination of desk researches, field investigations, census data, structured interviews, maps, reports to generate the data required for description of the existing social environment and assessment of the potential impacts due to the construction of the subprojects. Data/information was collected during June-July 2017 by the SES team on the following aspects given below: Demographics; Livelihoods; Education, Health, Community Facilities, Cultural Sites etc.

(vi) GIS Mapping

The Geographical Information Systems (GIS) was used as a specialized analysis and presentation tool. Before commencing field investigations, spatial analysis of satellite imagery was used to identify present administrative areas and other boundaries/constraints to be considered for both the environmental and social assessments. For example, the administrative boundaries of Local Government areas were defined, and transport routes, settlement areas and drainage networks were identified. It also supports more detailed on-ground survey, particularly spatial features (for example vegetation and ephemeral waterways) that may be directly or indirectly influenced by sub-project activities.

Detailed on-ground validation of spatial information – particularly land use was undertaken using a hand-held, non-differential GPS as well as an internet and GPS enabled tablet phone. The spatial data acquisition team undertook detailed transect walks through the Project area in order to identify

various land use types and confirm the findings of the satellite imagery analysis. The extensive ground-truthing exercise both validated the land use mapping and identified additional sensitive areas to include within the environmental fieldwork for sampling.

The collected data/information has been demonstrated by means of the numerous GIS mapping figures found throughout this report.

(vii) Public Consultation

The Public consultation is an important component of the EIA preparation activities. The Local knowledge about the ecosystem and problems associated with the project activities were carefully recorded and used in impact assessment and develop mitigation plan. Formal public consultation, in random with opportunistic informal ones involving local villagers, and people whose livelihood depends on these project areas, were executed during 25 August to 30 August 2017.



2 ENVIRONMENTAL POLICIES, LAWS, REGULATIONS AND STANDARDS

2.1 General

Transmission project activities by their inherent nature and flexibility have negligible impacts on environmental and social attributes. The Bangladesh laws relating to environmental and social issues have strengthened in the last decade both due to local needs and international commitments. All activities under the project shall be within the purview of these laws keeping in mind appropriate international obligations and directives and guidelines with respect to environmental and social considerations of Funding Agencies.

The proposed project will be implemented in compliance with the applicable environmental laws and regulations, Bangladesh and WB. Bangladesh has an environmental legal framework that is conducive to both environmental protection and natural resources conservation. This environmental legal framework applies to the proposed project. In addition, there are several laws and regulations related to environmental issues in Bangladesh. Many of these are cross-sectoral and partially related to environmental issues. This section presents an overview of the major national environmental laws and regulations that are relevant and may apply to activities supported by the project, institutional arrangement and national and sub-national level, and WB safeguard policies.

According to the national environmental legislation of Bangladesh all development projects are governed by some legal and institutional requirements. As such, assessment of relevant legal provisions, policies, strategies and institutional issues are very important for any project proponent or developer before execution of a program or plan. The proponent has to be well aware of these requirements and comply with the provisions as applicable and necessary.

Before initiating any development project, it is hence required to obtain environmental clearance from Department of Environment (DOE), under the Ministry of Environment and Forests (MOEF) is the regulatory body responsible for enforcing the environmental laws and regulations like ECA'95 (amended in 2010) and ECR'97.

The need to comply with the requirements of the EIA Regulations ensures that decision makers are provided the opportunity to consider the potential environmental impacts of a project early in the project development process, and assess if environmental impacts can be avoided, minimized or mitigated to acceptable levels. Comprehensive, independent environmental studies are required to be undertaken in accordance with the EIA Regulations to provide the competent authority with sufficient information in order for an informed decision to be made. The following activities have been carried out under the EIA study:

- Identification of national legal obligations in relation to the interventions which will be required to review under the EIA study of the proposed project;
- Exploration of the national legislative provisions and policy guidelines on environmental sectors;
- Identification of the international legal obligations and relevant provisions of multilateral environmental agreements related to the renewable energy project;
- Exploration of national and international legal provisions on energy sector; and

- Identification of the standard guidelines at regional and international level related to the project.

2.2 Applicable Policies in Bangladesh

2.2.1 Relevant National Legislations

2.2.1.1 Environmental Policy, 1992

The concept of environmental protection through national efforts was first recognized and declared with the adoption of the Environmental Policy, 1992 and the Environmental Action Plan, 1992. The importance of policies in beefing up the environmental regime is recognized in a number of international instruments including the World Conservation Strategy in 1980 and the Brundtland Commission Report, 1987. Paragraph 14 of Chapter 8 of Agenda 21 underscored the necessity of formulation of national policies as well as laws for environmental protection and sustainable development. The major objectives of Environmental Policy are to:

- (i) Maintain ecological balance and overall development through protection and improvement of the environment;
- (ii) Protect country against natural disaster;
- (iii) Identify and regulate activities, which pollute and degrade the environment;
- (iv) Ensure environmentally sound development in all sectors; and
- (v) Ensure sustainable, long term and environmentally sound base of natural resources; and
- (vi) Actively remain associate with all international environmental initiatives to the maximum possible extent.

According to this policy the proposed project needs full environmental assessment. The proposed interventions are required to comply with all the policy directives emphasizing particularly on reducing adverse environmental impacts. The EIA studies are required to address the potential impacts and propose mitigation measures. In compliance to the policy detail EIA is prepared.

2.2.1.2 Environmental Action Plan, 1992

The National Environmental Action Plan, 1992 recommended sector specific action plan to achieve the objectives and implement the policy recommendations of the National Environment Policy. The followings are water resources key recommended actions:

- Environmental audit on an emergency basis will be conducted for water resources development, flood control and irrigation projects. Steps to mitigate the adverse impact on the environment identified in the audit will be taken through appropriate modification of these projects.
- Environmental Impact Assessment will be incorporated in all new projects. Adverse impacts will be prevented through proper steps and adequate investments.
- Operation and maintenance will be ensured subsequent to execution of projects related to water resources development and management. Regular monitoring will be conducted to evaluate the impact of all projects.

2.2.1.3 National Environment Policy (NEP), 1992

The National Environment Policy (NEP) is one of the key policy documents of the Government. The policy addresses 15 sectors in all, in addition to providing directives on the legal framework and institutional arrangements. The NEP sets out the basic framework for environmental action together with a set of broad sectoral guidelines for action. Major elements of the policy are as follows:

- a. Maintaining of the ecological balance for ensuring sustainable development;
- b. Protection of the country against natural disasters;
- c. Identifying and controlling activities which are polluting and destroying the environment;
- d. Ensuring environment-friendly development in all sectors;
- e. Promoting sustainable and sound management of natural resources; and
- f. Active collaboration with international initiatives related to the environment.

With regard to the project, the environmental policy aims at prevention of pollution and degradation of resources caused by electricity transmission project. The policy mentions that the EIA should be conducted before projects are undertaken.

2.2.1.4 National Environmental Management Action Plan (NEMAP), 1995

The National Environmental Management Action Plan (NEMAP) builds on the NEP and was developed to address specific issues and management requirements during the period 1995-2005. The plan includes a framework within which the recommendations of a National Conservation Strategy (NCS) are to be implemented. The NEMAP was developed with the following objectives:

- To identify key environmental issues affecting Bangladesh;
- To identify actions to halt or reduce the rate of environmental degradation;
- To improve management of the natural environment;
- To conserve and protect habitats and bio-diversity;
- To promote sustainable development; and
- To improve the quality of life.

2.2.1.5 Environmental Conservation Act (ECA), 1995

The ECA is currently the main legislation relating to environment protection in Bangladesh. This Act is promulgated for environment conservation, environmental standards development and environment pollution control and abatement.

The main objectives of ECA are:

- Conservation and improvement of the environment; and
- Control and mitigation of pollution of the environment.

The main focuses of the Act can be summarized as:

- Declaration of ecologically critical areas and restriction on the operations and processes, which can or cannot be carried out/ initiated in the ecologically critical areas (ECA);
- Regulations in respect of vehicles emitting smoke harmful for the environment;
- Environmental clearance;
- Regulation of industries and other development activities' discharge permits;

- Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes;
- Promulgation of a standard limit for discharging and emitting waste; and
- Formulation and declaration of environmental guidelines.

Before any new project can go ahead, as stipulated under the ECA, the project promoter must obtain Environmental Clearance from the Director General (DG), DOE. An appeal procedure does exist for those promoters who fail to obtain clearance. Failure to comply with any part of this Act may result in punishment to a maximum of 5 years imprisonment or a maximum fine of Tk.100, 000 or both. The DOE executes the Act under the leadership of the DG.

The EIA study is prepared following guidelines of this Act. In accordance with the Act, the dredging project will need DoE's clearance prior to the commencement of the project. Also the Ecologically Critical Areas, defined by DoE under this act, will be considered while planning and designing of the project interventions.

▪ **Environmental Conservation Act (Amendment 2000)**

The Bangladesh Environment Conservation Act Amendment 2000 focuses on ascertaining responsibility for compensation in cases of damage to ecosystems, increased provision of punitive measures both for fines and imprisonment and the authority to take cognizance of offences.

▪ **Environmental Conservation Act (Amendment 2002)**

The 2002 Amendment of the ECA elaborates on the following parts of the Act:

- Restrictions on polluting automobiles;
- Restrictions on the sale, production of environmentally harmful items like polythene bags;
- Assistance from law enforcement agencies for environmental actions;
- Break up of punitive measures; and
- Authority to try environmental cases.

▪ **Environmental Conservation Act (Amendment 2010)**

This amendment of the act introduces new rules & restriction on:

- No individual or institution (Gov. or Semi Gov, / Non Gov. / Self Governing) cannot cut any Hill and Hillock. In case of national interest; it can be done after getting clearance from respective the department
- Owner of the ship breaking yard will be bound to ensure proper management of their hazardous wastes to prevent environmental pollution and Health Risk
- No remarked water body cannot be filled up/changed; in case of national interest; it can be done after getting clearance from the respective department; and
- Emitter of any activities/incident will be bound to control emission of environmental pollutants that exceeds the existing emission standards.

2.2.1.6 Environmental Conservation Rules (ECR), 1997 and Amendments

Environment Conservation Rules (ECR) 1997 has provided categorization of industries and projects and identified types of Environment assessments needed against respective category of industries or projects. Among other things, these rules set (i) the National Environmental Quality Standards for

ambient air, various types of water, industrial effluent, emission, noise, vehicular exhaust etc., (ii) requirement for and procedures to obtain environment clearance (iii) requirement for IEE/EIA according to categories of industrial and other development interventions. In the ECR 1997, there is a section on ecologically critical area. This is Section 3, 'Declaration of ecologically critical area' and reads, "(1) The Government will take the following into consideration in order to declare any area as Ecologically Critical area vide Section 5(1) of the Act (ECA 1995):

- Human settlement
- Ancient monument
- Archaeological site
- Forest sanctuary
- National Park
- Game reserve
- Wildlife habitat
- Wetland
- Mangrove
- Forest area
- Biodiversity area
- Similar other areas.

The activities or processes which cannot be continued or initiated in Ecologically Critical area shall be specified by the Government as per standards described in following Rules 12 and 13 of the ECR '97).

According to the rules, any project/development intervention of the Red Category is to obtain environmental clearance in two steps - first to obtain site/location clearance (based on the application along with necessary papers, including the Initial Environmental Examination (IEE) which will contain the scope of work of the proposed EIA, if required, and then to obtain Environmental Clearance (by submitting the application along with necessary papers including the EIA).

2.2.1.7 National Agriculture Policy, 1999

This policy aims to make the nation self-sufficient in food through increasing production of all crops including cereals and ensure a dependable and secure food system for all. One of the objectives of this Act is to preserve and develop land productivity. The policy particularly stresses on research and development of improved varieties and technologies for cultivation in water-logged and salinity affected areas. The policy also recognizes that adequate measures should be taken to reduce water-logging and salinity and provide irrigation facilities for crop production.

Adequate measures should be taken to reduce water-logging and hamper of irrigation system due to construction of the transmission lines and substations.

2.2.1.8 National Land Use Policy, 2001

The National Land Use Policy was adopted by Bangladesh government in 2001, setting out guidelines for improved land-use and zoning regulations. The main objectives of this policy is to ensure criteria based uses of land and to provide guidelines for usage of land for the purpose of agriculture, housing, afforestation, commercial and industrial establishments, rail and highway and for tea and rubber gardens. Overall, this policy promotes a sustainable and planned utilization of land.

The main contents of this policy are:

- Stopping the high conversion rate of agricultural land to non-agricultural purposes;
- Utilizing agro-ecological zones to determine maximum land use efficiency;
- Adopting measures to discourage the conversion of agricultural land for urban or development purposes;
- Improving the environmental sustainability of land-use practices.

The proposed project must adhere to this policy so that environmental sustainability of land-use practices is assured.

2.2.1.9 The Electricity Act, 1910

The primary objective of this act is to amend the laws relating to the supply and use of electrical energy in Bangladesh. This act comprises of guidelines related to licenses, works, and supply for the supply of energy. It also includes guidelines related to supply, transmission and use of energy by non-licensees. A licensee is a person authorized by the Government to supply energy in any specified area and permitted to lie down or place electric supply lines for the conveyance and transmission of energy. In Part II of this act, guidelines are provided for carrying out works for the supply of energy. This act includes guidelines related to the execution of any works involved in placing of any infrastructure in, under, over, along or across any street, part of a street, railway, tramway, canal or waterway. Also, information on lying of electric supply lines, aerial lines, or other works near sewers, pipes or other electric supply-lines or works is provided in Part II of the act. According to this act a licensee shall, in exercise of any of the powers conferred by or under this act, cause as little damage, detriment and inconvenience as may be, and shall make full compensation of any damage, detriment and inconvenience caused by him or by any one employed by him. In Part IV of this act, Protective Clauses are provided for protection of railways and canals/waterways, docks, wharves and piers, telegraphic, telephonic and electric signaling lines. Part IV also includes guidelines for occurrences of any criminal offences such as dishonest abstraction of energy, installation of artificial means, malicious wasting of energy or injuring works, theft of line materials, tower members, equipment etc. and subsequent procedures to follow up that criminal offence.

2.2.1.10 Electricity (Amendment) Act, 2012 (Draft)

This act is an amendment to The Electricity Act, 1910. In addition to the guidelines provided in the original act (The Electricity Act, 1910), this act includes more specific instruction relating to obligation on licensee to supply energy. According to section 22A (Sub section 1) of this act: a person authorized by a license, or exempted from the requirement to obtain a license, to generate, transmit, distribute or supply electricity – (a) shall, in generating, transmitting, distributing or supplying electricity, have regard to the desirability of preserving natural beauty, of conserving flora, fauna and geological or physiographical features of special interest and of protecting sites, buildings and objects of architectural, historic or archaeological interest; and (b) shall do what the person reasonably can to mitigate any effect which such generation, transmission, distribution or supply would have on the natural beauty of the countryside or on any such flora, fauna, features, sites, buildings or objects. In section 22A (Sub- section 2) it is mentioned that, without prejudice to the provisions of Sub- section (1), a person authorized by a license, or exempted from the requirement to obtain a license, to generate, transmit, distribute or supply electricity and the Commission shall, in generating, transmitting, distributing or supplying electricity, or as the case may be, in the discharge

of the Commission's functions, avoid, so far as reasonably practicable, causing injury to fisheries or to the stock of fish in any waters. section 22A (Sub- section 3 and 4) of this act also mentions that a generation licensee shall, in circumstances specified by the Commission, be entitled to construct, subject to conditions specified by the commission in consultation with the relevant water authority, water ways and pipelines, and to use water for its licensed activities and the relevant water authority shall not unreasonably deny such right. For this purpose the 'relevant water authority' means such authority, as the Commission shall determine.

2.2.1.11 Bangladesh National Building Code (BNBC)

The main purpose of the BNBC is to establish minimum standards for design, construction, quality of materials, use and occupancy, location and maintenance of all buildings within Bangladesh in order to safeguard, within achievable limits, life, limb, health, property and public welfare. The installation and use of certain equipment, services and appurtenances related, connected or attached to such buildings are also regulated herein to achieve the same purpose.

Chapter-3, part -7 of the BNBC has clarified the issue of safety of workmen during construction and with relation to this, set out the details about the different safety tools of specified standard. In relation with the health hazards of the workers during construction, this chapter describes the nature of the different health hazards that normally occur in the site during construction and at the same time specifies the specific measures to be taken to prevent such health hazards. According to this chapter, exhaust ventilation, use of protective devices, medical checkups etc. are the measures to be taken by the particular employer to ensure a healthy workplace for the workers.

Chapter-1, part-7 of the BNBC, states the general duties of the employer to the public as well as workers - "All equipment and safeguards required for the construction work such as temporary stair, ladder, ramp, scaffold, hoist, run way, barricade, chute, lift etc. shall be substantially constructed and erected so as not to create any unsafe situation for the workmen using them or the workmen and general public passing under, on or near them".

Chapter -1, Part-7 of the BNBC clearly sets out the constructional responsibilities according to which the relevant authority of a particular construction site shall adopt some precautionary measures to ensure the safety of the workmen. According to section 1.2.1 of chapter 1 of part 7; "in a construction or demolition work, the terms of contract between the owner and the contractor and between a consultant and the owner shall be clearly defined and put in writing. These however will not absolve the owner from any of his responsibilities under the various provisions of this BNBC and other applicable regulations and bye-laws. The terms of contract between the owner and the contractor will determine the responsibilities and liabilities of either party in the concerned matters, within the provisions of the relevant Acts and Codes (e.g.) the Employers' Liability Act, 1938, the Factories Act 1965, the Fatal Accident Act, 1955 and Workmen's Compensation Act 1923". (After the introduction of the Bangladesh Labor Act, 2006, these Acts have been repealed).

To prevent workers falling from heights, the BNBC in chapter 3 of part 7 sets out the detailed requirements on the formation and use of scaffolding. According to section 11.2 of the same chapter, "every temporary floor openings shall either have railing of at least 900 mm height or shall be constantly attended. Every floor hole shall be guarded by either a railing with toe board or a hinged cover. Alternatively, the hole may be constantly attended or protected by a removable

railing. Every stairway floor opening shall be guarded by railing at least 900 mm high on the exposed sides except at entrance to stairway. Every ladder way floor opening or platform shall be guarded by a guard railing with toe board except at entrance to opening. Every open sided floor or platform 1.2 meters or more above adjacent ground level shall be guarded by a railing on all open sides except where there is entrance to ramp, stairway or fixed ladder. The precautions shall also be taken near the open edges of the floors and the roofs”.

2.2.1.12 Other Relevant National Policies, Act, Rules, Laws and Ordinances

Considerable number of national policy documents has been prepared during recent years and these have been accepted by the GOB. These policy initiatives, strategies and plans all emphasize consideration of the environment and natural resources in order to achieve sustainable development. A summary of the key relevant policy documents prepared is mentioned in Table 2.1.

Table 2.1: Relevant Key Policies

Policy	Brief Description	Responsible Agency
The National Water Policy (1999)	<ul style="list-style-type: none"> Protection and restoration of water resources; Protection of water quality including strengthening regulations concerning agro-chemicals and industrial effluents; Sanitation and potable water; 	MOWR
National Land use Policy (2001)	The policy deals with land uses for several purposes including agriculture, housing, forestry, industrialization, railways and roads. The plan identifies land use constraints in these sectors.	Ministry of Land (MOL)
National Fisheries Policy, 1998	Preservation and management of inland open water fisheries	MOFL
National Forest Policy and Forest Sector Review (1994, 2005)	<ul style="list-style-type: none"> Afforestation of 20% land; Bio-diversity of the existing degraded forests; Strengthening of agricultural sector; Control of global warming, desertification, control of trade in wild birds and animals; Prevention illegal occupation of the forestlands, tree felling and hunting of wild animals. 	MOEF
National Biodiversity Strategy and Action Plan (2004)	<ul style="list-style-type: none"> Conserve, and restore the biodiversity of the country; Maintain and improve environmental stability of ecosystems; Ensure preservation of the unique biological heritage of the nation for the benefit of the present and future generations; Guarantee safe passage and conservation of globally endangered migratory species, especially birds and mammals in the country; Stop introduction of invasive alien species, genetically modified organisms and living modified organisms. 	MOEF
Bangladesh Climate Change Strategy and Action Plan (2008)	Establishment of six strategic pillars for action, including: (1) food security, social protection and health, (2) disaster management, (3) protective infrastructure, (4) research and knowledge management, (5) decreased carbon development, and (6) capacity building and institutional strengthening.	MOEF
National Land-use Policy, 2001	The Government of Bangladesh has adopted national Land use Policy, 2001. The salient features of the policy objectives relevant to the proposed are as follows: <ul style="list-style-type: none"> To prevent the current tendency of gradual and consistent decrease of cultivable land for the production of food to meet 	

Policy	Brief Description	Responsible Agency
	<p>the demand of expanding population;</p> <ul style="list-style-type: none"> • To ensure that land use is in harmony with natural environment; • To use land resources in the best possible way and to play supplementary role in controlling the consistent increase in the number of land less people towards the elimination of poverty and the increase of employment; • To protect natural forest areas, prevent river erosion and destruction of hills; • To prevent land pollution; and • To ensure the minimal use of land for construction of both government and nongovernment buildings. 	

Table 2.2 presents an outline of the other national legal instrument that will have relevance to the project with respect to the social and environment considerations. The EIA is prepared in compliance with these national policies.

Table 2.2: Other Relevant National Act, Rules, Laws and Ordinances

Act/Rule/Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features-Potential Applicability
Environment Court Act, 2000 and subsequent amendments in 2002	Ministry of Environment and Forest	The aim and objective of the Act is to materialize the Environmental Conservation Act, 1995 through judicial activities. This Act established Environmental Courts (one or more in every division), set the jurisdiction of the courts, and outlined the procedure of activities and power of the courts, right of entry for judicial inspection and for appeal as well as the constitution of Appeal Court.
Public Procurement Rule (PPR), 2008	Ministry of Public Works (MOPW)	This rule shall apply to the Procurement of Goods, Works or Services by any government, semi-government or any statutory body established under any law. The rule includes the adequate measure regarding the "Safety, Security and Protection of the Environment" in the construction works. This clause includes mainly, the contractor shall take all reasonable steps to (i) safeguard the health and safety of all workers working on the Site and (ii) protect the environment on and off the Site and to avoid damage or nuisance to persons or to property of the public or others.
The Brick Burning (Control) Act, 1989 The Brick Burning (Control) Amendment Act, 1992 and 2001	Ministry of Environment and Forest	<ul style="list-style-type: none"> ▪ Control of brick burning; ▪ Requires a license from the MOEF for operation; ▪ Restricts brick burning with fuel wood.
Water Supply and Sanitation Act, 1996	Ministry of Local Government, Rural Development and Cooperatives	Management and control of water supply and sanitation in urban areas.
Bangladesh Wildlife Preservation Order 1973	Ministry of Environment and	Restricts people from damaging or destroying vegetation in wildlife sanctuaries and hunting and

Act/Rule/Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features-Potential Applicability
and Revision 2008 (Draft)	Forests (MOEF)	capturing of wild animals
National Forest Policy and Forest Sector Review (1994, 2005)	Forest Department (FD), MOEF	<ul style="list-style-type: none"> ▪ Afforestation of 20% land; ▪ Bio-diversity of the existing degraded forests; ▪ Strengthening of agricultural sector; ▪ Control of global warming, desertification, control of trade in wild birds and animals; and ▪ Prevention illegal occupation of the forest lands, tree felling and hunting of wild animals.
The Forest Act 1927, Amendment 2000 (Protected, village Forests and Social Forestry)	FD, MOEF	<ul style="list-style-type: none"> ▪ Declare any forests land or wasteland as protected forests; ▪ May stop public or private way or watercourse in the interest of preservation of the forest; ▪ Declare a reserved forest area as village forests; and ▪ Declare an area as Social forests or launch a social forestry programme in Govt. land or private land with permission.
Bangladesh Climate Change Strategy and Action Plan (2008)	MOEF	<p>Establishment of six strategic pillars for action, including:</p> <ol style="list-style-type: none"> 1. food security, social protection and health 2. disaster management 3. protective infrastructure 4. research and knowledge management, 5. decreased carbon development, and capacity building and institutional strengthening.
Wetland Protection Act 2000	MOWR	<ul style="list-style-type: none"> ▪ Advocates protection against degradation and resuscitation of natural water-bodies such as lakes, ponds, beels, khals, tanks, etc. affected by man-made interventions or other causes; ▪ Prevents the filling of publicly-owned water bodies and depressions in urban areas for preservation of the natural aquifers and environment; and ▪ Prevents unplanned construction on riverbanks and indiscriminate clearance of vegetation on newly accreted land.
Vehicle Act 1927 and Motor vehicle ordinance 1983	Bangladesh Road Transport Authority (BRTA)	<ul style="list-style-type: none"> ▪ Road/traffic safety; ▪ Vehicular air and noise pollutions; and ▪ Fitness of vehicles and registration.

2.3 Categories of Projects

Under the Environmental Conservation Rules (ECR) of the DOE, Bangladesh (1997), a classification system was established for development projects and industries on basis of the location, the size and the severity of potential pollution. There are four categories of projects: green, orange A, orange B and Red with respectively no, minor, medium and severe environmental impacts. According to the guidelines illustrated in the ECR, this project falls under the red category of projects.

“Red Category: According to EIA Guidelines for Industry of DOE “Power Stations” projects fall under Red category; Red category project needs to conduct EIA and submit the report to DoE for ECC.”

Therefore, for this project, it needs to prepare an EIA in due course following prescribed format and be submitted to the DOE for getting the ECC of the project. The EIA should include the prediction, evaluation and mitigation of environmental impacts and an EMP. Noted that according to the WB and impact assessment as mentioned in ESMF, this project falls under category B and therefore needs to carry out the IEE.

2.4 International Treaties

Bangladesh has signed most international treaties, conventions and protocols on environment, pollution control, bio-diversity conservation and climate change, including the Ramsar Convention, the Bonn Convention on migratory birds, the Rio de Janeiro Convention on biodiversity conservation and the Kyoto protocol on climate change. An overview of the relevant international treaties and conventions signed by GOB is shown in Table 2.3.

Table 2.3: Relevant International Treaties, Conventions and Protocols Signed by Bangladesh

Treaty or Convention	Year	Brief description	Responsible Agency
On protection of birds (Paris)	1950	Protection of birds in wild state	DOE/DOF
Occupational hazards due to air pollution, noise and vibration (Geneva)	1977	Protect workers against occupational hazards in the working environment	Ministry of Health and Family Welfare (MOHFW)
Occupational safety and health in working environment (Geneva)	1981	Prevent accidents and injury to health by minimizing hazards in the working environment	MOHFW
Occupational health services (Geneva)	1985	To promote a safe and healthy working environment	MOHFW
International convention on climate changes (Kyoto Protocol)	1997	International treaty on climate change and emission of greenhouse gases	DOE/MOEF

2.5 World Bank Environmental and Social Safeguard Policies

The objective of these policies is to prevent and mitigate undue harm to people and their environment in the development process. Safeguard policies provide a platform for the participation of stakeholders in project design, and act as an important instrument for building ownership among local populations. The effectiveness and development impact of projects and programs supported by the Bank has substantially increased as a result of attention to these policies. The WB's relevant environmental, social, and legal safeguard policies are given below:

Environmental Policies:

- OP/BP 4.01 Environmental Assessment
- OP/BP 4.04 Natural Habitats
- OP/BP 4.11 Physical Cultural Resources
- OP/BP 4.36 Forests

Social Policies:

- OP/BP 4.10 Indigenous Peoples
- OP/BP 4.12 Involuntary Resettlement

Legal Policies:

- OP/BP 7.50 International Waterways
- OP/BP 7.60 Disputed Areas

Operational Policies (OP) are the statement of policy objectives and operational principles including the roles and obligations of the Borrower and the Bank, whereas Bank Procedures (BP) is the mandatory procedures to be followed by the Borrower and the Bank. Apart from these, the IFC guidelines for Environmental Health and safety have been adopted by the World Bank Group which is also relevant for environmental protection and monitoring. In addition to that the Policy on Access to Information of World Bank also relates to environmental safeguard. The environmental safeguard and access to information policy as well as the IFC guidelines are discussed below:

I. OP/BP 4.01 Environmental Assessment

This policy is considered to be the umbrella safeguard policy to identify, avoid, and mitigate the potential negative environmental and social impacts associated with Bank lending operations. In World Bank operations, the purpose of Environmental Assessment (EA) is to improve decision making, to ensure that project options under consideration are sound and sustainable, and that potentially affected people have been properly consulted. The borrower is responsible for carrying out the EA and the Bank advises the borrower on the Bank's EA requirements. The Bank classifies the proposed project into three major categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts:

- Category A: The proposed project is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works.
- Category B: The proposed project's potential adverse environmental impacts on human population or environmentally important areas-including wetlands, forests, grasslands, or other natural habitats- are less adverse than those of Category A projects. These impacts are site specific; few if any of them are irreversible; and in most cases mitigation measures can be designed more readily than Category A projects.
- Category C: The proposed project is likely to have minimal or no adverse environmental impacts.

II. OP/BP 4.04 Natural Habitats

The conservation of natural habitats is essential for long-term sustainable development. The Bank therefore supports the protection, maintenance, and rehabilitation of natural habitats and their functions in its economic and sector work, project financing, and policy dialogue. The Bank supports, and expects borrowers to apply, a precautionary approach to natural resource management to ensure opportunities for environmentally sustainable development. The Bank does not support projects that involve the significant conversion or degradation of critical natural habitats.

III. OP/BP 4.11 Physical Cultural Resources

Physical cultural resources are defined as movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical,

architectural, religious, aesthetic, or other cultural significance. Their cultural interest may be at the local, provincial or national level, or within the international community. Physical cultural resources are important as sources of valuable scientific and historical information, as assets for economic and social development, and as integral parts of a people's cultural identity and practices. The Bank assists countries to avoid or mitigate adverse impacts on physical cultural resources from development projects that it finances. The impacts on physical cultural resources resulting from project activities, including mitigating measures, may not contravene either the borrower's national legislation, or its obligations under relevant international environmental treaties and agreements. The borrower addresses impacts on physical cultural resources in projects proposed for Bank financing, as an integral part of the environmental assessment process.

IV. OP/BP 4.36 Forests

Forest is defined as an area of land of not less than 1.0 hectare with tree crown cover (or equivalent stocking level) of more than 10 percent that have trees with the potential to reach a minimum height of 2 meters at maturity in situ. A forest may consist of either closed forest formations, where trees of various stories and undergrowth cover a high proportion of the ground, or open forest. The definition includes forests dedicated to forest production, protection, multiple uses, or conservation, whether formally recognized or not. The definition excludes areas where other land uses not dependent on tree cover predominate, such as agriculture, grazing or settlements. In countries with low forest cover, the definition may be expanded to include areas covered by trees that fall below the 10 percent threshold for canopy density, but are considered forest under local conditions. The Bank's forests policy recognizes the importance of forests to reduce poverty in a sustainable manner integrates forests effectively in economic development, aims to reduce deforestation, promote afforestation and enhance the environmental contribution of forested areas. The Bank assists borrowers with the establishment and sustainable management of environmentally appropriate, socially beneficial, and economically viable forest plantations to help meet growing demands for forest goods and services.

V. OP/BP 4.12 Involuntary Resettlement

This policy is triggered in situations involving involuntary taking of land and involuntary restrictions of access to legally designated parks and protected areas. The policy aims to avoid involuntary resettlement to the extent feasible, or to minimize and mitigate its adverse social and economic impacts. It promotes participation of displaced people in resettlement planning and implementation, and its key economic objective is to assist displaced persons in their efforts to improve or at least restore their incomes and standards of living after displacement. The policy prescribes compensation and other resettlement measures to achieve its objectives and requires that borrowers prepare adequate resettlement planning instruments prior to Bank appraisal of proposed projects.

VI. OP 4.10 Indigenous People

The term "Indigenous Peoples" is used in a generic sense to refer to a distinct, vulnerable, social and cultural group possessing the following characteristics in varying degrees:

- self-identification as members of a distinct indigenous cultural group and recognition of this identity by others;

- collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories;
- customary cultural, economic, social, or political institutions that are separate from those of the dominant society and culture; and
- an indigenous language, often different from official language of the country/ region.

The Bank provides project financing only where free, prior, and informed consultation results in broad community support to the project by the affected Indigenous Peoples. Such Bank-financed projects include measures to (a) avoid potentially adverse effects on the Indigenous Peoples' communities; or (b) when avoidance is not feasible, minimize, mitigate, or compensate for such effects. Bank-financed projects are also designed to ensure that the Indigenous Peoples receive social and economic benefits that are culturally appropriate and gender and inter-generationally inclusive.

VII. OP/BP 7.50 Projects on International Waterways

The WB recognizes the issues involving projects in international waterways and attaches importance to the riparian's making appropriate agreements or arrangements for the entire waterway, or parts thereof. In the absence of such agreements or arrangements, the Bank requires, as a general rule, that the prospective borrower notifies the other riparian's of the project. The Policy lays down detailed procedures for the notification requirement, including the role of the Bank in affecting the notification, period of reply and the procedures in case there is an objection by one of the riparian's to the project.

VIII. OP/BP 7.60 Projects in Disputed Areas

The World Bank finances projects in disputed areas when either there is no objection from the other claimant to the disputed area, or when special circumstances of case support Bank financing, notwithstanding the objection. The policy details those special circumstances.

2.5.1 IFC Environmental, Health and Safety Guidelines

The Environmental, Health and Safety (EHS) Guidelines of the World Bank Group (WBG)/International Finance Corporation (IFC), 2008 is the safeguard guidelines for environment, health and safety for the development of the industrial and other projects. They contain performance levels and measures that are considered to be achievable in new facilities at reasonable costs using existing technologies. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment.

2.5.2 World Bank Policy on Access to Information

In addition to the safeguard policies, the Access to Information Policy also relates to safeguards. To promote transparency and facilitate accountability, Bank Access to Information Policy supports decision making by the Borrower and Bank by allowing the public access to information on

environmental and social aspects of projects in an accessible place and understandable form and language to key stakeholders. The Bank ensures that relevant project-related environmental and social safeguard documents, including the procedures prepared for projects involving subprojects, are disclosed in a timely manner before project appraisal formally begins. The policy requires disclosure in both English and Local language and must meet the WB standards.

2.6 GoB Environmental Clearance Procedure

Formal EIA guidelines in Bangladesh are set out in “Rules and Regulations under the 1995 Environmental Protection Acts” as published in the official Gazette on August 27, 1997. Any proponent planning an industrial project is currently required under Paragraph 12 of the Environmental Protection Acts, 1995 to obtain “environmental clearance letter.” from the Department of Environment.

Steps to be followed for obtaining the Environmental Clearance Certificate for this electricity transmission project are shown in Figure 2.1 as the project is under ‘Category Red’ and to prepare a full EIA prior to implementation of such project for approval.

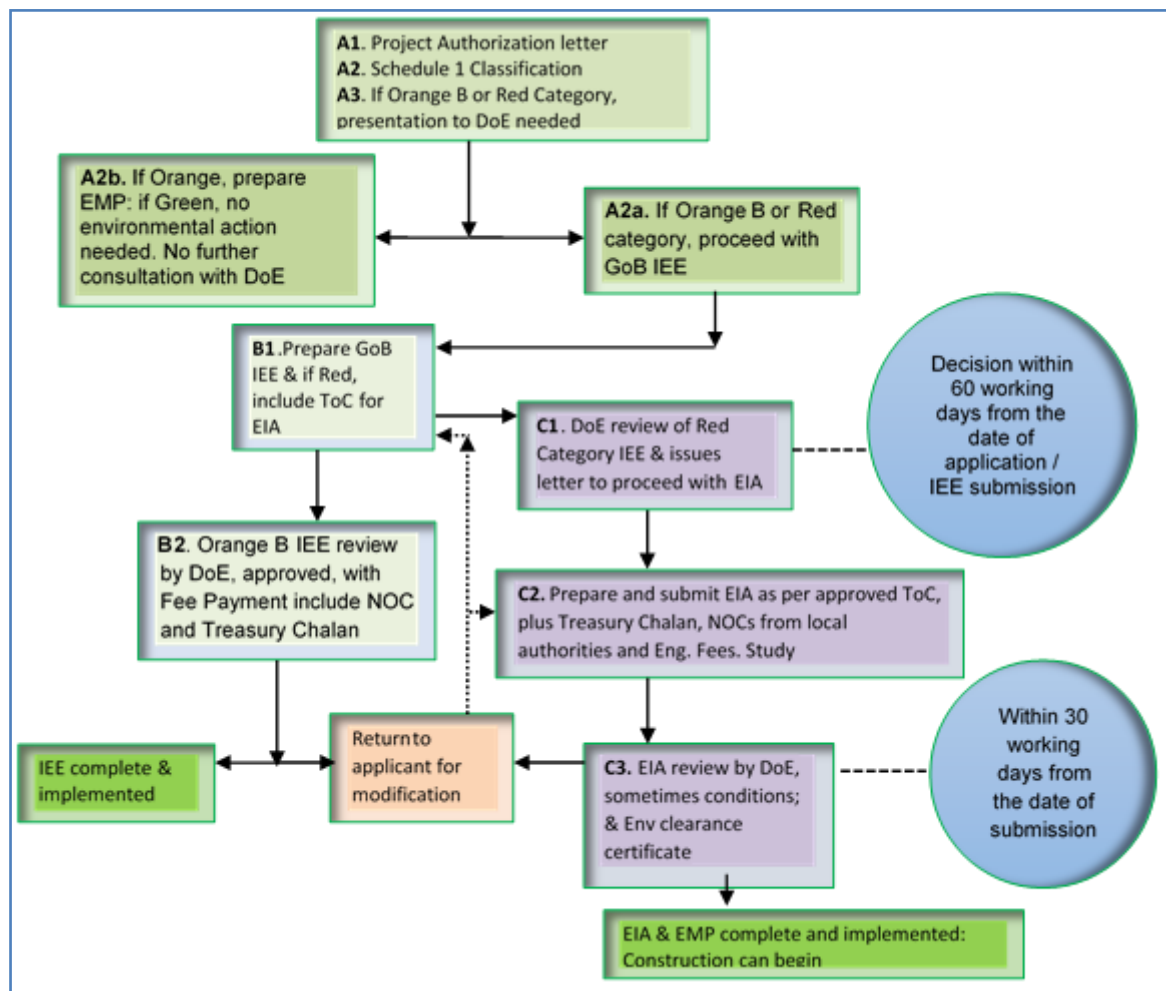


Figure 2.1: Government of Bangladesh Environmental Clearance Process

The first to obtain environmental clearance is for the project proponent to complete & submit an application form which may be obtained from the appropriate DoE regional offices as per the

category. The application is accompanied by other supporting documents (i.e. project profile, lay-out plan, NOC from local authority, Government fees etc.) reviewed by the divisional and district offices of DoE who has the authority to request supporting documents as applicable. The divisional office has the power to take decision on Green and Amber-A & B category projects and the Red category projects are forwarded to head office for approval. The proposed project will receive an environmental site clearance at the beginning and the environmental clearance subject to the implementation of the project activities and all mitigation measures suggested in the EIA report or in the application.

2.7 Applicable Environmental Quality Standards

2.7.1 National Environment Quality Standards

Details of the environmental standards applicable in Bangladesh are described in ECR. Regulated Areas spread to all industries, and regulated items are air quality, water quality (surface water, drink water), noise (boundary, source), emissions from motor vehicles or ships, odor, sewage discharge, waste from industrial units and industrial effluents or emissions. Items and standards, which are related to the construction and operation of access road, are listed below. Tables and annotations of environmental regulation are described as textual description of ECR.

ECR is currently in the process of amendment. There is a possibility that the environmental regulation of the following items will be amended, but the current regulation is applied until the amendment process is completed.

At present there are environmental standards in operation in Bangladesh also promulgated under the ECR of 1997. There are standards prescribed for varying water sources; ambient air; noise; odor; industrial effluent and emission discharges; and vehicular emissions, etc. The standards, commonly known as Environmental Quality Standards (EQS), are legally binding. The Bangladesh standards for ambient air, noise, odor, sewage, industrial effluent and emission are furnished hereinafter (Table 2.4-2.11). These are all in an authentic translation from original Bengali citing the specific source.

2.7.1.1 Air Quality

Table 2.4 shows the air quality standard in Bangladesh. Air quality standard adhere to World Health Organization (WHO) guidelines is also mentioned in Table 2.4.

Table 2.4: Bangladesh Standards for Ambient Air Quality Schedule-2, Rule 12, Environment Conservation Rules of 1997

No.	Parameter	Concentration (mg/m ³)	Exposure Time
a)	Carbon Mono-oxide	10	8 hours
		40	1 hour
b)	Lead (Pb)	0.5	Year
c)	Nitrogen Oxide	0.1	Year
		-	1 hour
d)	Suspended Particulate Matter (SPM)	0.2	8 hours
e)	Particulate Matter 10µm (PM ₁₀)	0.05	Year
		0.15	24 hours
f)	Particulate Matter 2.5µm (PM _{2.5})	0.015	Year

		0.065	24 hours
g)	Ozone	0.235	1 hour
		0.157	8 hours
h)	Sulfur Dioxide	0.08	Year
		0.365	24 hours

Source: DOE. Schedule-2, Rule 12, ECR of 1997 (Page 3123, Bangladesh Gazette, 28 August 1997).

Notes:

- (1) Sensitive area includes national monuments, health resorts, hospitals, archaeological sites, educational institutions and other government designated areas (if any).
- (2). Any industrial unit located not in a designated industrial area will not discharge such pollutants, which may contribute to exceed the ambient air quality above in the surrounding areas of category 'Ga' and 'Gha'.
- (3). Suspended particulate matters mean airborne particles of diameter of 10 micron or less.

2.7.1.2 Water Quality

Table 2.5 shows ambient water quality standard (inland surface water), and Table 2.6 shows environmental water quality standard (drinking water).

Table 2.5: National Standard for Inland Surface Water

No.	Best Practice Based Classification	pH	BOD mg/1	Dissolved Oxygen (DO), mg/l	Total Coliform Bacteria quantity/ml
a)	Potable water source supply after bacteria freeing only	6.5-8.5	2 or less	6 or above	50 or less
b)	Water used for recreation purpose	6.5-8.5	3 or less	5 or above	200 or less
c)	Potable water source supply after Conventional processing	6.5-8.5	3 or less	6 or above	5000 or less
d)	Water used for pisci-culture	6.5-8.5	6 or less	5 or above	5000 or less
f)	Water used for irrigation	6.5-8.5	10 or less	5 or above	1000 or less

Source: DOE.

BOD = biological oxygen demand, mg/l = milligram per liter, pH = negative decimal logarithm of the hydrogen ion activity in a solution

Notes:

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

Table 2.6: National Standard for Drinking Water

No.	Parameter	Unit	Standard Limit	WHO Guidelines
1	Aluminum	mg/l	0.2	0.2
2	Ammonia (NH ₃)	mg/l	0.5	-
3	Arsenic	mg/l	0.05	0.01
4	Barium	mg/l	0.01	0.7
5	Benzene	mg/l	0.01	0.01
6	BOD ₅ 20°C	mg/l	0.2	-
7	Boron	mg/l	1.0	0.5
8	Cadmium	mg/l	0.005	0.003
9	Calcium	mg/l	75	-
10	Chloride	mg/l	150-600	-
	Chlorinated Alkanes			-

No.	Parameter	Unit	Standard Limit	WHO Guidelines
11	Carbon Tetrachloride	mg/l	0.01	-
	1.1 Dichloroethylene	mg/l	0.001	-
	1.2 Dichloroethylene	mg/l	0.03	-
	Tetrachloroethylene	mg/l	0.03	-
	Trichloroethylene	mg/l	0.09	-
12	Chlorinated Phenols			-
	Pentachlorophenol	mg/l	0.03	-
	2.4.6 Trichlorophenol	mg/l	0.03	-
13	Chlorine (residual)	mg/l	0.2	-
14	Chloroform	mg/l	0.09	0.3
15	Chromium (hexavalent)	mg/l	0.05	-
16	Chromium (total)	mg/l	0.05	0.05
17	COD	mg/l	4	-
18	Coliform (fecal)	n/100 ml	0	-
19	Coliform (total)	n/100 ml	0	-
20	Color	Huyghens unit	15	-
21	Copper	mg/l	1	-
22	Cyanide	mg/l	0.1	-
23	Detergents	mg/l	0.2	-
24	DO	mg/l	6	-
25	Fluoride	mg/l	1	1.5
26	Hardness (as CaCO ₃)	mg/l	200-500	-
27	Iron	mg/l	0.3-1.0	-
28	Nitrogen (Total)	mg/l	1	-
29	Lead	mg/l	0.05	0.01
30	Magnesium	mg/l	30-35	-
31	Manganese	mg/l	0.1	0.4
32	Mercury	mg/l	0.001	0.006
33	Nickel	mg/l	0.1	0.07
34	Nitrate	mg/l	10	3
35	Nitrite	mg/l	Less than 1	-
36	Odor		Odorless	-
37	Oil & Grease	mg/l	0.01	-
38	pH		6.5-8.5	-
39	Phenolic compounds	mg/l	0.002	-
40	Phosphate	mg/l	6	-
41	Phosphorus	mg/l	0	-
42	Potassium	mg/l	12	-
43	Radioactive Materials (gross alpha activity)	Bq/l	0.01	-
44	Radioactive Materials (gross beta activity)	mg/l	0.1	-
45	Selenium	mg/l	0.01	-
46	Silver	mg/l	0.02	-
47	Sodium	mg/l	200	-
48	Suspended particulate matters	mg/l	10	-
49	Sulfide	mg/l	0	-
50	Sulfate	mg/l	400	-
51	Total dissolved solids	mg/l	1000	1000
52	Temperature	°C	20-30	-
53	Tin	mg/l	2	-
54	Turbidity	JTU	10	-

No.	Parameter	Unit	Standard Limit	WHO Guidelines
55	Zinc	mg/l	5	-

Source: DOE.

BOD = biological oxygen demand, mg/l = milligram per liter, ml = milliliter

Notes: In coastal area 1000. Reference: Bangladesh Gazette, Addendum, August 28, 1997.

2.7.2 Noise

As for noise, the standard limit is set for every category of zone class. Table 2.4 shows the Noise standard in Bangladesh.

Table 2.7: Bangladesh Standards for Noise

No	Zone Class	Limits in dBA	
		ECR	
		Day	Night
a)	Silent Zone	45	35
b)	Residential Zone	50	40
c)	Mixed Zone (this area is used combining residential, commercial and industrial purposes)	60	50
d)	Commercial Zone	70	60
e)	Industrial Zone	70	70

(Source: The Environmental Conservation Rules, 1997; IFC Environmental Health and Safety Guidelines, 2008)

Note:

(1) The day time is considered from 6 a.m. to 9 p.m. and the night time is from 9 p.m. to 6 p.m.

(2) From 9 at night to 6 morning is considered night time.

(3) Area within 100 meters of hospital or education institution or educational institution or government designated / to be designated / specific institution / establishment are considered Silent Zones. Use of motor vehicle horn or other signals and loudspeaker are forbidden in Silent Zone.

2.7.3 International Standards

The international standards for heavy metals of the river bed materials are given in Table 2.8.

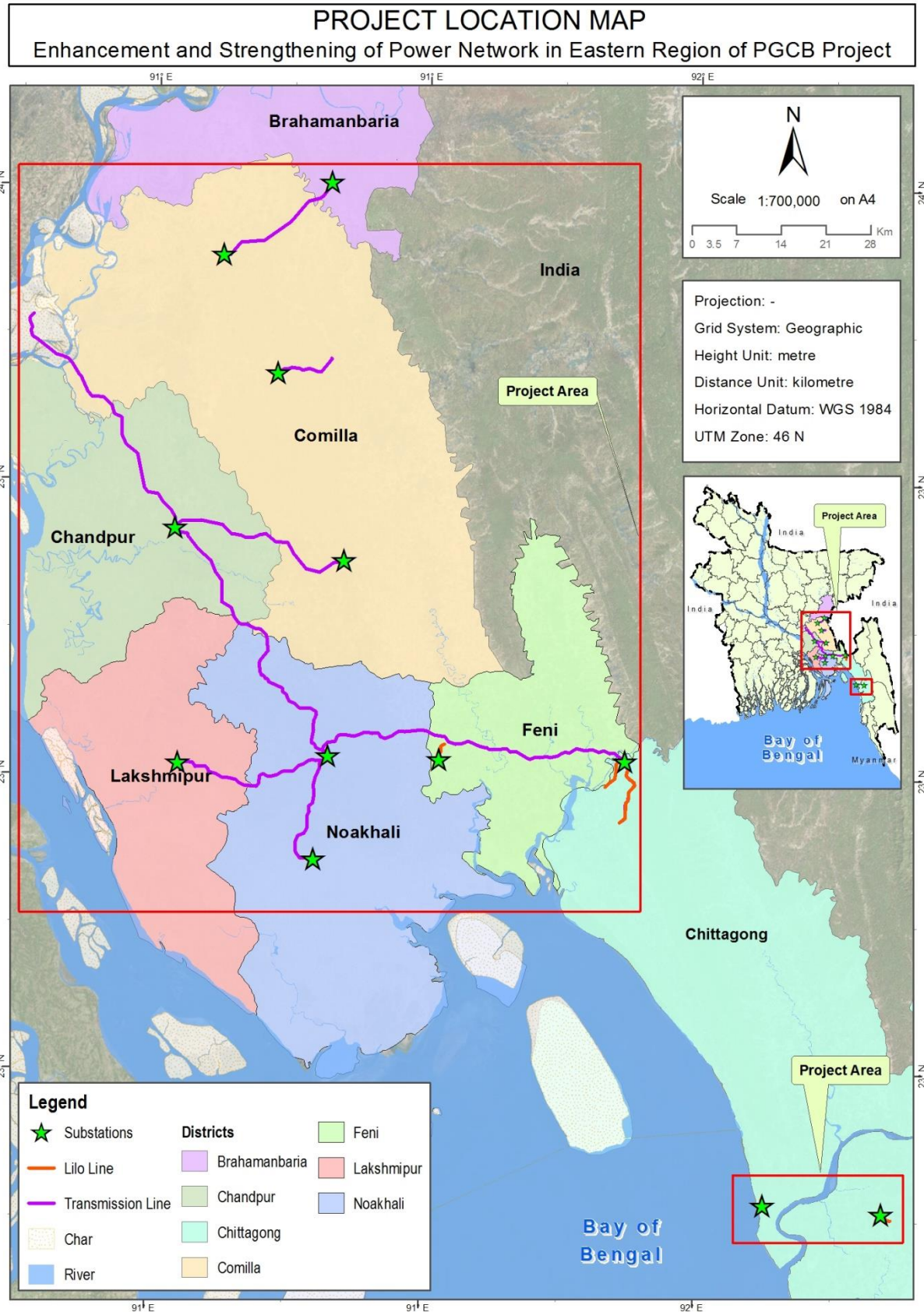
Table 2.8: USA EPA, 2000 Standard Value of Heavy Metals of River Bed Materials (Sand)

Parameters	Unit	Standard Values	Remarks
Lead (Pb)	mg/kg	128	
Cadmium (Cd)	mg/kg	4.98	
Chromium (Cr)	mg/kg	111	
Copper (Cu)	mg/kg	144	
Zinc (Zn)	mg/kg	459	
Manganese (Mn)	mg/kg	-	
Arsenic (As)	mg/kg	33	
Mercury (Hg)	mg/kg	1.06	
Selenium (Se)	mg/kg	-	

3 PROJECT DESCRIPTION

3.1 Project Location

The project components such as substations (12 numbers), transmission lines (total length is 283.64 km) and 11 LILO lines (toatal 44 km) are located in the 7 districts of Bangladesh. Among them six districts (such as Chittagong, Feni, Noakhali, Laxmipur, Comilla and Chandpur district) are in Chittagong division of the eastern region of PBCB's jurisdiction and Munshiganj district (small part of 45.09km long Gazaria (Munshiganj)-Kachua (Chandpur) TL is in Dhaka division (Figure 3.1). There are 12 subprojects of the substations, 8 subprojects of the TL and 8 subprojects of the LILO lines.



3.2 Project Components/Subprojects

The proposed project will have three components with the following estimated cost: 1) enhancement and strengthening of power network in eastern region (US\$ 440 million); 2) Technical assistance for institutional development and implementation support (US\$ 5 million); and 3) Equipment and tools for improved maintenance practice (US\$ 10 million). However, this EIA report is only for the first component of the main project and can be described as below.

This component will cover the following activities:

1. Two (2) nos. of 230/132kV substations and nine (9) nos. of 132/33kV substations will be built. 230/133kV substations are Chowmuhoni and Kachua. 132/33 kV substations are Kosba, Muradnagar, Chandina, Laksham, Laxmipur, Bashurhat, Maijdee, Patiya and New Mooring. Keeping in mind the scarcity of land in the project areas (due to high population density), all these substations are planned with GIS configuration. The 132/33kV New Mooring substation to be built on the western side of Chittagong City will become a 400/230/132/33kV power hub in future. The 132/33kV part will be built by this project but the land acquisition and layout planning will incorporate the future 400/230/132kV design. Some other 132/33kV substations will also be designed keeping provisions for upgradation to 230kV in future.
- 1 The only substation that will be replaced under this project is the Haliashahar 132/33kV air insulated substation (AIS). This substation is one of the oldest substations of PGCB and will be replaced by advanced gas insulated substation (GIS) after the commissioning of the New Mooring substation. This will require modification and extension of local 33kV and 11 kV network so that load at Haliashahar can be fed from New Mooring S/S during replacement works at Haliashahar.
- 2 A 230kV high capacity four circuit backbone transmission line (with twin Finch conductor per phase and only two circuits will be stringing now) has been planned through greater Comilla region (Korerhat– Chowmuhoni – Kachua-Gazaria) to make it the primary transmission backbone of this area for future. This line will supplement the existing 230kV double circuit line which is a low capacity (300 MW per circuit) line currently acting as the main transmission backbone between Comilla and Chittagong. Four (4) short distance 132kV double circuit lines are planned to be built to connect the new 132/33kV substations to the existing ones in Comilla and Noakhali area. Summary of the proposed scope of works under this project is given below (Table 3.1):

Table 3.1: Summary of Proposed Scope of Works

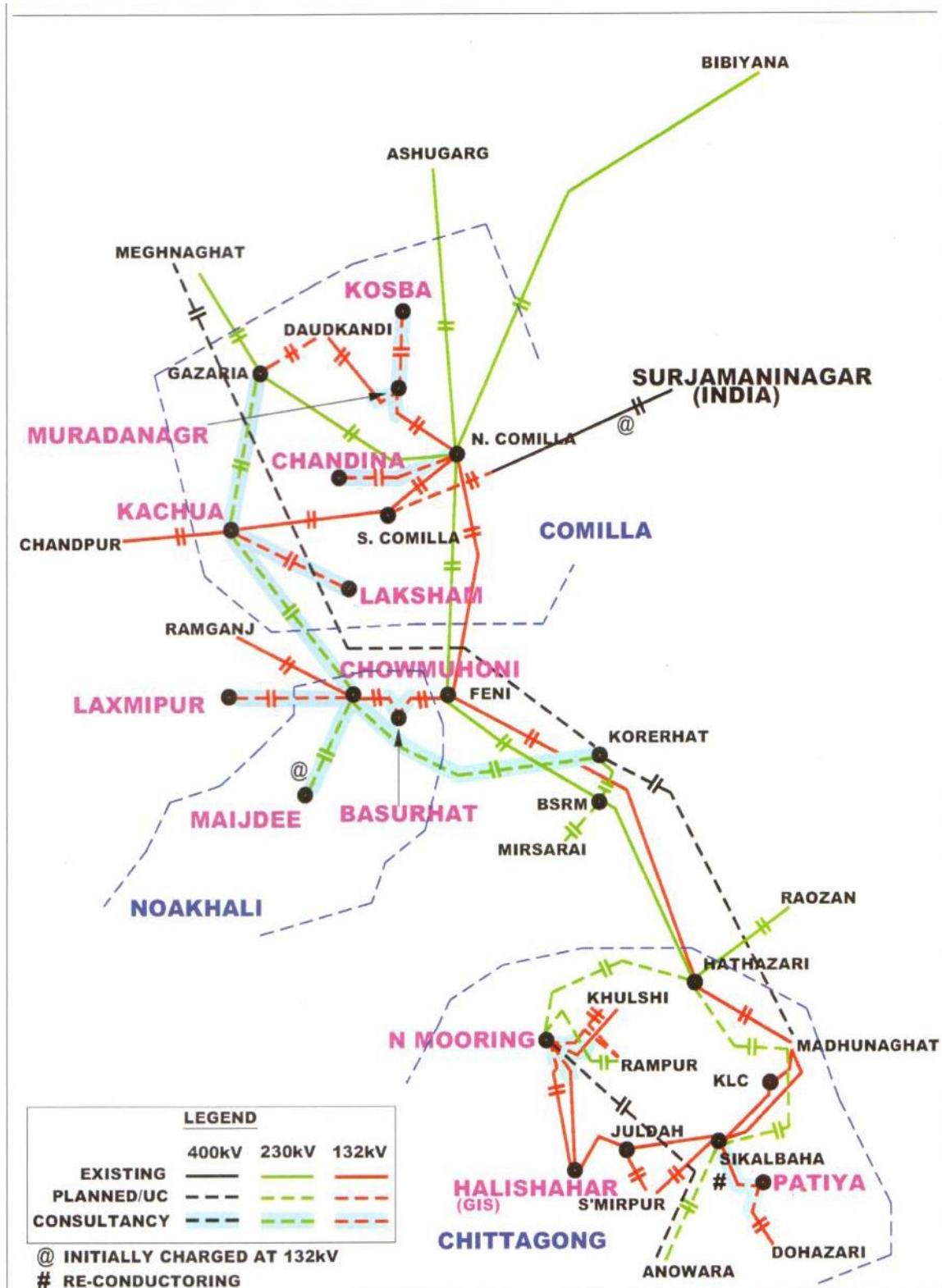
Transmission Lines		Substations	
Voltage level	Circuit Km	Voltage Level	No of S/S
230kV	386	230/132kV	2
132kV	266	132/33kV	10

About 283.642 km new transmission line (TL) involved with proposed 12 new substations. The following transmission systems are proposed under the project. The diagrammatic representation of the proposed transmission system is shown in Map 3.2.

Table 3.2: Details of the Proposed Project Components/Subprojects

Sl. No.	Name of the New Substations	Name of the Transmission Lines and LILO Lines
1	230/132 kV GIS Substation at Chowmuhoni	Chowmuhoni – Kachua 230 kV M/C Line- 49.05 km
2	230/132 kV GIS Substation at Kachua	Gazaria – Kachua 230 kV M/C Line - 45.09 km
3	132/33 kV GIS Substation at Muradnagar	LILO of Comilla (N) – Daukandi 132 kV D/C Line at Muradnagar – 0.5 km
4	132/33 kV GIS Substation at Laksham	Kachua- Laksham 132 kV D/C Line - 30.93 km(Four Circuit Tower with Twin Mallard Conductor)
5	132/33 kV GIS Substation at Maijdee	Chowmuhoni – Maijdee 230 kV D/C Line- 20.55 km
6	132/33 kV GIS Substation at Patiya	LILO of Dohazari – Sikalbaha 132 kV D/C Line at Patiya – 1.16 Km
7	132/33 kV GIS Substation at Chandina	Comilla (N) – Chandina 132 kV D/C Line - 9.85 km
8	132/33 kV GIS Substation at New Mooring (Anand Bazaar)	LILO of Haliashar- Khulsi 132 kV S/C (ckt-1, 2&3) Line at New Mooring-0.630 km
9	132/33 kV GIS Substation at Basurhat	Two Ckt LILO from Feni – Chowmuhoni 132 kV D/C line at Basurhat – 2.74 km
10	132/33 kV GIS Substation at Laxmipur	Chowmuhoni – Laxmipur 132 kV D/C Line - 27.38 km
11	132/33 kV GIS Substation at Kosba	Muradnagar – Kosba 132 kV D/C Line- 22.79 km
12	400/230 kV GIS Substation at Korerhat	Korerhat- Chowmuhoni 230 kV M/C Line- 52.73 km(Four Circuit Tower with Twin Mallard Conductor)
		LILO of Modunghat – Meghnaghat 400 kV D/C Line at Korerhat – 0.4 Km
		LILO of Comilla (N)/ Feni – BSRM/ Hathazari 230 kV D/C Line – 5.728 Km
		LILO of Feni/ Baroihat – Hathazari 132 kV D/C Line – 2.8 Km
		Extension of Mirsharai – BSRM 400 kV D/C Line to Korerhat – 11.314 Km

Note: *Initial capacity of 132/33kV substation was 50/75MVA but now it is 80/120MVA.



Map 3:2: Diagrammatic Representation of the proposed Transmission System

4 DESCRIPTION OF ENVIRONMENTAL BASELINE

4.1 General

The baseline condition of environmental quality in the locality of sub-project site serves as the basis for identification, prediction and evaluation of impacts. The baseline environmental quality is assessed through field studies within the impact zone for various components of the environment, viz. air, noise, water, land and socio-economic, etc.

Information of baseline environmental status of the project area is useful for impact assessment process of assessing and predicting the environmental consequences of the significant actions. Based on the existing environmental scenario, potential impacts of subprojects associated will be identified and accordingly management plan will be proposed in forthcoming sections. The baseline environmental conditions will help in comparing and to monitor the predicted negative and positive impacts resulting from the project during pre-construction, construction and operation phases. Significant action depicts direct adverse changes caused by the action and its effect on the health of the biota including flora, fauna and human being, socio-economic conditions, current use of land and resources, climate change aspects, physical and cultural heritage properties and biophysical surroundings. Baseline data generation of the following environmental attributes is essential in EIA studies.

Data/information was collected from secondary sources for the macro-environmental setting like climate (temperature, rainfall, humidity, and wind speed), topography, geology, soils etc. Firsthand information have been collected to record the micro-environmental features within and adjacent to the project corridor. Collection of primary/field data/information includes extrapolating environmental features on proposed subprojects design, tree inventories, location and measurement of socio-cultural features adjoining proposed subprojects. Ambient air, noise quality, surface water and ground/drinking water quality have been assessed based on measurement/testing as well as visual inspection to prepare a baseline database. Consultation was another source of information and to explain local environmental conditions, impacts, and suggestions, etc.

The following section describes the baseline environment in three broad categories:

- Physical Environment- factors such topography, geology, earthquake, climate and hydrology/drainage, environmental pollution, ;
- Biological Environment- factors related to life such as flora, fauna and ecosystem; and
- Socio-economic Environment- anthropological factors like demography, income, land use, land requirement and infrastructure.

As mentioned earlier in chapter 3, all the subprojects under the Enhancement and Strengthening of Power Network in Eastern Region (ESPNER) project of PGCB are located in six districts of Chittagong division one district of Dhaka Division. The environmental baseline chapter is described according to the classification, nature and primary observation during field survey. The subproject specific Environmental Baseline data of Substations (SS), Transmission Lines (TL) and LILO lines (LL) are given in the following Table 4.1.

Table 4.1: Environmental Baseline Data/Information of the Subprojects of SS and TL

Sl. No.	Subproject Site/Route	Location	Type of Land	Inundation during HFL	Topography	Earthquake Zone	Air	Av. Noise Level (dB)	Water Bodies in & crossing ROW	Trees in ROW	Major Fauna (mainly in SPIA)	EPA in ROW/ SPIA	Affected Land in ROW (acre)	Family (Nos)	CS in ROW of SS	Cultural Sites in SPIA	Traffic Condition on nearby Roads
Substations:																	
1	230/132 kV GIS at Chowmuhoni	Begumganj, Noakhali.	Partially 2 cropped agricultural land & partially fellow land	Yes	Flat Terrain	Zone-2	Dusty	65.32	No		sparrow, kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, bengal monitor, common house lizard, snakes, frog etc.	No	5	0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
2	230/132 kV GIS at Kachua	Kachua, Chandpur	3 cropped agricultural land	Yes	Flat Terrain	Zone-2	Good	62.84	No		sparrow, kingstork, dove, crow, fox, mouse, grew musk, common house lizard, snakes, frog etc.	No	5	0	0	Mosque at about 200m east	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
3	132/33 kV GIS at Muradnagar	Muradnagar, Comilla	3 cropped agricultural land	Yes	Flat Terrain	Zone-2	Good	57.93	No		shalik, sparrow, kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, , bengal monitor, common house lizard, snakes, frog	No	5	0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
4	132/33 kV GIS at Laksham	Laksham, Comilla	3 cropped agricultural land	Yes	Flat Terrain	Zone-2	Good	56.34	No		shalik, sparrow, kingstork,	No	2	0	0	0	trucks, buses, microbus, sedan cars, taxi,

Sl. No.	Subproject Site/Route	Location	Type of Land	Inundation during HFL	Topography	Earthquake Zone	Air	Av. Noise Level (dB)	Water Bodies in & crossing ROW	Trees in ROW	Major Fauna (mainly in SPIA)	EPA in ROW/ SPIA	Affected Land in ROW (acre)	Family (Nos)	CS in ROW of SS	Cultural Sites in SPIA	Traffic Condition on nearby Roads
											dove, crow, fox, mouse, shrew, squirrel, , bengal monitor, common house lizard, snakes, frog etc.						vans, motorbikes etc.
5	132/33 kV GIS at Maijdee	Maijdee, Noakhali	2 cropped agricultural land	Not	Flat Terrain	Zone-2	Good	66.88	No		sparrow, kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, common house lizard, snakes, frog etc.	No	5	0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
6	132/33 kV GIS at Patiya	Patiya, Chittagong	2 cropped agricultural land	Not	Flat Terrain	Zone-1	Dusty	67.23	No		shalik, sparrow, kingstork, dove, crow, fox, mouse, shrew, back, bengal monitor, snakes, frog	No	5	0	.0	Mosque at 200m east of the SS	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
7	132/33 kV GIS at Chandina	Debidwar, Comilla	3 cropped agricultural land	Yes	Plain lands	Zone-2	Dusty	71.51	No	420	shalik, sparrow, kingstork, dove, crow, fox, mouse, grew musk, squirrel, stripped keel back, common house lizard, snakes, frog	No	2	0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.

Sl. No.	Subproject Site/Route	Location	Type of Land	Inundation during HFL	Topography	Earthquake Zone	Air	Av. Noise Level (dB)	Water Bodies in & crossing ROW	Trees in ROW	Major Fauna (mainly in SPIA)	EPA in ROW/ SPIA	Affected Land in ROW (acre)	Family (Nos)	CS in ROW of SS	Cultural Sites in SPIA	Traffic Condition on nearby Roads
											etc.						
8	132/33 kV GIS at New Mooring/Anand Bazar	JL. 1, Mouza: Madha Halishahar, Thana: Bandar, District: Chittagong	2 cropped agricultural land	Not	Undulation	Zone-1	Dusty	57.55	No		shalik, sparrow, kingstork, dove, crow, fox, mouse, , squirrel, common house lizard, snakes, frog	No	20	0	0	2 Mosques, and a School at ch 400	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
9	132/33 kV GIS at Bashurhat	Bashurhat, Daganbhuiyan, Noakhali	3 cropped agri. land	Not	Flat terrain	Zone-2	Good	57.55	No	136	shalik, sparrow, dove, crow, fox, mouse, , squirrel, bengal monitor, common house lizard, snakes, frog etc.	No	2	0	0	Mosque at 100m east.	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
10	132/33 kV GIS at Laksmipur	Laksmipur Sadar, Laksmipur	2 cropped agricultural land	Yes	Flat Terrain	Zone-2	Dusty	68.35	No		shalik, sparrow, , fox, mouse, grew musk shrew, Bengal monitor, common house lizard, snakes, frog	No	5	0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
11	132/33 kV GIS at Kosba	Kosba, Brahmanbaria	2 cropped agricultural land	Yes	Flat Terrain	Zone-2	Dusty	59.64	No		sparrow, kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, snakes, frog	No	5	0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
12	400/230 kV GIS at Korerhat	Korerhat, Mirsarai, Chittagong	2 cropped agricultural land	Not	Flat terrain	Zone-2	Good	70.57	Small seasonal Khal	2945	shalik, sparrow, , crow, fox,	No	25	0	0	0	trucks, buses, microbus, sedan cars, taxi,

Sl. No.	Subproject Site/Route	Location	Type of Land	Inundation during HFL	Topography	Earthquake Zone	Air	Av. Noise Level (dB)	Water Bodies in & crossing ROW	Trees in ROW	Major Fauna (mainly in SPIA)	EPA in ROW/ SPIA	Affected Land in ROW (acre)	Family (Nos)	CS in ROW of SS	Cultural Sites in SPIA	Traffic Condition on nearby Roads
											mouse, shrew, squirrel, , common house lizard, snakes, frog etc.						vans, motorbikes etc.
Transmission Line																	
1	Chowmuhoni – Kachua 230 kV Double Circuit TL	Started at Chowmohuni substation, UZ: Chowmohuni, Dt:Noakhali and ended at Kachua substation, UZ: Kachua, Dist.: Chandpur	Two to three cropped agricultural lands	Yes	Flat	Zone-2	Good	-	30 Khals & 10 Ponds	2836	kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, stripped keel back, common house lizard, snakes, frog	No	149.42	0	0	A mosque at distance about 0+030	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
2	Kachua-Gazaria 230 kV TL	Started at Kachua substation, UZ: Kachua, Dt: Chandpur and ended at Gazaria substation, UZ: Gazaria, Dist.: Munshiganj	- Two to three cropped agricultural lands	Yes	Flat	Zone-2	Good	-	12Khals & 7Ponds	2544	kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, stripped keel back, common house lizard, snakes, frog	No	132.00	0	0	o	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
3	Kachua-Laksham 132 kV TL	Started at Kachua substation, UZ: Kachua Dt: Chandpur and ended at Laksham substation, UZ: Laksham, Dist.: Comilla	- Two to three cropped agricultural lands	Yes	Flat	Zone-2	Good	-	Khals & Ponds	2990	kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, stripped keel back, common house lizard, snakes, frog	No	101.46	0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
4	Chowmuhoni –	Started at	- Two to	Yes	Flat	Zone-2	Good	-	6Khals	1795	kingstork, ,	No	63.04	0	o	0	trucks, buses,

Sl. No.	Subproject Site/Route	Location	Type of Land	Inundation during HFL	Topography	Earthquake Zone	Air	Av. Noise Level (dB)	Water Bodies in & crossing ROW	Trees in ROW	Major Fauna (mainly in SPIA)	EPA in ROW/ SPIA	Affected Land in ROW (acre)	Family (Nos)	CS in ROW of SS	Cultural Sites in SPIA	Traffic Condition on nearby Roads
	Maijdee 230 kV Double Circuit TL	Chowmohuni substation, UZ: Chowmohuni, Dt:Noakhali and ended at Maidee substation, , UZ: Chowmohuni, Dt:Noakhali	three cropped agricultural lands						&5Ponds		crow, fox, mouse, grew musk shrew, squirrel, , common house lizard, snakes, frog .						microbus, sedan cars, taxi, vans, motorbikes etc.
5	Comilla – Chandina 132 KV DC TL	Started at Comilla (North) substation Dt:Comilla and ended at Chandina substation, UZ: Chandina, Dist.: Comilla	- Two to three cropped agricultural lands	Yes	Flat	Zone-2	Good	-	1 khal	No	kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, stripped keel back, bengal monitor, snakes, frog	No	33.49	0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
6	Chowmuhoni – Laxmipur 132 kV Double Circuit TL	Started at Chowmohuni substation, UZ: Chowmohuni, Dt:Noakhali and ended at Laxmipur substation, Dist.: Laxmipur	- Two to three cropped agricultural lands	Yes	Flat	Zone-2	Good	-	12Khals &7Ponds	1740	kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, bengal monitor, common house lizard, snakes, frog	No	94.56	0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
7	Muradnagar – Kosba 132 KV DC TL	Started at Muradnagar substation, UZ: Muradnagar, Dt: Comilla and ended at Kosba substation,	Two to three cropped agricultural lands -	Yes	Flat	Zone-2	Good	-	14Khals &4Ponds	337	kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, stripped keel back, bengal monitor,	No	68.95	0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.

Sl. No.	Subproject Site/Route	Location	Type of Land	Inundation during HFL	Topography	Earthquake Zone	Air	Av. Noise Level (dB)	Water Bodies in & crossing ROW	Trees in ROW	Major Fauna (mainly in SPIA)	EPA in ROW/ SPIA	Affected Land in ROW (acre)	Family (Nos)	CS in ROW of SS	Cultural Sites in SPIA	Traffic Condition on nearby Roads
		UZ: Kosba, Dist.: B. Baria.									common house lizard, snakes, frog						
8	Korerhat-Chowmuhoni 230KV MC TL	Started at Korerhat substation, UZ: Mirersorai, Dt: CTG and ended at Chowmuhoni substation, UZ: Chowmuhoni, Dist.: Noakhali.	Two to three cropped agricultural lands	Not	Flat	Zone-2	Good	-	30Khals & 10Ponds	8010	kingstork, dove, crow, fox, mouse, shrew, squirrel, stripped keel back, bengal monitor, , snakes, frog	No	160.56	0	0	A mosque at 40m distance at ch 49+250 at R/S and a graveyard at 25 m distance at L/S at Ch 10+000.	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
LILO Lines:																	
1	LILO of 132 KV DC Feni-Chowmuhani, L=2.915km,	0+000-2+915	Two to three cropped agricultural lands	Yes	Flat	Zone- 2	Good	-	30 Khals & 10 Ponds	No	dove, crow, fox, mouse, grew musk shrew, squirrel, stripped keel back, common house lizard, snakes, frog	No		0	0	A mosque at distance at ch 0+030	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
2	LILO of 230 KV DC Korerhat – Comilla, L=5.735	0+000-5+191	- Two to three cropped agricultural lands	Yes	Flat	Zone-2	Good	-	12Khals & 7Ponds	No	kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, common house lizard, snakes, frog	No		0	0	o	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
3	LILO of 132 KV DC Korerhat-Hathazari-Feni	0+000-3+327	- Two to three cropped agricultural lands	Yes	Flat	Zone-1	Good	-	Khals & Ponds	No	dove, crow, fox, mouse, grew musk shrew, squirrel, stripped keel	No		0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.

Sl. No.	Subproject Site/Route	Location	Type of Land	Inundation during HFL	Topography	Earthquake Zone	Air	Av. Noise Level (dB)	Water Bodies in & crossing ROW	Trees in ROW	Major Fauna (mainly in SPIA)	EPA in ROW/ SPIA	Affected Land in ROW (acre)	Family (Nos)	CS in ROW of SS	Cultural Sites in SPIA	Traffic Condition on nearby Roads
	6										back, common house lizard, snakes, frog						
4	.LILO of 8132 KV DC Dohazari-Shikalbaha	0+000-0+750	- Two to three cropped agricultural lands	Yes	Flat	Zone-1	Good	-	Seasonal ponds/khals	No	crow, fox, mouse, grew musk shrew, squirrel, , common house lizard, snakes, frog .	No		0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
5	LILo of 132 KV DC Halishahar-Kulshi	0+000-1+105	- Two to three cropped agricultural lands	Yes	Flat	Zone-1	Good	-	Seasonal ponds/khals	No	kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, stripped keel back, bengal monitor, snakes, frog	No		0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
6	LILo of 400 KV DC Korerhat-BSRM	0+000-11+850	- Two to three cropped agricultural lands	Yes	Undulated	Zone-2	Good	-	Seasonal ponds/khals	, small to medium size forest trees (not densely) from ch 3+450 –	kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, common house lizard, snakes, frog	No		0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.

Sl. No.	Subproject Site/Route	Location	Type of Land	Inundation during HFL	Topography	Earthquake Zone	Air	Av. Noise Level (dB)	Water Bodies in & crossing ROW	Trees in ROW	Major Fauna (mainly in SPIA)	EPA in ROW/ SPIA	Affected Land in ROW (acre)	Family (Nos)	CS in ROW of SS	Cultural Sites in SPIA	Traffic Condition on nearby Roads
										11+700							
7	.LILO of 132 KV DC Modhunaghat-Meghnaghat	000-0+775	Two to three cropped agricultural lands -	Yes	Flat	Zone-2	Good	-	Seasonal ponds/khals		kingstork, dove, crow, fox, mouse, grew musk shrew, squirrel, stripped keel back, bengal monitor, common house lizard, snakes, frog	No		0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.
8	LILo of 400 KV DC Comilla(N)-Daudkandi)	0+000-0+424	Two to three cropped agricultural lands -	Not	Flat	Zone-2 & 3	Good	-	Seasonal ponds/khals		kingstork, dove, crow, fox, mouse, shrew, squirrel, stripped keel back, bengal monitor, , snakes, frog	No		0	0	0	trucks, buses, microbus, sedan cars, taxi, vans, motorbikes etc.

Source: Literature Review, Top survey, SES & Environmental Survey in 2017.

4.2 Chittagong Division

Chittagong Division area 33771.18 sq km, located in between 20°43' and 24°16' north latitudes and in between 90°32' and 92°41' east longitudes. It is bounded by Dhaka and Sylhet divisions on the north, Bay of Bengal and Arakan (Myanmar) on the south, Mizoram, Tripura states of India and Chin state of Myanmar on the east, Dhaka and Barisal divisions on the west. There are many lofty hills in Rangamati, Khagrachhari, Bandarban and in the eastern part of Chittagong districts. A map of Chittagong division is shown is Figure 4.1.

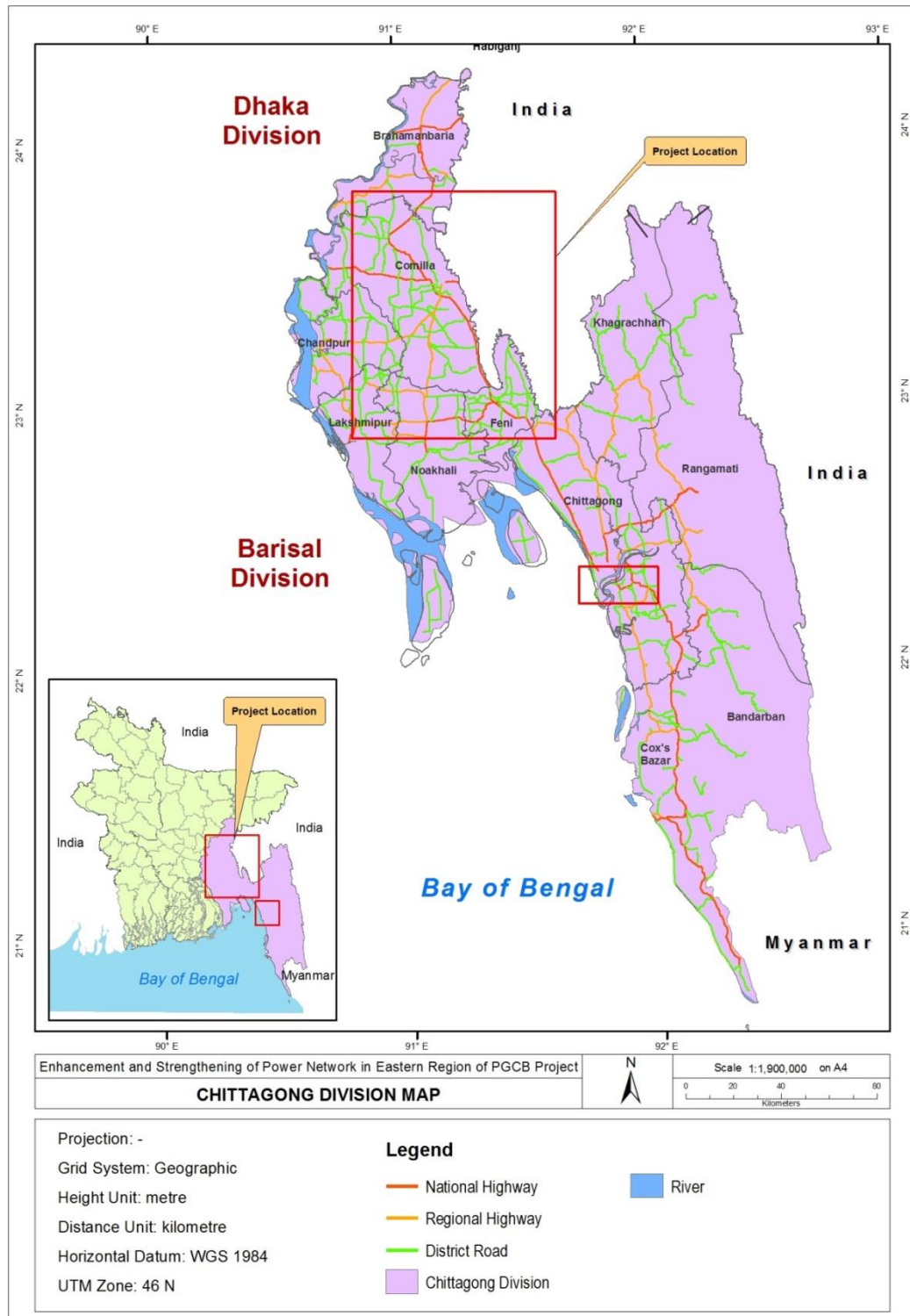


Figure 4.1: Map of Chittagong Division and the Subprojects Location

4.3 Physical Environment

4.3.1 Climate

The Project area has a tropical monsoon climate with four seasons: dry or winter season (December–February); pre-monsoon or hot season (March–May); monsoon or rainy season (June–September); and post-monsoon or autumn season (October–November). Although less than half of Bangladesh lies within the tropics, the presence of the Himalaya mountain range has created a tropical macroclimate across most of the east Bengal land mass. Bangladesh can be divided into seven climatic zones. According to the classification, the project areas are located in the south-central and south-eastern region climatic zones (Figure 4.2).

South-Central Zone: In this zone rainfall is abundant, being above 1,900 mm. The range of temperature is, as can be expected, much less than to the west, but somewhat more than in South-eastern zone. This is a transitory zone between the South-eastern, North-western and South-western zones and most of the severe hail storms, nor'westers and tornadoes are recorded in this area.

South-Eastern Zone: It comprises the Chittagong sub-region and a strip of land extending from southwest Sundarbans to the south of Comilla. The hills over 300m in height have north-eastern zone climate. The rest of the area has a small range of temperature, rarely goes over a mean of 320 °C and below a mean of 130 °C. Rainfall is heavy, usually over 2,540 mm. In winter dew fall is heavy.

Like other parts of the country, the project areas are heavily influenced by the asiatic monsoon, and it has these three distinct seasons:

- Pre-monsoon hot season (from March to May),
- Rainy monsoon season (from June to October), and
- Cool dry winter season (from November to February).

The pre-monsoon hot season is characterized by high temperatures and thunderstorms. April is the hottest month in the country with mean temperatures ranging from 27°C in the east and south, to 31°C in the west-central part of the country. After April, increasing cloud-cover reduces the temperature. Wind direction is variable during this season, especially during the early part. Rainfall, mostly caused by thunderstorms, at this time can account for 10 to 25 percent of the annual total.

The rainy monsoon season is characterized by southerly or south-westerly winds, very high humidity, heavy rainfall and long periods of consecutive days of rainfall. The monsoon rain is caused by a tropical depression that enters the country from the Bay of Bengal. About 90% of the annual precipitation occurs during the five-month monsoon season from May to September.

The cool dry season is characterized by low temperatures, cool air blowing from the west or northwest, clear skies and meager rainfall. The average temperature in January varies from 17°C in the south west and south-eastern parts of the country to 20°C to 21°C in the coastal areas. Minimum temperatures in the extreme in late December and early January reach even in between 7°C to 8°C.

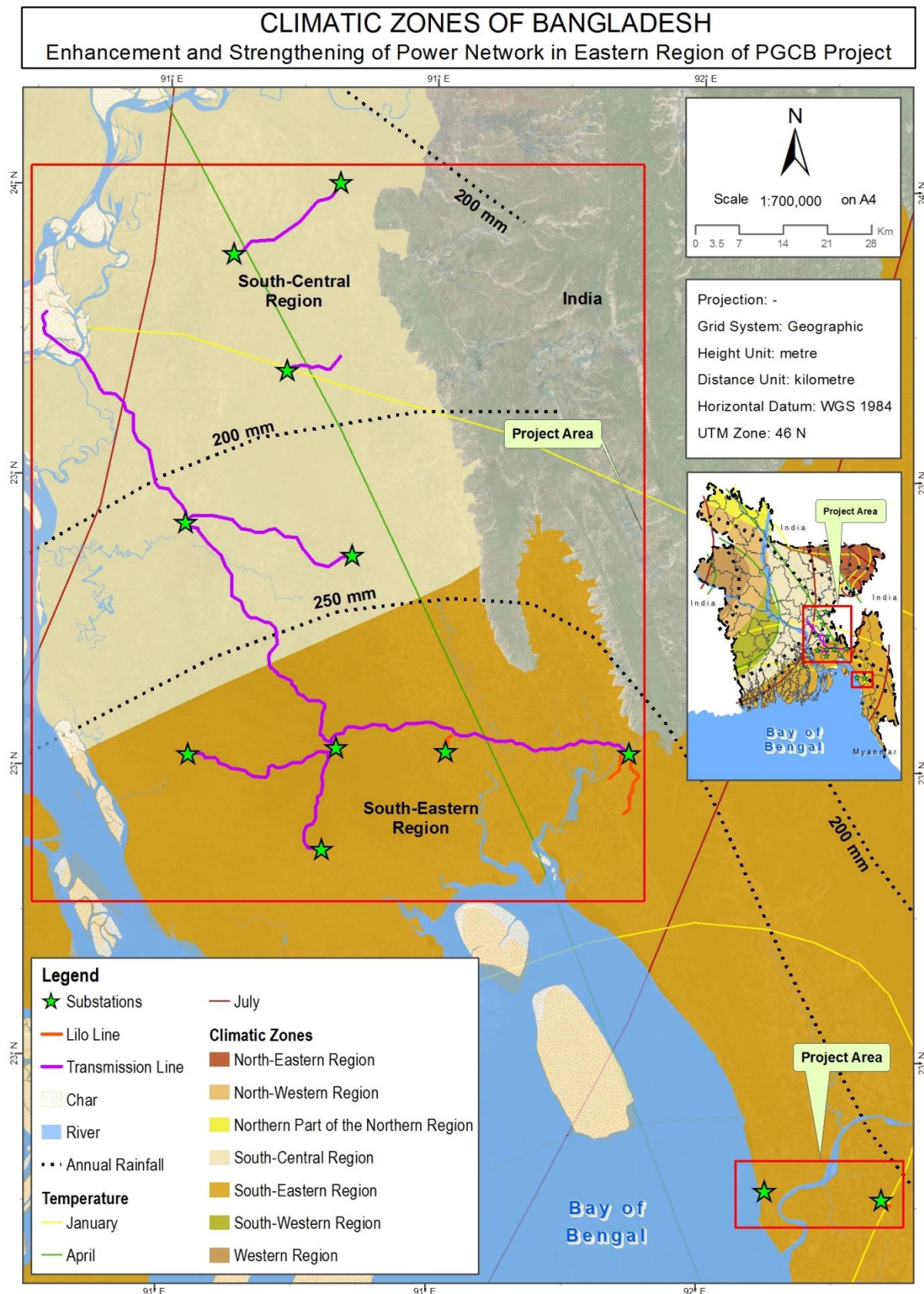


Figure 4.2: Climatic Zones of Bangladesh

To define meteorological conditions in and around the proposed construction area of the Project, temperature, rainfall, humidity and wind data were collected. Long-term average climatic data (1961-2016) collected from Comilla, Feni and Sitakunda Weather Stations of the Bangladesh

Meteorological Department (BMD) reflect the expected South-Central and South-Eastern Zone weather pattern as outlined below in tabular form.

	Comilla	Feni	Sitakunda
Average Annual Maximum Temperature (1961-2015)	31.07 (°C)	30.80 (°C)	31.2 (°C)
Average Annual Minimum Temperature (1961-2015)	17.50(°C)	18.20 (°C)	18.80 (°C)
Average Annual Rainfall (1961-2015)	170.09 mm	216.90mm	261.88 mm
Average Annual Relative Humidity (1961-2015)	79.74%	79.20%	78.48%

Temperature - Bangladesh has warm temperatures throughout the year, with relatively little variation from month to month (BMD). Figure 4.3 to Figure 4.5 shows the mean maximum and minimum air temperature (during 1961-2015) of Comilla, Feni and Sitakunda. As temperature record shows, May is the warmest month with average temperatures of 32.5, 32.1 and 32.2°C respectively these three locations. Although in short spell, there exists a winter season in Bangladesh from December to February. The average winter maximum temp is 30.1°C and minimum is 11.8°C. As recorded, January is the coolest month in Comilla, Feni and Sitakunda with temperatures averaging near 12.0, 12.4, and 11.8°C respectively.

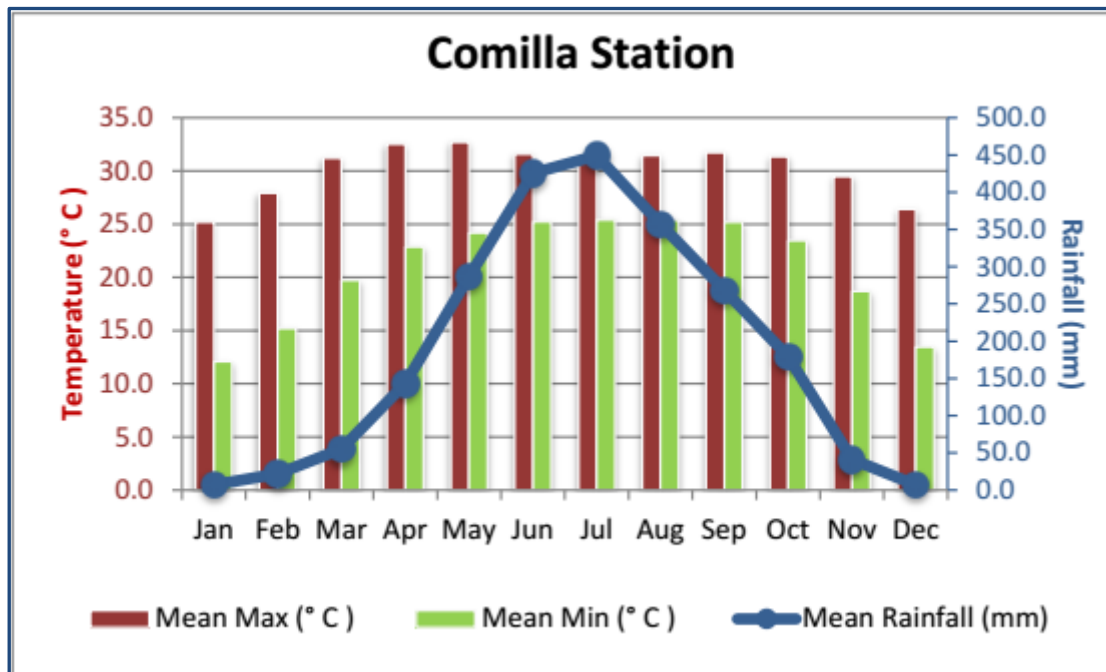


Figure 4.3: Mean Monthly Maximum & Minimum Temperature and Total Rainfall in Comilla Station (1961-2015)

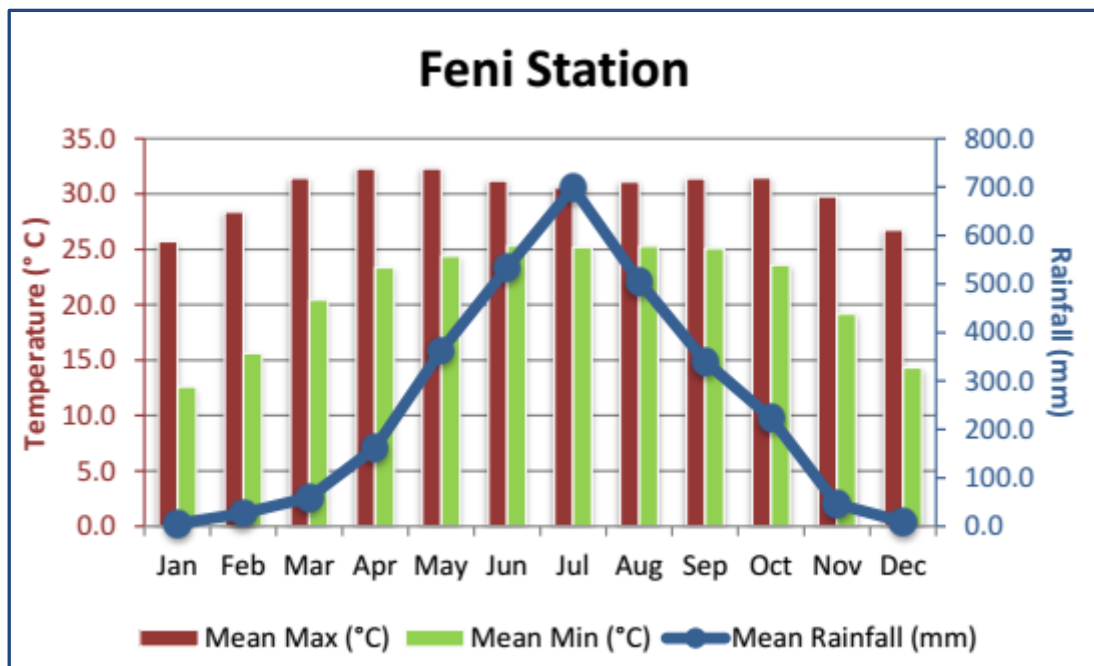


Figure 4.4: Mean Monthly Maximum & Minimum Temperature and Total Rainfall in Feni Station (1973-1915)

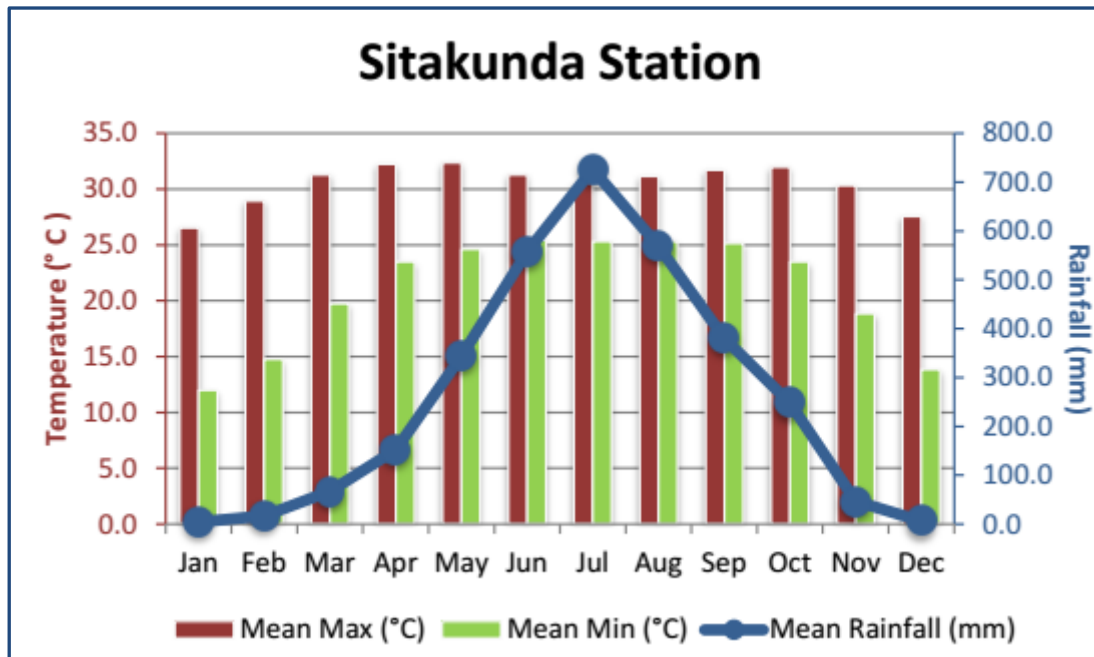


Figure 4.5: Mean Monthly Maximum & Minimum Temperature and Total Rainfall in Sitakunda Station (1961-2015)

Rainfall - Heavy rainfall is characteristic of Bangladesh frequently causing flood across the country or at local scale. With the exception of the relatively dry western region of Rajshahi, where the annual rainfall is about 1,600 mm, most parts of the country receive at least 2,300 mm of rainfall per year. About 80% of Bangladesh's rain falls during the monsoon season. Maximum rainfall occurs during May to September and the lowest rainfall occurs in November to February during winter season. Figure 4.3 to Figure 4.5 show that July wettest month according to records in Comilla, Feni and Sitakunda with average rainfall of 449.1mm, 698.8mm and 726.3 mm. No or minimum rainfall were recorded during the months of November, December and January. About 88% rainfall occurs during the period from May to October; of which about 36% pours during June – July.

Relative Humidity - Humidity levels are consistently very high during the monsoon season, and drop significantly for a relatively short period at the end of the dry season. Sunshine levels are low during

the monsoon, but from November to May are consistently high. In the project area the relative humidity is the lowest (69%) during December to March, and from April there is a steady increase till July (Figure 4.6).

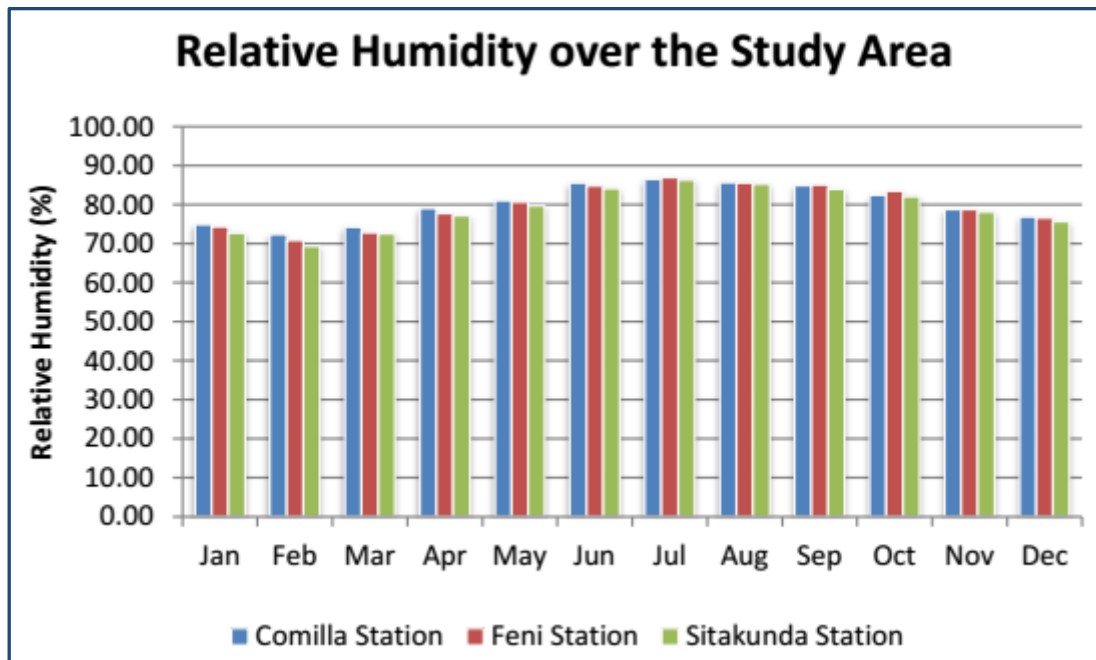


Figure 4.6: Mean Monthly Relative Humidity over the Study Area (1961-2016)

Wind Speed and Wind Direction - Wind could be the biggest and most influential weather factor. So it is extremely important to know the direction and velocity. The Wind Rose model is used to understand wind factors. Monthly prevailing wind data (wind speed and wind directions) were collected from Comilla, Feni and Sitakunda substations for the period of 1961-2012 and analysed to determine the distribution of wind force within the study area. These data were then used to formulate the wind rose (Figure 4.7 to Figure 4.9) which provides an overview of prevailing wind conditions within the survey area.

Historical wind data (wind speed, wind direction) shows that the wind speed is at a maximum in the early part of the monsoon, but drops substantially by the beginning of the dry season and is assumed to reflect the Project corridor conditions.

In Comilla (Figure 4.7), the long arrows or petal indicates the wind blows more frequently with a speed range between 0.5-11.1m/s from south to north direction and comprises nearly 65percent wind of the data period. It is recorded that the prevailing wind speeds mostly remain in the range of 1.7-9.4m/s. But in the winter months it remains in the range of 1.6-3.6m/soccasionally rising up to 10.8m/s. The highest speed is recorded as 14m/sin the month of April, 1977among the data period of 1961-2012 blowing from south direction.

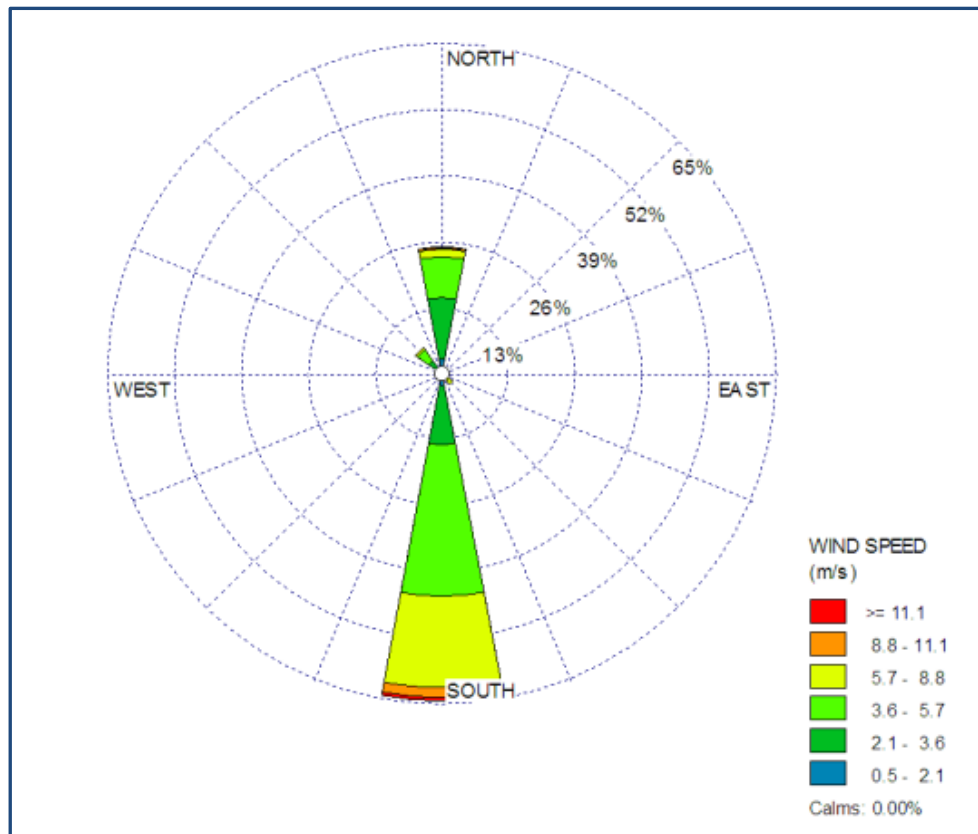


Figure 4.7: Comilla Meteorological Substation

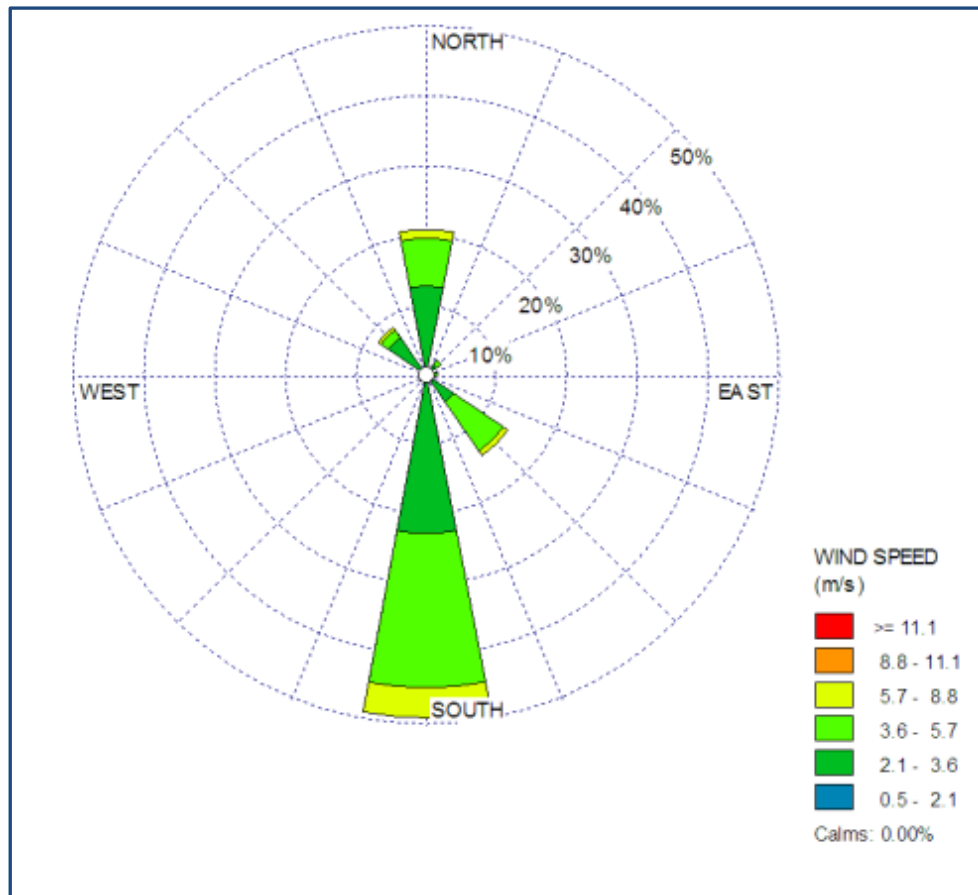


Figure 4.8: Feni Meteorological Substation

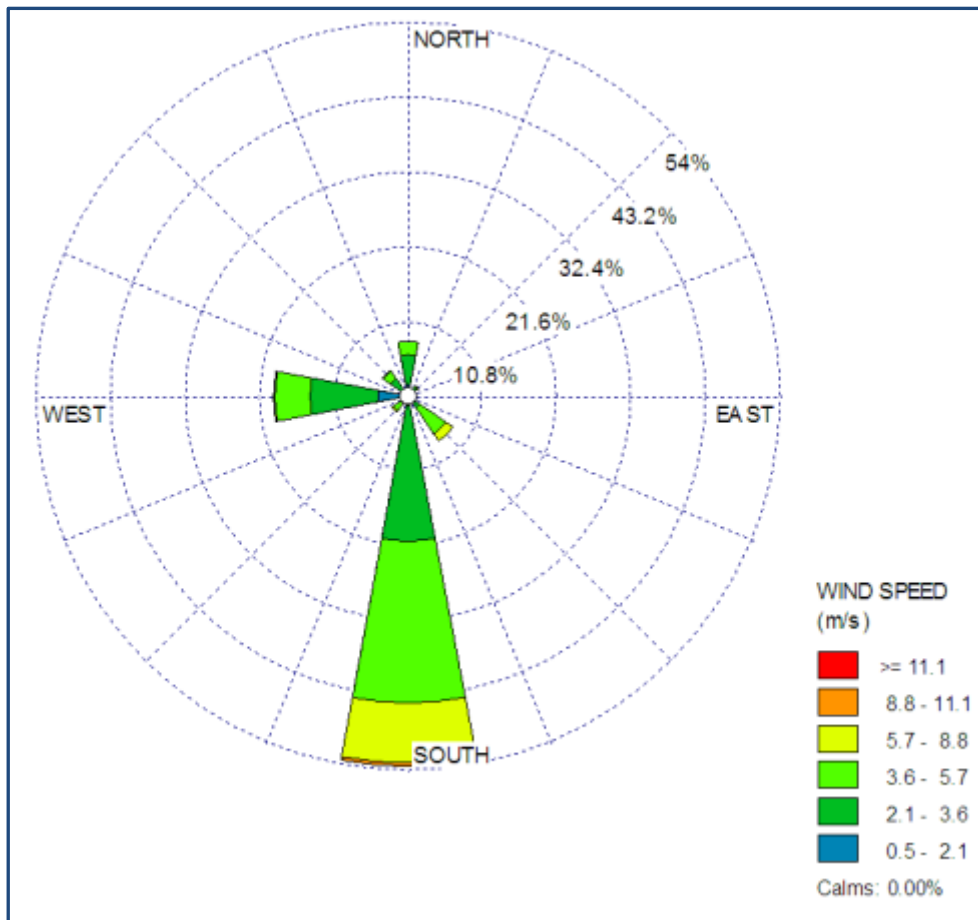


Figure 4.9: Sitakunda Meteorological Substation

In Feni the long arrows or petal indicates that wind blows mostly 2.1-8.8m/s from south to north direction comprising nearly 50percent wind of the data period (Figure 4.8). It is recorded that the wind speeds mostly remain in the range of 2.2-5.7m/s. But in the winter months it remains in the range of 2-2.8m/s occasionally rising up to 7.6m/s. The highest speed is recorded as 7.6m/s in the month of February, 1993 among the data period of 1973-2012 blowing from south direction.

For Sitakunda station, the long arrows or petal indicates that wind blows more frequently with a dominant speed range between 2.1-11.1m/s from the south direction and which comprises nearly 54 percent wind of the data period (Figure 4.9). It is recorded that the wind speeds mostly remain in the range of 1.8- 7.2m/s. But in the winter months it remains in the range of 1.3-2.9m/s occasionally rising up to 6.4m/s. The highest speed is recorded as 9.8m/s in the month of May, 1977among the data period of 1977-2012 blowing towards south and southeast directions.

4.3.2 Physiographic Features

The Chittagong division as well as the subproject areas of the SS, TL & LL in this division comprises the following physiographic units within the project areas (Figure 4.6).

Middle Meghna Floodplain- The floodplain of this river occupies a low-lying landscape of broad islands and many broad meandering channels which formed part of the Brahmaputra before it abandoned this channel when it changed course into the Jamuna two centuries ago. The Meghna sediments are mainly silty and clays and sandy Brahmaputra sediments occur at the surface on some ridges in the north. The seasonal flooding from the Meghna is mainly deep. The basin sites are submerged early and drain late.

Old Meghna Estuarine Floodplain- The landscape in this extensive unit is quite different from that on river and tidal floodplains. The relief is almost level, with little difference in elevation between ridges and basins. Natural rivers and streams are far apart in the southern part and drainage is provided by a network of man-made canals (khal). The sediments are predominantly deep and silty, but a shallow clay layer in some basin centres overlies them. Seasonal flooding is mainly deep, but it is shallow in the southeast. Some basin centres stay wet throughout the dry season. Virtually everywhere, this flooding is by rainwater ponded on the land when external rivers flow at high levels; the exceptions are the narrow floodplains alongside small rivers (such as the Gumti) which cross the unit from adjoining hill and piedmont areas.

Young Meghna Estuarine Floodplain- This sub-unit occupies almost the level land within and adjoining the Meghna estuary. It includes both island and mainland areas. New deposition and erosion are constantly taking place on the margins, continuously altering the shape of the land areas. The sediments are deep silts, which are finally stratified and are slightly calcareous. In many, but not all parts, the soil surface becomes saline to varying degrees in the dry season. Seasonal flooding is mainly shallow, but fluctuates tidally, and is caused mainly by rainwater or non-saline river water. Flooding by salt water occurs mainly on the lamed margins and during exceptional high tides during the monsoon; also when storm surges associated with tropical cyclones occur.

Chittagong Coastal Plain- The plain along the coast extends from the Feni River to the mouth of the Matamuhuri delta, a distance of 121 km. It comprises gently sloping piedmont plains near the hills, river floodplains alongside the Feni, Karnafuli, Halda and other rivers, tidal floodplains along the lower courses of these rivers, a small area of a young estuarine floodplain in the north, adjoining sub-regional young Meghna estuarine floodplain, and sandy beach ridges adjoining the coast in the south. Sediments near the hills are mainly silty, locally sandy, with clays more extensive in floodplain basins. The whole of the mainland area is subjected to flash floods. Flooding is mainly shallow and fluctuates in depth with the tide (except where this is prevented by river or coastal embankments). The average daily rise in the tide is about two metres. Some soils on tidal and estuarine floodplains become saline in the dry season.

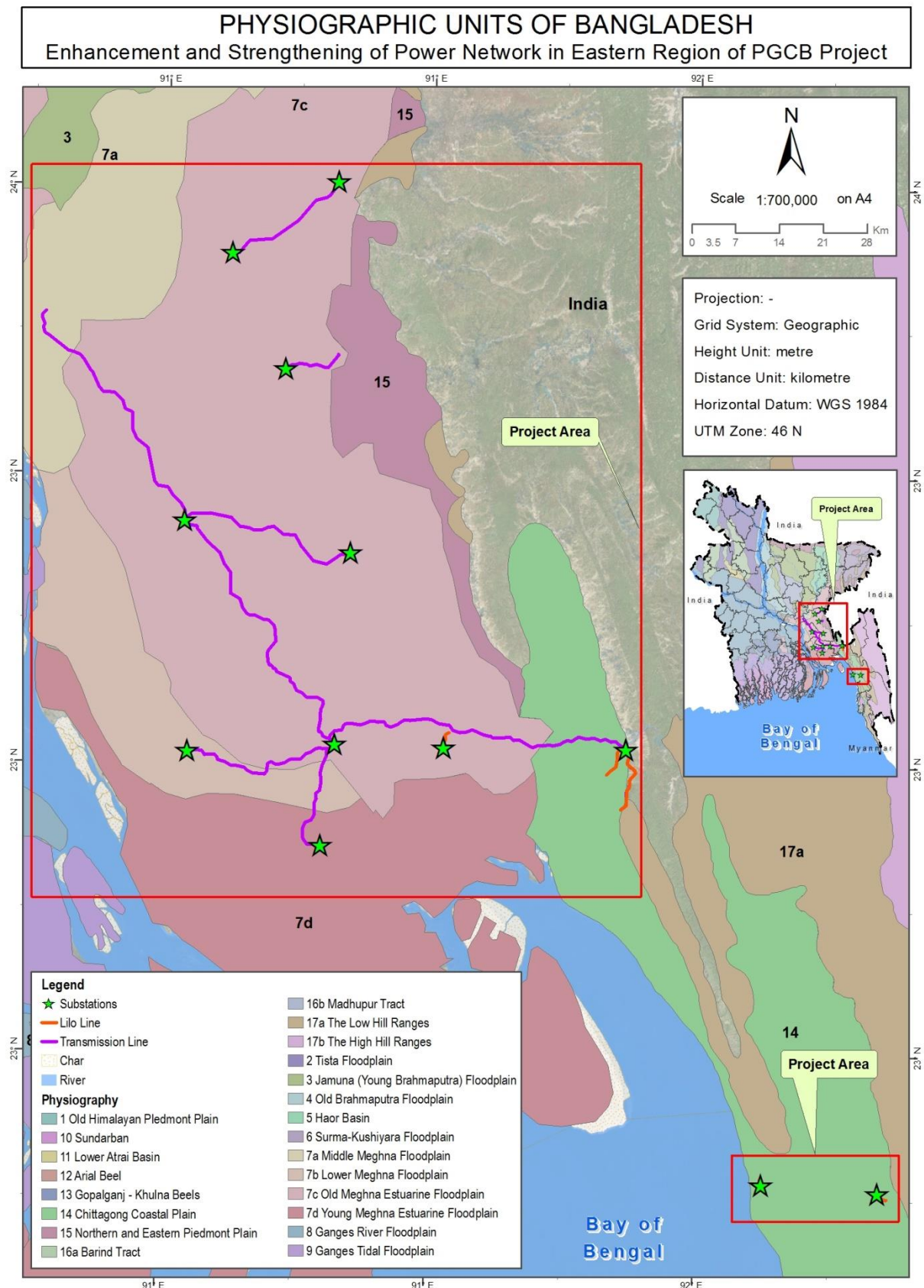


Figure 4.10: Physiographic Units of Bangladesh and the Subprojects Locations

Northern and Eastern Piedmont Plains- Generally sloping piedmont plains border the northern and eastern hills. These plains, which comprise coalesced alluvial fans, mainly have silty or sandy deposits near to the hills, grading into clays in the basin adjoining the neighboring floodplains. The

whole area is subject to flash floods during the rainy season. On the higher parts, flooding is mainly intermittent and shallow; but it is moderately deep or deep in the basin.

Low Hill Ranges- Comparatively low hill ranges occur between and outside the high hill ranges. They are mainly formed over unconsolidated sandstone and shale. Their summits generally are <300m above MSL. Most areas are strongly dissected, with short steep slopes, but there are some areas with rolling to early-level relief (eg in the best tea-growing areas of Sylhet region). In the Sylhet region, there are four main hillocks in the northern zone and six hill ranges project into the south of Sylhet district from the Indian state of Tripura. These six ranges, which project into the plains from the south, are, from east to west, Patharia, Harargaj, Rajkandi-Ita, Bhanugach, Tarap and Raghunandan.

In the Chittagong region, this unit includes the Sitakunda and Mara Tong ranges and the complex of hills to the south and east of Ramgarh, including the eastern part of the middle Feni river valley. The Sitakunda range has 32-km long ridge in the middle, which reaches 352m at Sitakunda peak. To the north, the high peaks on this range are Rajbari Tila (274m) and Sajidhala (244m). To the south, there is an abrupt fall and Chittagong city heights are less than 92m. In the Mara Tong range a height of only 113m is reached. Further northeast the hills are higher. The topography is deeply eroded and rounded; the valleys are curved and almost isolated hillocks are common. At the Sitakunda peak, there are several hot springs. There are five broken ranges of hills between Karnafuli River and the southern tip of Bangladesh. South of Bakkhali River the hills reach the sea at Cox's Bazar. Thereafter the main mass of hills goes down the Teknaf peninsula as the Teknaf range. There is a slight break in the west along the Rejukhal valley. In its northern part, the Teknaf range is comparatively low (61 to 91m). From Whykong a high ridge runs south; its main peaks are Baragong (119m), Taunganga (268m), and Nytong (168m). The southwestern end of this range ends at a village called Noakhali where there are a series of impressive cliffs, some 30m in height. The range ends at Teknaf Bazar. South of Gorjania (northeast of Teknaf peninsula) these hills continue into Myanmar. The Rejukhal valley is an important component of this broken-up landscape.

4.3.3 Topography

Most of Bangladesh is situated on the river deltas. The Chittagong coastal region to the southeast has a narrow attachment to the bulk of the country. Small hill regions in the northeast and southeast are the only variations of the land's flat alluvial plains (flat lands containing deposits of clay, silt, sand, or gravel deposited by running water, such as a stream or river). The topography of Chittagong division is much diversified. In general, the ground elevation of the Chittagong division varies about 5mPWD to 300mPWD.

A topographic map of the subproject areas is shown in Figure 4.11. From this figure and topo survey in 2017, it is known that the ground elevation of the project area varies from 3mPWD to 10mPWD. The region comprises plane, coastal, semi-hilly and hilly areas. The subproject site specific topography has given in earlier Table 4.1.

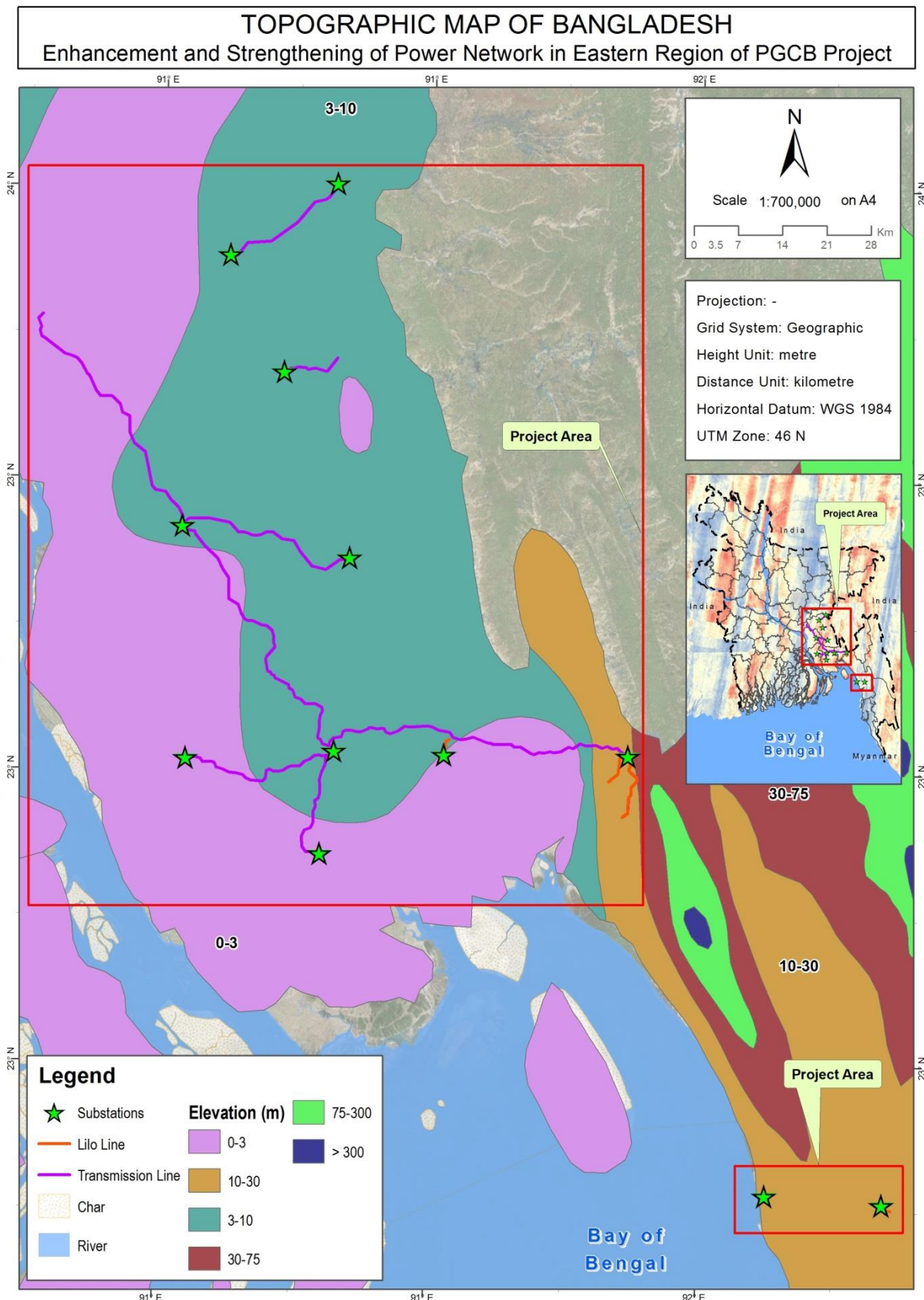


Figure 4.11: Topography of Bangladesh and the Project Area

4.3.4 Geology

Bangladesh is situated to the east of the Indian sub-continental plate. Nearly 85% of Bangladesh is underlain by deltaic and alluvial deposits of the Ganges, Brahmaputra, and Meghna river systems. The project area consists of Holocene alluvial deposits flood plain and predominantly consisting of fine sand, silts and clay. The site is on deep Cainozoic deposits that overlie Precambrian basement rock. The Precambrian rocks form the basement of all geological formations of Bengal Basin and shield areas. The materials deposited are a mixture of sediments transported by the old Brahmaputra and by the Jamuna (Brahmaputra) River. The generalized geological features of the project area are shown in the geological map of Bangladesh (Figures 4.12). The majority areas of the subprojects are under the Barisal Gravity High. However, some portions are also under the Hatia Trough and Barisal Gravity High.

4.3.5 Soil

The subprojects' areas fall in to the ten different soil formation zones (Figure 4.13). The general soil types of the Chittagong division predominantly include the following:

- I. *Calcareous Alluvium Soils (saline)*: The properties of this type of soil are similar to acid sulphate soils.
- II. *Non-calcareous Dark Grey & Grey Floodplain Soils*: They have a cambic B-horizon, non-calcareous dark grey topsoil and subsoil. They occur extensively on the Old Brahmaputra and old Meghna estuarine floodplain. Silt loam and silty clay loam are predominant on the Meghna estuarine floodplain and in the Tista meander floodplain, whereas silty clays and heavy clays are extensive on the Old Brahmaputra floodplain. The majority of these soils are Eutric Gleysols.
- III. *Non-calcareous Grey Floodplain Soils*: Generally, comprise a grey topsoil and a cambic B-horizon in the subsoil with a grey matrix or grey gleans. They extensively occupy Tista, Karatoya-Bangali, Jamuna, middle Meghna and eastern Surma-Kushiyara floodplains. However, there are considerable regional differences in the proportions occupied by individual soil textures. Silt loam texture is dominant in the Tista meander floodplain whereas silty clays are predominant in the Ganges tidal floodplain and in the Surma-Kushiyara floodplain. But the Jamuna floodplain has a more even distribution of silt loam, silty clay loam and silty clays. Most of these soils have been included in Eutric Gleysols.
- IV. *Acid Sulphate Soils*: Occur predominantly on the Chittagong coastal plain and in minor areas of the Ganges tidal floodplain. These soils contain sulphidic material, which turns extremely acid if exposed to air. The soils, which are under Mangrove Forest and flooded by saline tidal water, are finely stratified soft muddy sediments. But where it has been embanked to prevent flooding with saline water, the soils of these areas have developed profiles similar to non-calcareous grey and dark grey floodplain soils with extremely acidic horizon. They are either Thionic Fluvisols or Thionic Gleysols.

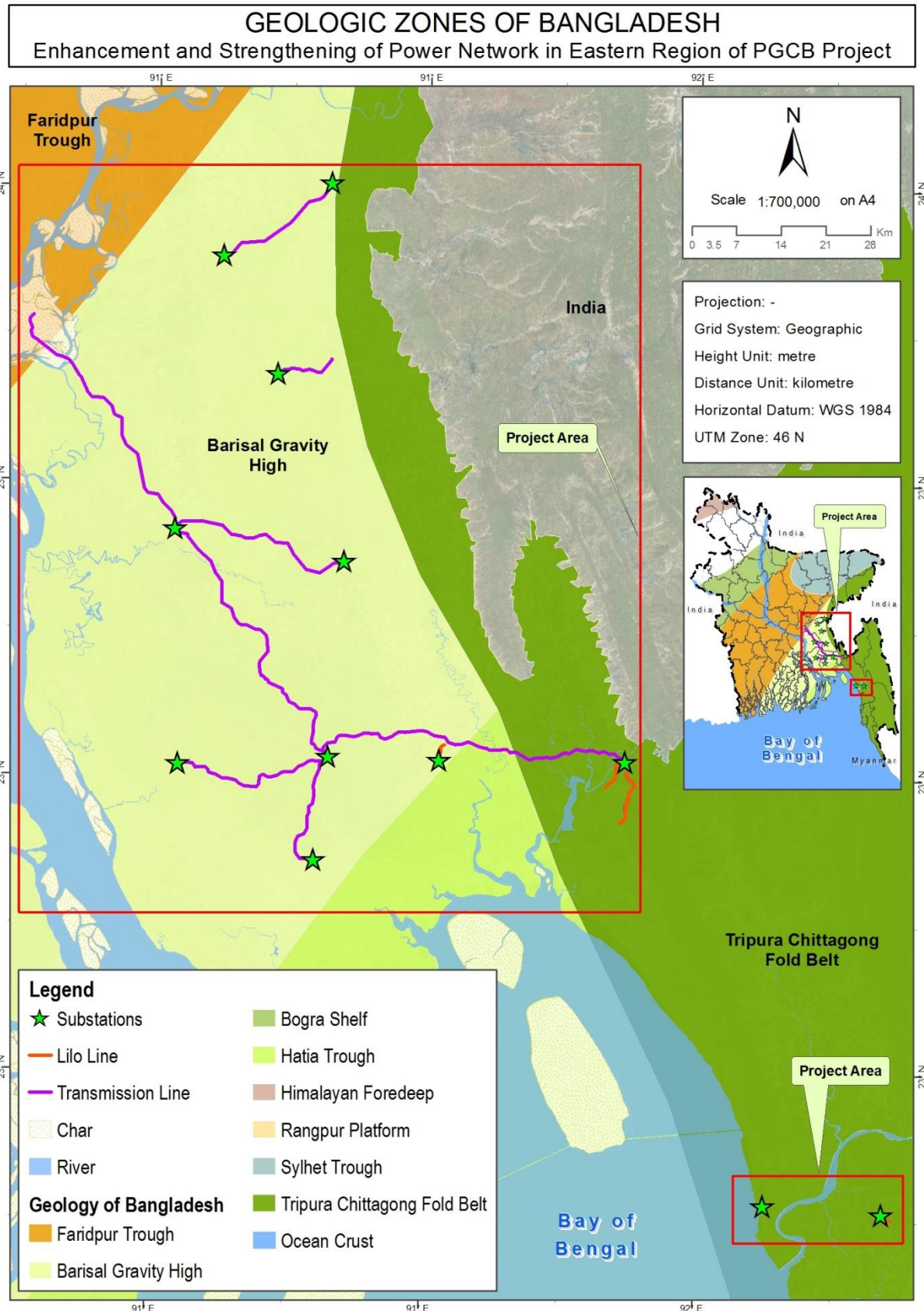


Figure 4.12: Geology of Bangladesh and the Project Area

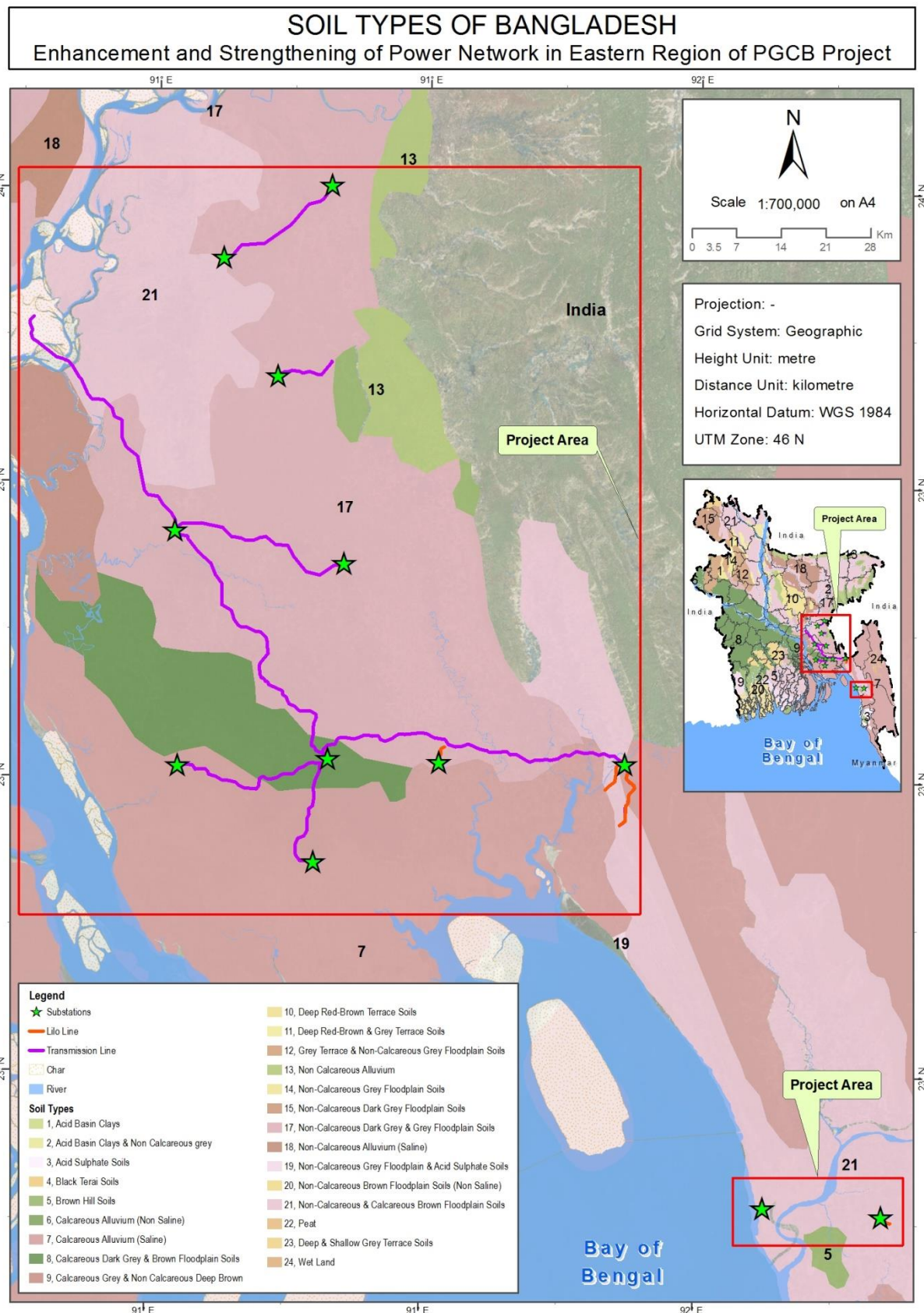


Figure 4.13: Soil Types of Bangladesh and the Project Area

4.3.6 Agro-ecological Zones

A 1988 study carried out by the United Nations Development Program (UNDP) classified Bangladesh into a series of Agro-ecological Zones (AEZs) based on an assessment of commonalities in characteristics such as physiography, soil types, climate and drainage. In total, 34 regions were identified and characterized, however this information has been updated and further refined on numerous occasions since the original study was undertaken.

The purpose of assessing the AEZs within the project area is to establish a broad overview of expected soil conditions which can be compared against more detailed, upazila-level data sources.

The most recent assessment was completed by the Soil Resource Development Institute (SRDI), 1998 which classified Bangladesh into 30 AEZs. The subproject areas contain the following major AEZ (Figure 4.14):

- I. **Lower Meghna River Floodplain** - This area occupies the transitional area between the middle Meghna river floodplain and the young Meghna estuarine floodplain. Soils of this area are relatively uniform, silt loams occupy relatively higher areas and silty clay loams occupy the depressions. Non-calcareous dark grey floodplain and calcareous grey floodplain soils are major components of general soil types. Topsoils are moderately acidic and subsoils neutral in reaction. General fertility level is medium to high with low to medium organic matter status and K-bearing minerals.
- II. **Young Meghna Estuarine Floodplain** - This region occupies young alluvial land in and adjoining the Meghna estuary. The major soils are grey to olive, deep calcareous silt loam and silty clay loams, and are stratified either throughout or at shallow depth. Calcareous alluvium and non-calcareous grey floodplain soils are the dominant general soil types. Topsoils and subsoils of the area are mildly alkaline. General fertility is medium but low in N and organic matter.
- III. **Old Meghna Estuarine Floodplain** - This region occupies a large area, mainly low-lying land between the south of the Surma-Kushiyara floodplain and the northern edge of the young Meghna estuarine floodplain. Silt loam soils predominate on highlands and silty clay to clay on lowlands. Organic matter content of the soils is moderate. Topsoils are moderately acidic, but subsoils neutral in reaction. General fertility level is medium.
- IV. **Northern and Eastern Piedmont Plains** - This is a discontinuous region occurring as a narrow strip of land at the foot of the northern and eastern hills. The region comprises merging alluvial fans which slope gently outward from the foot of the northern and eastern hills into smooth, low-lying basins. Grey piedmont soils and non-calcareous grey floodplain soils are the major general soil types of the area. Soils of the area are loams to clays, slightly acidic to strongly acidic in reaction. General fertility level is low to medium.
- V. **Chittagong Coastal Plain** - This region occupies the plain land in greater Chittagong district and the eastern part of Feni district. It is a compound unit of piedmont, river, tidal and estuarine floodplain landscapes. The major problem in these soils is high salinity during the dry season (October to May). Grey silt loams and silty clay loam soils are predominant. Acid sulphate soils occur in mangrove tidal floodplains. General fertility level of the soils is medium, but N and K are limiting. Organic matter content is low to moderate.
- VI. **Northern and Eastern Hills** - This region includes the country's hill areas. Relief is complex. Hills have been dissected to different degrees over different rocks. In general, slopes are very steep and few low hills have flat summits. Brown hill soils are the predominant general soil type of the area. Organic matter content and general fertility level are low.

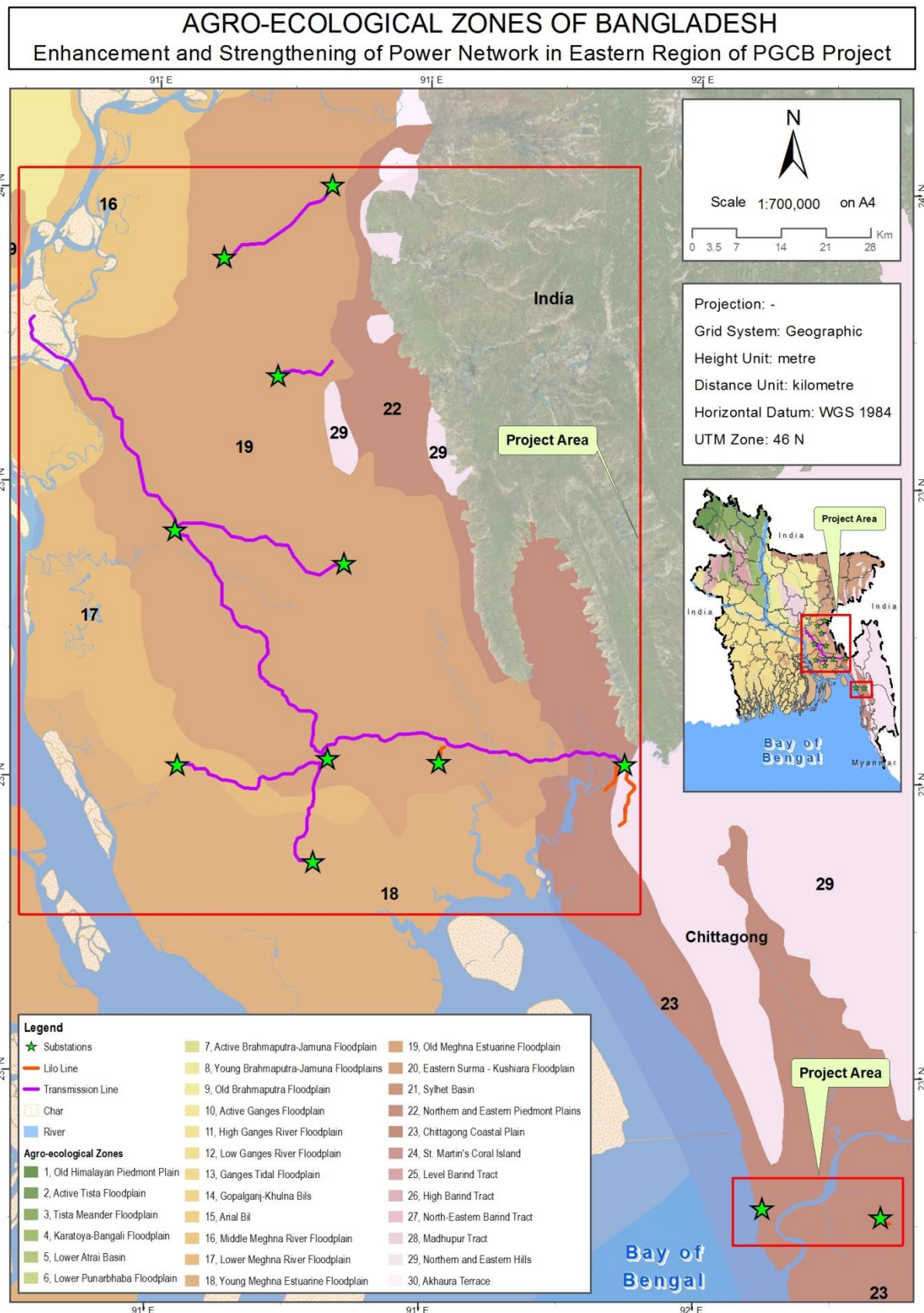


Figure 4.14: Agro-ecological Zones of Bangladesh and the Project Area

4.3.7 Hydrology/Drainage

The Chittagong division forms with several notable river systems. The Meghna, Matamuhuri, Titas, Dakatia, Gumti, Feni, Karnafuli, Halda, Bagkhali and Sangu are the major rivers of this division. Some of the rivers are among the longest river systems in the country and drains significant water of this area. These rivers are used extensively by the local population as a transport route, irrigation and for other livelihood activities.

The hydrology of this division is dominated by the Sangu, Bagkhali, Matamuhuri, and Tributary of the Matamuhuri Rivers, all originating in India and Myanmar. These rivers, especially the Bagkhali, Matamuhuri and Sangu exhibit flash flooding during heavy monsoon rains. The Bagkhali, Matamuhuri and Sangu and its tributaries have no or less than 10% of normal flow during the dry season (November–April), due to withdrawal of water for irrigation by low-lift pumps. Generally, ponds remain unchanged from year to year due to rejuvenation during the rainy season.

Most of the areas of this division are not flood-prone. However, the area adjacent to the other divisions is affected to flood every year during monsoon from severe to normal flooding. A flood map focusing the sub-projects areas is shown in Figure 4.15 and the inundation of the sub-project sites for the last 30 years (from 1987-2017) has presented in Table 4.1.

An overview of the surface water bodies and catchments within the Chittagong division is provided in the following Figure 4.16.

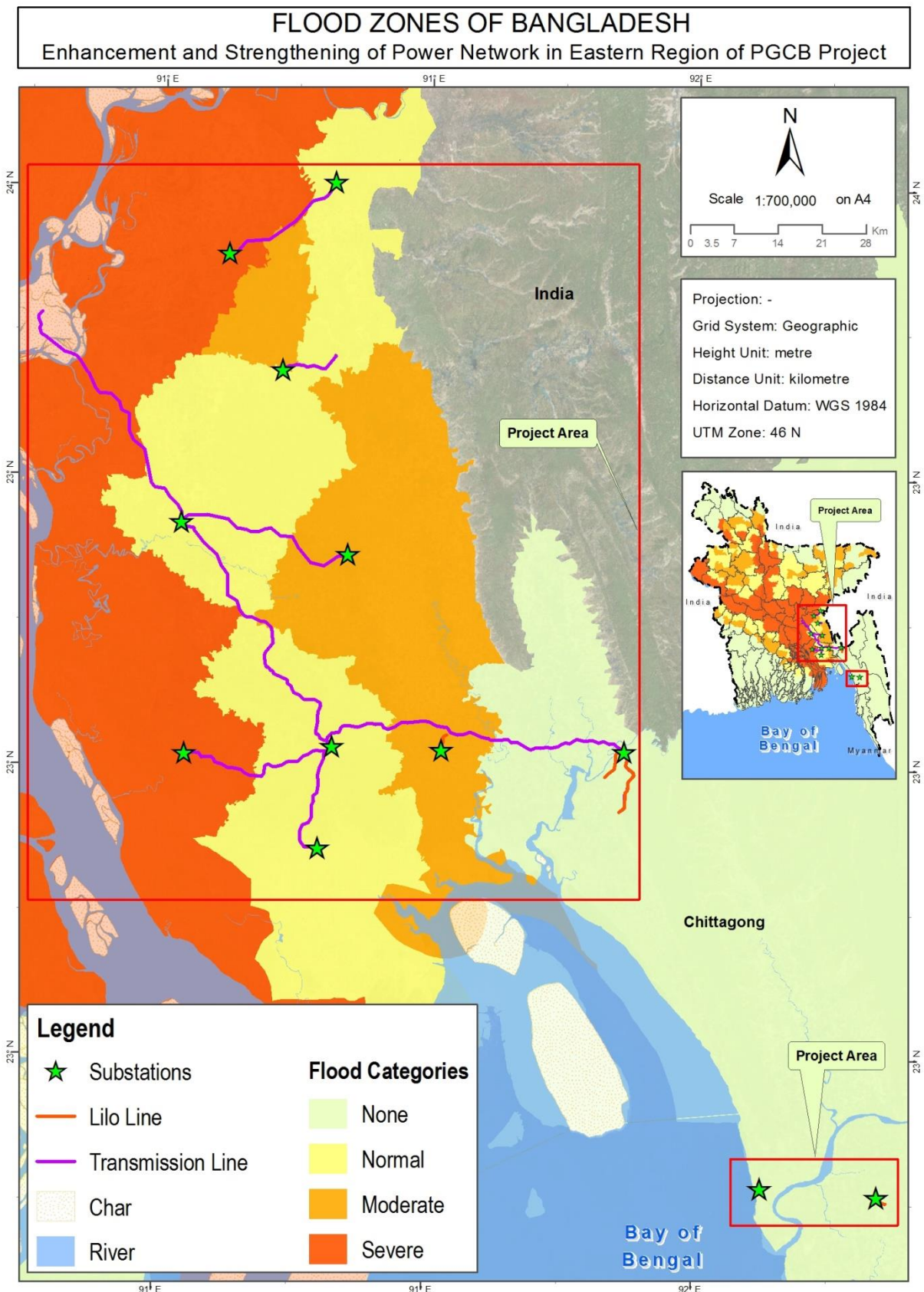


Figure 4.15: Floods of Bangladesh Map, also showing the floods severity in the subproject areas

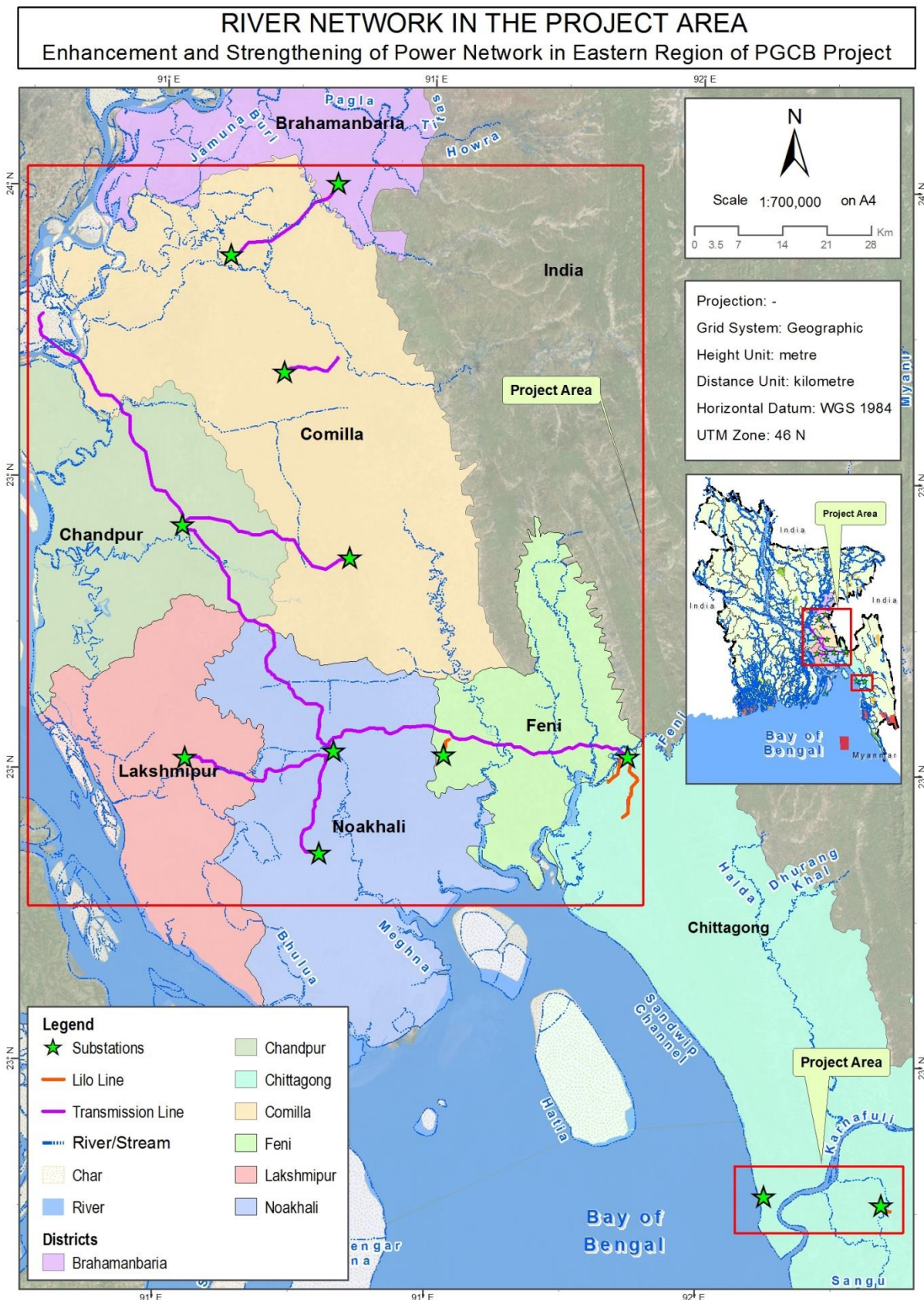
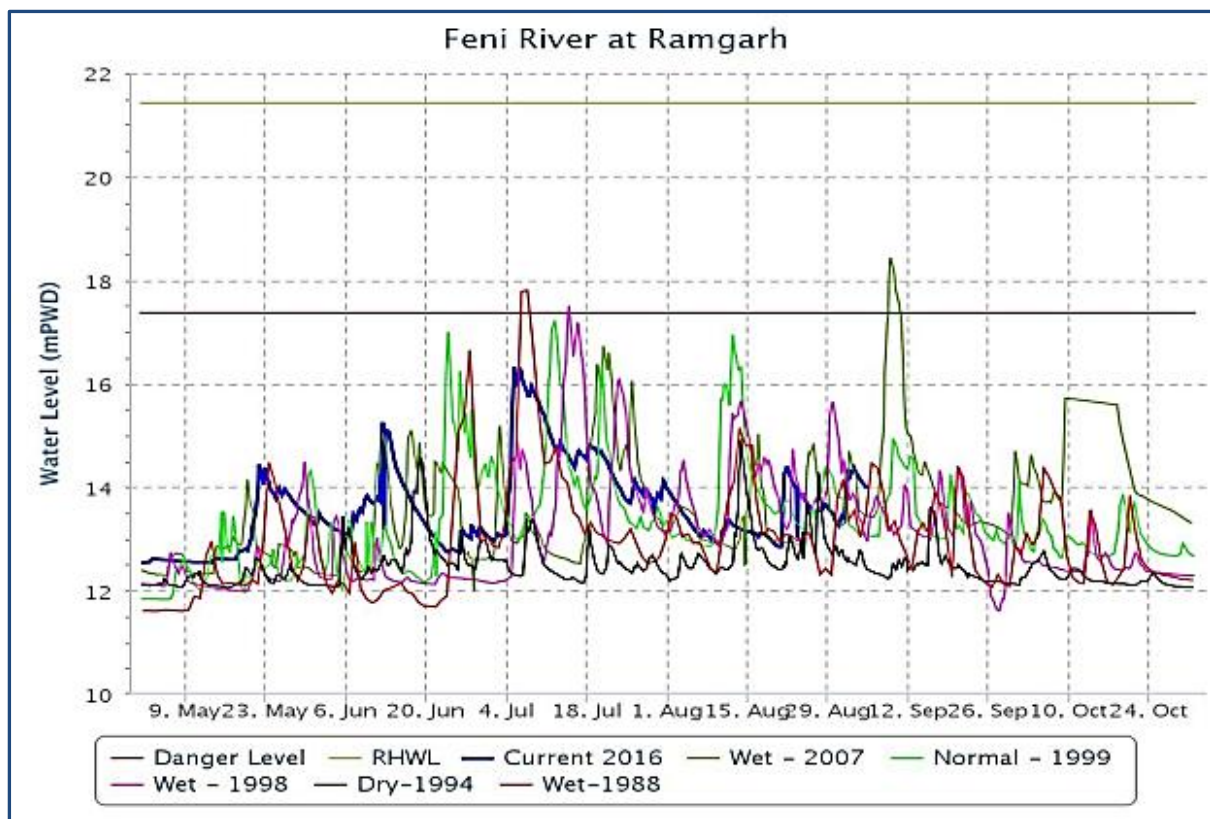


Figure 4.16: Rivers Of Bangladesh Map, Also Showing the Major Rivers in the Subproject Areas

In Bangladesh, rainfall and trans-boundary river flows are the main sources of surface water. According to Banglapedia, Bangladesh has an average annual surface flow of approximately 1,073

million acre feet (MAF), of which about 870 MAF (93%) is received from India as inflow, and the remaining 203 MAF (7%) as rainfall. This magnitude of water is sufficient to cover the whole of Bangladesh to a depth of 9.14m. Approximately 132 MAF (65% of rainfall and 12% of total) is lost in evaporation (114.30 cm) and the remainder, approximately 5 million cubic feet (MCF) flows out to the Bay of Bengal that includes sediment load of 1.5-2.4 MCF. A brief description on the main rivers found in the study areas is given below.

Feni River: The Feni River is a trans-boundary river originated from Tripura, India. The river, after entering Bangladesh, flows towards south-west direction dividing Chittagong and Noakhali before meeting with the Bay of Bengal after traversing 116 kilometers. During the monsoon season when there are heavy rains in the region, it does not lack the water quantity but when there is excessive rains the river gains more energy and creates whirling eddies and currents at its sharp turns. The water level difference between high tide and low tide is maximum 1.2 m. The Feni is a perennial river, but has tidal influence, when it is fully inflated during the monsoon months (July to September) and measured flow rate is 10,800 m³/s (at Kaliachari) at that time. The flow is decreased in the months of February to April and the flow rate identified at that time 1.35 m³/s (at Kaliachari). The course of this river is meandering and the flood flow slope is nearly 15 cm/km. Water level of the Feni River is considered as NTWL (Non-tidal Water Level) at Ramgar & Kaliachari and TDWL (Tidal Water Level) at Dhumghat & Sonapur (Islam, Mokhlessuzzaman, & Chowdhury, 2011). Hydrograph of the Feni River at Ramrarh gauge station is given below (Figure 4.17).

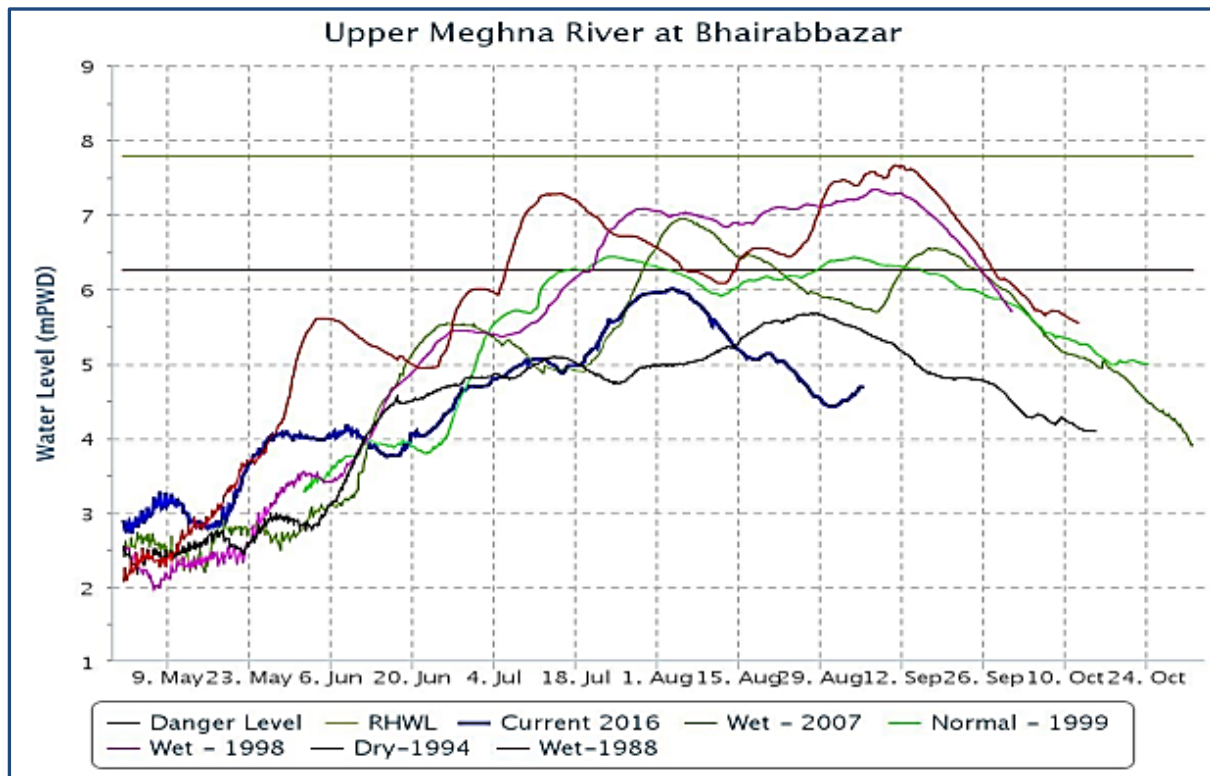


(Source: FFWC, 2016)

Figure 4.17: Hydrograph of Feni River at Ramgarh Gauge Station

Meghna River: The Meghna is formed inside Bangladesh with the joining of the Surma and Kushiya rivers originating from the hilly regions of eastern India. The Meghna has two distinct parts. The Upper Meghna from Kuliarchar to Shatnol is a comparatively small river. The Lower Meghna below Shatnol is one of the largest rivers in the world because of its wide estuary mouth. The Lower Meghna is at times treated as a separate river. The upper Meghna river which is major consideration

for Dhaka-Chittagong Expressway Project receives old Brahmaputra near Bhairab Bazar. The upper Meghna forms several off shoots which later rejoins with Meghna after long bends and meandering through lowland areas of northeastern areas Bangladesh. Among off shoots Titas, Pagli, Kathalia, Dhonagoda, Matlab and Udhamdi are important. The Meghna and these offshoots receive water of a number of hilly streams from the Tripura Hills. The important hill streams are the Gumti, Kakrai, Kagni, Dakatia, Hawrah, Sonaiburi, Harimangal, Pagli, Kurulia, Balujuri, Sonaichhari, Handachora, Jangalia and. All of these are liable to flash floods. The Gumti, Kakrai and Hawrah are the most destructive rivers. They have silted their beds to the extent that they now flow above the mean level of the land when brimful. Bangladesh Water Development Board (BWDB) constructed numbers of embankments to protect adjacent crops fields, small towns from flash floods.



(Source: FFWC, 2016)

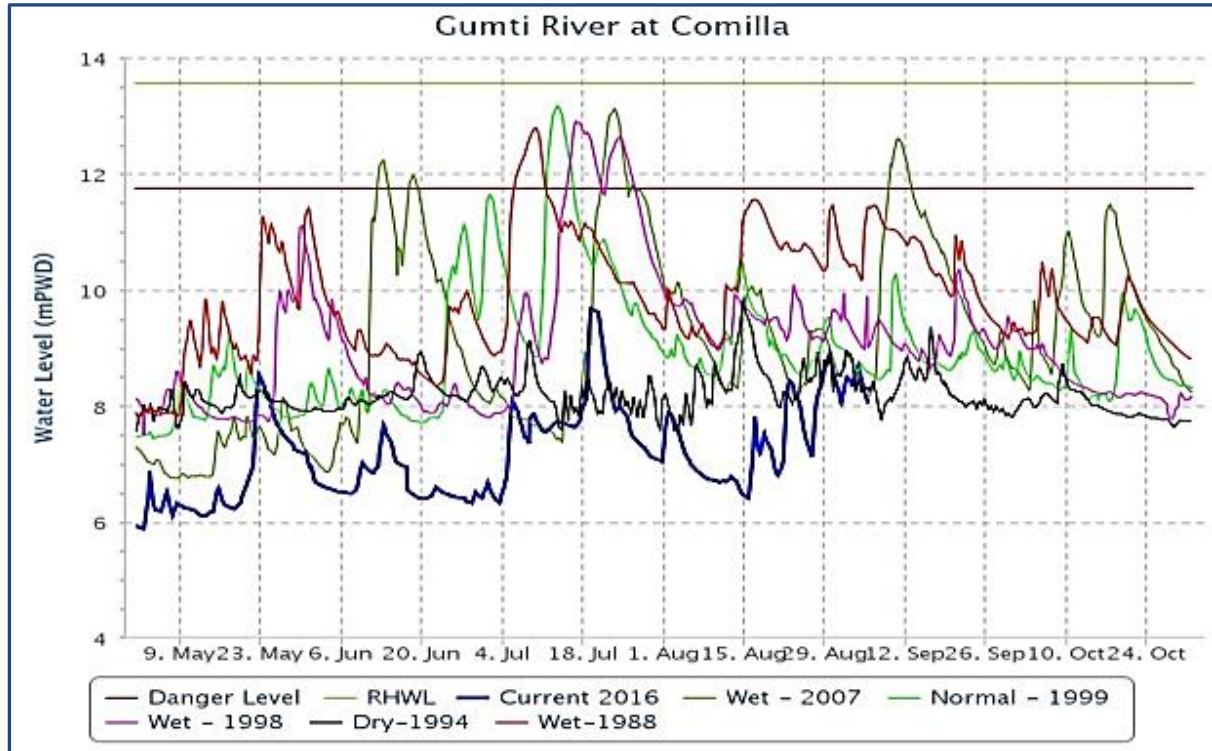
Figure 4.18: Hydrograph of Upper Meghna River at Bhairabbazar Gauge Station

The historical flood analysis shows that every other year one or the other of these streams overflows and causes considerable damage to crops, livestock and homestead. The Meghna River is a perennial river in nature; it is fully inflated during the monsoon months (July to September) and measured flow rate is 19900 m³/s (at Bhairab Bazar Station) at that time. The flow is decreased in the months of February to April and the flow rate identified at that time 2 m³/s (at Bhairab Bazar Station). Water level of the Meghna River is considered as TDWL (Tidal Water Level) at Ostogram, Bhairab Bazar, Narshingdi, Baiddarbazar, Meghna Ferry Ghat and Satnal. Hydrograph of Upper Meghna River at Bhairab Bazar gauge station is given below (Figure 4.18).

Gumti River: The Gumti River originates from Dumur in the northeastern hilly region of Tripura state of India. The Gumti is about 135 km long within Bangladesh. The Gumti River is a perennial river in nature; it is fully inflated during the monsoon months (July to September). Mainly the water level for Gumti River is considered as NTWL (Non-tidal Water Level) at Bibir Bazar, Comilla, Solanal, Gobindapur, Kongshanagor, Jibanpur (Gumti Bridge), and Jibanpur (BuriNadi) and TDWL (Tidal Water Level) at Daudkandi. The Dakatia is one of the important tributaries of the Gumti and the Buri River is its distributary. Being a hilly river, the Gumti has strong current and tendency of flash flood. Its

flow varies from 2.83 to 566 m³/s at Comilla. During the monsoon, its average breadth is about 100m (Wikipedia, 2016). The flood flow slope is nearly 9 cm/km of this river. Hydrograph of Gumti River at Comilla gauge station is given below (Figure 4.19). Noted that Meghna & Gumti rivers at downstream of the Meghna & Gumti bridges meet together and follow toward downstream.

Other than the above mentioned major rivers, the TL passes over the small rivers, khals, ponds which are presented in the tables (1b.1.1-1b.1.8) of Appendix-C.



(Source: FFWC, 2016)

Figure 4.19: Hydrograph of Gumti River at Comilla Gauge Station

4.3.7.1 Riverbed Materials

The riverbed materials are an integral component of the aquatic ecosystem providing habitat and a source of food for key components of the food web. The sediment often becomes a catchment for natural and anthropogenic toxic substances that bind to particles and settle from the water column to the riverbed. The toxicity from the build-up of these contaminants may threaten the sediment-dwelling benthic organisms, vegetative communities, and the aquatic food web that depend on them. Organisms and plants, particularly those living in the sediment, can acquire and accumulate toxic substances through epidermal contact, respiration, or by ingestion of toxins.

The riverbed materials of the Meghna -Gumti River will be used for the filling of the proposed substations, located in Comilla, Chandpur, Noakhali, Munshiganj and Feni Districts. Therefore for knowing the quality of heavy metals, river bed materials have been tested. The riverbed materials of the Meghna -Gumti River have been tested (tested parameters were: Lead (Pb), Cadmium (Cd), Chromium (Cr), Copper (Cu), Zinc (Zn), Manganese (Mn), Arsenic (As), Selenium (Se) and Mercury (Hg)) in DPHE laboratory, Dhaka during January 2016 under the KMG Project (Kanchpur, Meghna & Gumti Bridge funded by JICA) and test results are shown in the following Table 4.2. From this table it is understood that none of the parameters are exceeded the standards. Noted that the location of the collected sample of the Meghna-Gumti River at the TL crossing point is at about one km downstream of the Meghna and Gumti bridges on the Dhaka-Chittagong four Lanes Highway.

The riverbed materials of the Bay of Bengal (sea), nearby (about 1km far) will be used for the filling of the proposed substations, located in Chittagong District. Therefore for knowing the quality of heavy metals, river bed materials have been tested. The riverbed materials of the Bay of Bengal have been tested during December 2017 under the Chittagong City Outer Ring Road Project (CCORRP) also funded by JICA. The location of the collected sample of the sea bed materials is about 1km west from the proposed substation (Anandobazar), Bandar, CTG. The collected bed materials' samples of the Meghna-Gumti River & sea were analysed for Pb, Cd, Cr, Copper Cu, Zinc Zn, Manganese Mn, As, Se, Hg and the laboratory test results are given in the following Table 4.2. From this table, it is understood that none of the parameters are exceeded the USA standards. Noted that the Environmental Specialist of the ESPNER project is working as Environmental Expert of the above mentioned KMG (Three Bridges) project & CCORRP project, funded by JICA and participated in the sampling and testing of heavy metals of bed materials.

Table 4.2: Test Results of River Bed & Sea Bed Materials

Sl. No.	Parameters	Concentration Present (mg/kg)			US EPA Standard, 2000
		Megna-Gumti River* 23°31'45.4"N 090°42'03.8"E	Sea Bed-1**	Sea Bed-2**	
1	Lead (Pb)	5.3	3.28	3.98	128
2	Cadmium (Cd)	<2.0	BDL	BDL	4.98
3	Chromium (Cr)	8.1	8.73	8.21	111
4	Copper (Cu)	6.3	6.13	6.98	144
5	Zinc (Zn)	32.7	28.12	27.99	459
6	Manganese (Mn)	162.4	-	-	-
7	Arsenic (As)	2.51	1.09	1.20	33
8	Selenium (Se)	ND	ND	ND	-
9	Mercury (Hg)	BDL	BDL	BDL	1.06

Source: KMG Project; ** January 2016, CCORRP; December 2017; BDL=Below Detection Limit; ND=Not Detected, US EPA, 2000- United States, Environmental Protection Authority, 2000.

4.3.8 Surface Water Quality

Surface water is abundant in the wet season in Bangladesh. An estimated 795,000 million cubic meter (Mm³) of surface water is discharged through the Ganges-Brahmaputra system, in the downstream of the confluence of the Ganges and the Brahmaputra. This is equivalent to 5.52 m deep water over a land area of 144,000 km². There are other rivers discharging surface water into the Bay of Bengal. An average annual rainfall of 2.40 m within the country partly replenishes surface water sources. Each year about one-third of Bangladesh is submerged in a normal flood, and the area submerged may increase to about two-thirds during severe floods. In the dry season water scarcity persists in many areas. In this period surface water is only available in part of the 22,155 km of major rivers, 1,922 km² major standing water bodies and about 1,475 km² of ponds in the country. Surface water irrigation systems in the country compete for this available water in the dry season. The perennial water bodies are decreasing with the use of more and more surface water.

Traditionally, before and during the early stages of tube wells installation, rural water supply was largely based on protected ponds. There are about 1,288,222 ponds in Bangladesh having an area of 0.114 ha per pond and 21.5 ponds per mauza (BBS, 1997). About 17% of these ponds are derelict and probably dry up in the dry season. The biological quality of water in these ponds is extremely poor due to unhygienic sanitary practices and absence of any sanitary protection. Many of these ponds are chemically and bio-chemically contaminated for fish culture. If one pond per mauza could

be protected from contamination, it would provide a source of drinking water with minimal treatment and water for other domestic uses without treatment. The Government of Bangladesh has greatly emphasized the development of protected pond-based water supply systems. The protected ponds should not receive any surface discharge and should only be replenished by rain and groundwater infiltration.

The overall quality of surface water around the project site and its surroundings varies throughout the year. Typically water quality improves during the monsoon due to the influx of fresh rainwater, and worsens during the dry season as water evaporates and the concentration of contaminants increases.

During 25 to 29 August 2017, surface water samples were collected by the environmental survey team from different locations of the subproject areas(Figure 4.20) & preserved in the ice box and tested in the EQMS laboratory The result of the surface water sample and the GoB standards for fishing water (ECR, 1997) are shown in Table 4.3. The concentration levels of all the parameters for surface water were within the acceptable limit set by the DoE, GoB, according to the best practiced based classification. The details of the test results are given in the Appendix E.



Photo 4.1: Collection of Surface Water Sample from the Feni River & Meghna-Gumti River on 20 and 21 August 2019.

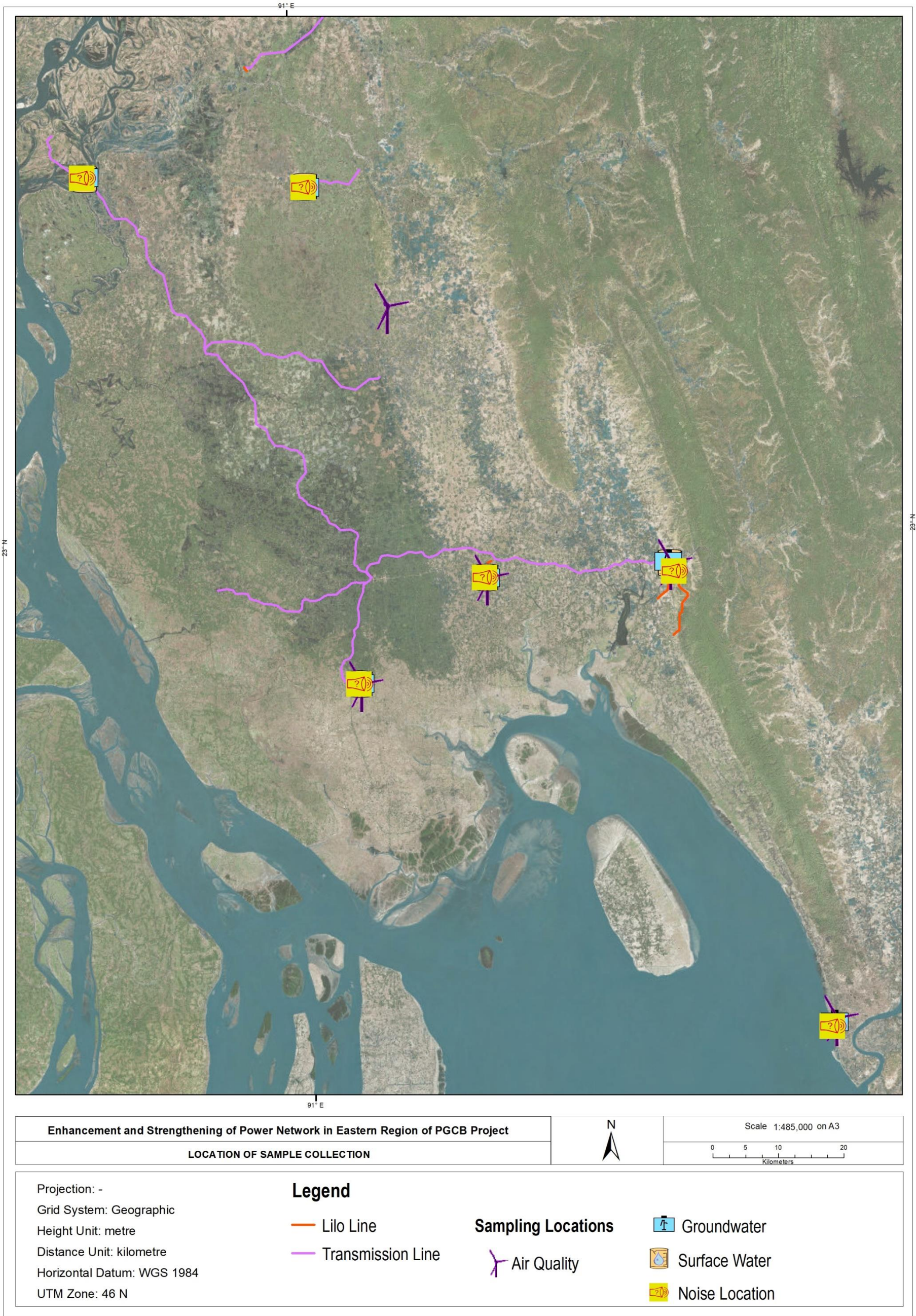


Figure 4.20: Sample Collection Location Map

Table 4.3: Test Results of Surface Water Quality Analysis

Parameter	Unit	Concentration Present					Bangladesh Standards
		Feni River 22°57'16.6"N 91°32'47.3"E	Maijdee, Noakhali 22°48'02.0"N 91°04'57.1"E	Basurhat, Feni 22°56'31.10"N 91°16'25.10"E	Chandina, Comilla 23°29'13.06"N 91° 1'14.19"E	Meghna-Gomoti River 23°30'19.65"N 90°41'31.30"E	
pH	--	6.35	6.86	6.89	6.35	7.14	6.5-8.5
Ammonia (NH ₃)	mg/l	0.26	0.41	0.26	0.17	0.11	0.50
Dissolved Oxygen (DO)	mg/l	6.4	5.7	6.4	6.2	6.5	5 or more
Chemical Oxygen Demand (COD)	mg/l	3.2	2.8	2.6	2.1	2.3	4.0
Biological Oxygen Demand (BOD) 5 days	mg/l	<2	<2	<2	<2	<1	2
Potassium	mg/l	3	1	3.9	2.7	2	12

Source: EQMS Laboratory, August 2017

4.3.9 Ground/Drinking Water Quality

Groundwater is the most important source of water supply in Bangladesh. Except for few hilly regions Bangladesh is entirely underlain by water-bearing aquifers at depths varying from zero to 20 m below ground surface. The soil is mostly stratified and formed by alluvial deposits of sand and silt, having occasional lenses of clay. The main constituent of the aquifer materials is the medium-grained sand deposited at the lower reach by the mighty rivers - the Ganges, the Brahmaputra and the Meghna with their tributaries. Groundwater can be easily abstracted by installation of wells for the development of water supply systems. The water abstracted for various purposes is replenished in the monsoon.

Physically groundwater is generally clear, colorless with little or no suspended solids and has a relatively constant temperature. Groundwater is also free from disease-producing micro-organisms which are normally present in large numbers in surface waters. The slow filtering action of fine-grained soil through which the surface water percolates to join the groundwater removes almost all suspended impurities. Moreover, the lack of oxygen and nutrients in groundwater makes it an unfavorable environment for disease-producing micro-organisms to survive, grow or multiply. On the other hand, being a universal solvent, water dissolves many of the minerals present in earth's crust during its slow travel through the ground. Anaerobic conditions in soils in some flood plains, and the presence of organic acids and carbon dioxide increase the solubility of groundwater. As a result, groundwater may contain minerals in varying concentrations depending on soil conditions. Arsenic contamination of groundwater is believed to be the result of such reactions in the adverse geo-environment.

In the context of high prevalence of diarrheal diseases in Bangladesh, groundwater received priority as a source of water supply because it is generally free from pathogenic micro-organisms. Almost all rural water supplies and most of urban water supplies are groundwater based. Groundwater collected by tube wells is fit for consumption. Groundwater abstracted from shallow aquifers by hand tube wells has received acceptance in rural areas for drinking purposes, but due to its high iron content, hardness, etc. people do not want to use hand tube well water for other domestic purposes like cooking, bathing and washing. The high iron in groundwater makes the cooked food blackish in color and produces stains on utensils.

Arsenic is a problem in large part of Bangladesh ground water. The project areas particularly in Chandpur and Lakshmipur have high level of Arsenic in ground water. The acceptable quantity of arsenic in potable water is 0.05 mg per liter under the Department of Environment standard and 0.01 mg per liter under the WHO standards (Figure 4.21).

Based on field observations and interviews with local residents it was found that groundwater in the area is used as a drinking water source in many instances, as well as for irrigation purposes. Water is generally extracted via hand pump (tube wells) from the shallow regions of the composite aquifer, and via machine-driven pumps (deep tube wells) which draw from the deeper main aquifers. The ground water reservoir usually recharges from rainfall, floods and river. In summer season, the water table slightly goes down and goes up in rainy season.

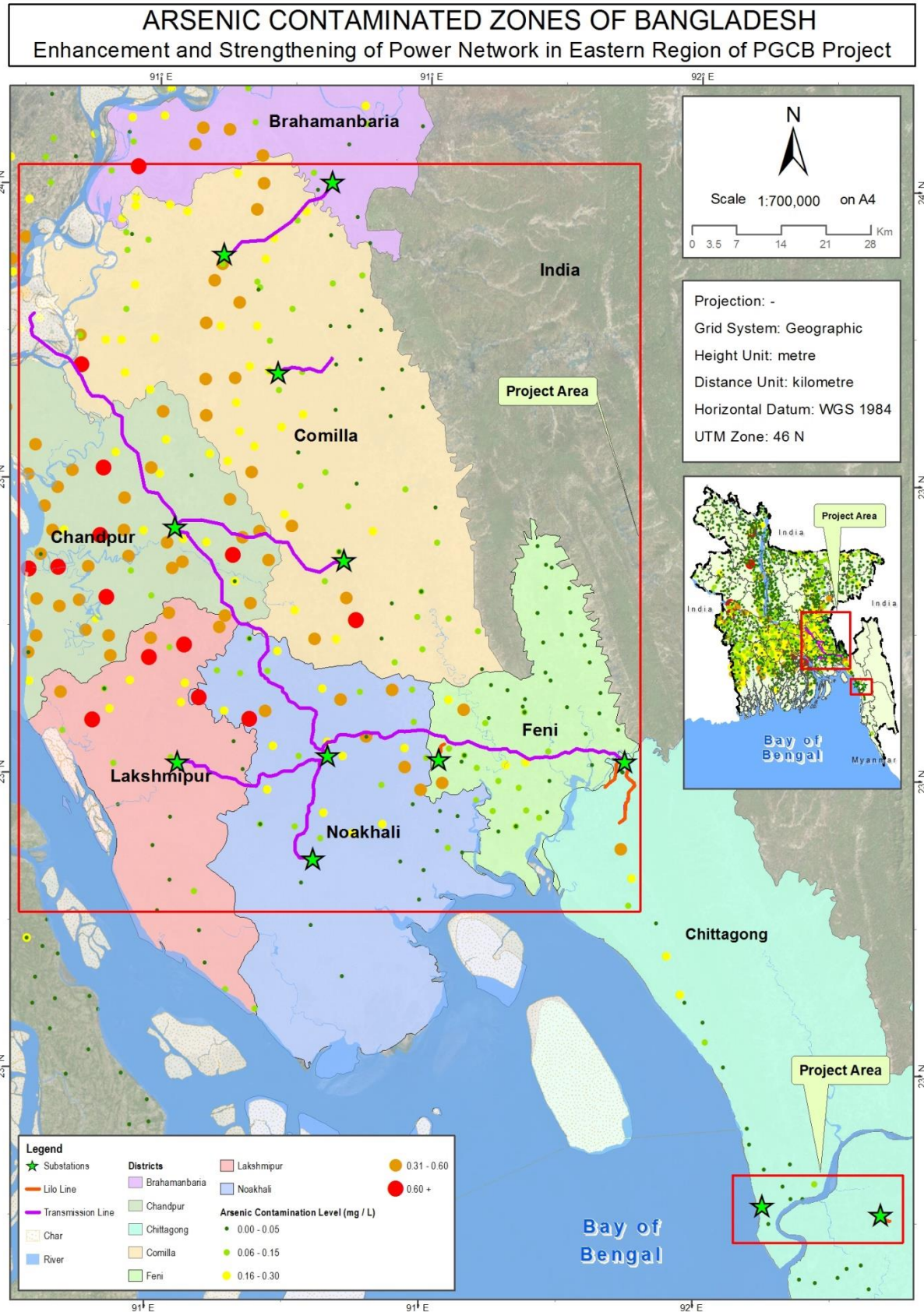


Figure 4.21: Arsenic Contamination in Bangladesh and the Project Area

During 25-29 August 2017, groundwater samples were collected by the environmental survey team from different locations (Figure 4.20) of the project area and preserved in the ice box. The result of the ground/drinking water sample and the DOE standards for drinking water (ECR, 1997) are shown in Table 4.4. The concentration levels of all the parameters for groundwater were within the acceptable limit for drinking water quality standard set by the DoE, GoB except the concentration of Chlorine at Chandina, Comilla. The details of the test results are given in the Appendix F. The ground /drinking water quality of the DTW, located at about 0.5km farway from the New Mooring Substation, CTG, tested by the CCORRP project during April 2017 is also included in Table 4.4.



Photo 4.2: Collection of Groundwater Samples from HTW at the proposed Basurhat & Chandina Substation sites.

Table 4.4: Test Results of Groundwater Quality Analysis

Parameter	Unit	Concentration Present						Bangladesh Standards
		Hossain Ali House, Mirsarai, Chittagong 22°57'24.95"N 91°32'40.13"E	Mofiz Mia House, Maijdee, Noakhali 22°48'03.2"N 91°04'56.5"E	Shatota Filling Station, Basurhat, Feni 22°56'29.55"N 91°16'23.46"E	Shahid Dealer House, Chandina, Comilla 23°29'09.3"N 91°01'15.6"E	Kader Mia House, Gozaria, Munshiganj 23°30'26.91"N 90°41'31.32"E	Anandabazar, Chittagong 22°18'58.6"N 91°46'10.3"E	
pH	--	5.88	6.57	6.60	6.50	6.70	6.7	6.5-8.5
Iron (Fe)	mg/l	0.03	0.01	0.06	0.02	0.06	2.9	0.3-1
Arsenic (As)	mg/l	0.001	<0.03	0.001	<0.05	<0.01	0.001	0.05
Manganese (Mn)	mg/l	0.7	0.7	0.7	0.6	0.5	0.03	0.10
Total Coliform (TC)	n/100 ml	0	0	0	0	0	0	Nil
Faecal Coliform (FC)	n/100 ml	0	0	0	0	0	0	Nil
Chlorine	mg/l	0.01	0.01	<0.02	0.06	<0.01	-	0.02
Salinity	ppt	-	-	-	-	-	0.25	

Source: EQMS Laboratory, August, 2017, CCORRP, April, 2017.

4.3.10 Ambient Air Quality

Within Bangladesh there are two major sources of air pollution: industrial emissions and vehicular emissions. Industrial sources include power generation, fertilizer factories, mills (sugar, paper, jute and textile), brick kilns, tanneries, chemical and pharmaceutical industries and the burning of solid waste. Emissions from these various sources contribute to the formation of the smog that regularly shrouds the major cities (Rahman et al, 2005).

Pollutants emitted from industrial sources include hydrogen sulfide, ammonia, and chlorine; all of which can result in health complaints such as skin irritation, headaches and nausea. Sustained exposure to these pollutants can result in other severe health effects such as severe respiratory health issues and birth defects (Rahman et al, 2005). In Bangladesh – where some 89% of the population use solid fuel – air-quality related deaths were estimated to be over 56,000 in 2007 alone (WHO, 2007). With increasing rates of urbanization, it is anticipated that vehicular ownership and usage will also increase, leading to a continued decline in air quality. DoE has identified two-stroke engines as a major polluter, and now discourages their use within Dhaka (Rahman et al, 2005).

Within the rural areas of Bangladesh, the main sources of air pollution are brick kilns and domestic heating and cooking – with wood, coal, diesel and biofuel (often manure) used as sources of energy (UNEP, 2002). It is therefore likely in rural areas that the principal air contaminants are particulate matter and volatile organic compounds (VOCs). Rural areas often also experience problems, particularly in the dry season, with dust generation due to construction, transport and agricultural activities such as tilling, threshing and plowing.

Ambient air quality measurements are essential to provide a description of the existing conditions or the baseline against which changes can be measured and to assist in the determination of potential impacts of the proposed project. Two hours air quality measurement (except CO) has been conducted during 25 to 29 August 2017 at the various locations of the subprojects by using LATA ENVIROTECH PM 250 (Combined P10/P2.5 Sampler) as an air pollution monitoring equipment (Figure 4.20) and an analysis of parameters was done by EQMS Environmental Laboratory. The measurement results are given in the below Table 4.4 (Appendix G). According to Bangladesh National Ambient Air Quality Standards from the Environmental Conservation Rules, 1997 which was amended on 19th July 2005 vide S.R.O. No. 220-Law/2005; any of the measures parameter of the local ambient air does not exceed Bangladesh standard. The air quality measurement at Anandabazar under CCORRP, located at about 0.5km farway from the New Mooring Substation, CTG, measured by the CCORRP project during April 2017 is also included in Table 5.5 and found that except CO, all parameters were within DOE standards. The measurement value of CO exceeded due to nearby (about 200m) location of CTG central waste dumping site and industries/factories.

Table 4.5: Measurement Results of Ambient Air Quality

Parameter	Unit	Duration	Concentration Present					Bangladesh Standards (ECR, 1997 Standard (Schedule-2))
			Balur Ghat, Korerhat , Mirsarai, Chittagong 22°57'20.23"N 91°32'46.83"E	Maijdee, Noakhali Sadar, Noakhali 22°48'02.1"N 91°04'57.2"E	Basurhat, Daganbhuiyan, Feni 22°56'31.18"N 91°16'24.45"E	Chandina, Debidwar, Comilla 23°29'10.5"N 91°01'10.8"E	Anandabazar, Chittagong 22°19'17"N 91°46'16"E	
PM ₁₀	µg/m ³	2 hr	67.20	62.25	59.29	73.22	37.7	150
PM _{2.5}	µg/m ³	2 hr	16.26	18.28	14.19	26.12	15.2	65
SO ₂	µg/m ³	2 hr	5.10	4.16	4.41	7.10	5.7	365
NO _x	µg/m ³	2 hr	11.29	12.29	11.73	13.36	19	100
CO	µg/m ³	1 hr	<1	<2	<1	<1	<1	9

Source: Field Survey, August 2017 and CCORRP, April, 2017



Photog 4.3: Air Quality Measurement at the proposed Majidee and Korerhat substation site.

4.3.11 Noise Level

Excessive noise is a potential issue for both human and biological receivers and can potentially cause a range of negative issues, from mild annoyance and moderately elevated levels of aggression to significant disturbance of behavioral patterns and in severe cases temporary or permanent hearing loss. According to World Health Organization's Guidelines for Community Noise (1999), daily sound pressure levels of 50 decibels (dB) or above can create discomfort amongst humans, while ongoing exposure to sound pressure levels over 85 dB is usually considered the critical level for temporary hearing damage.

The noise level of the surroundings of the project area is insignificant. The proposed site is presently using for agriculture and the anthropogenic disturbance is less. However, there is sound pollution from the traffic movement on the nearby road. Noise level has been monitored for 15 minutes at the various locations of the subproject sites (Figure 4.20) during day time of 25-29 August 2017. Results of the noise level monitored along with details of the measurement locations have been showed in Table 4.5. The results show that time weighted average value of the noise monitored at the project area exceeded the standard fixed for the respective areas except NM-05 & NM-06. The noise level measurement at Anandabazar under CCORRP, located at about 0.5km farway from the New Mooring Substation, CTG, measured by the CCORRP project during April 2017 is also included in Table 4.6.



Photo 4.4: Measurement of Noise Level at Gazari, Munshiganj and Balurghat (Korerhat) Sites

Table 4.6: Noise Level Measurement Results at Different Subproject Sites

ID	Location	Zone	GPS Location	Time	Noise Level dB(A)	Bangladesh Standard at Day Time dB (A)**	Remarks
NM-01	Balur Ghat, Korerhat , Mirsarai, Chittagong	Silent	22°56'35.8" N 91°33'16.6" E	3.20-3.35 pm	70.57	55	Exceeded the BD standard due to road traffics
NM-02	Maijdee, Noakhali Sadar, Noakhali	Mixed	22°48'02.1" N 91°04'57.2" E	10.25-10.40 am	66.88	60	Exceeded the BD standard due to road traffics
NM-03	Basurhat, Daganbhuiyan, Feni	Mixed	22°56'31.3" N 91°16'24.5" E	2.40-2.55 pm	57.55	60	Not exceeded the BD standard
NM-04	Chandina, Debidwar, Comilla	Mixed	23°29'10.5" N 91°01'10.8" E	10.00-10.15 am	71.51	60	Exceeded the BD standard due to road traffics
NM-05	Gozaria, Munshiganj	Silent	23°30'23.59" N 90°41'22.08" E	1.15-1.30 pm	55.55	55	Not exceeded the BD standard
NM-06	Anandabazar, Chittagong	Mixed	22°18'37.3"N 91°46'05.3"E	12.25-12.40 pm	53.7	60	Not exceeded the BD standard

Source: Field Survey, August 2017 and CCORRP, April, 2017

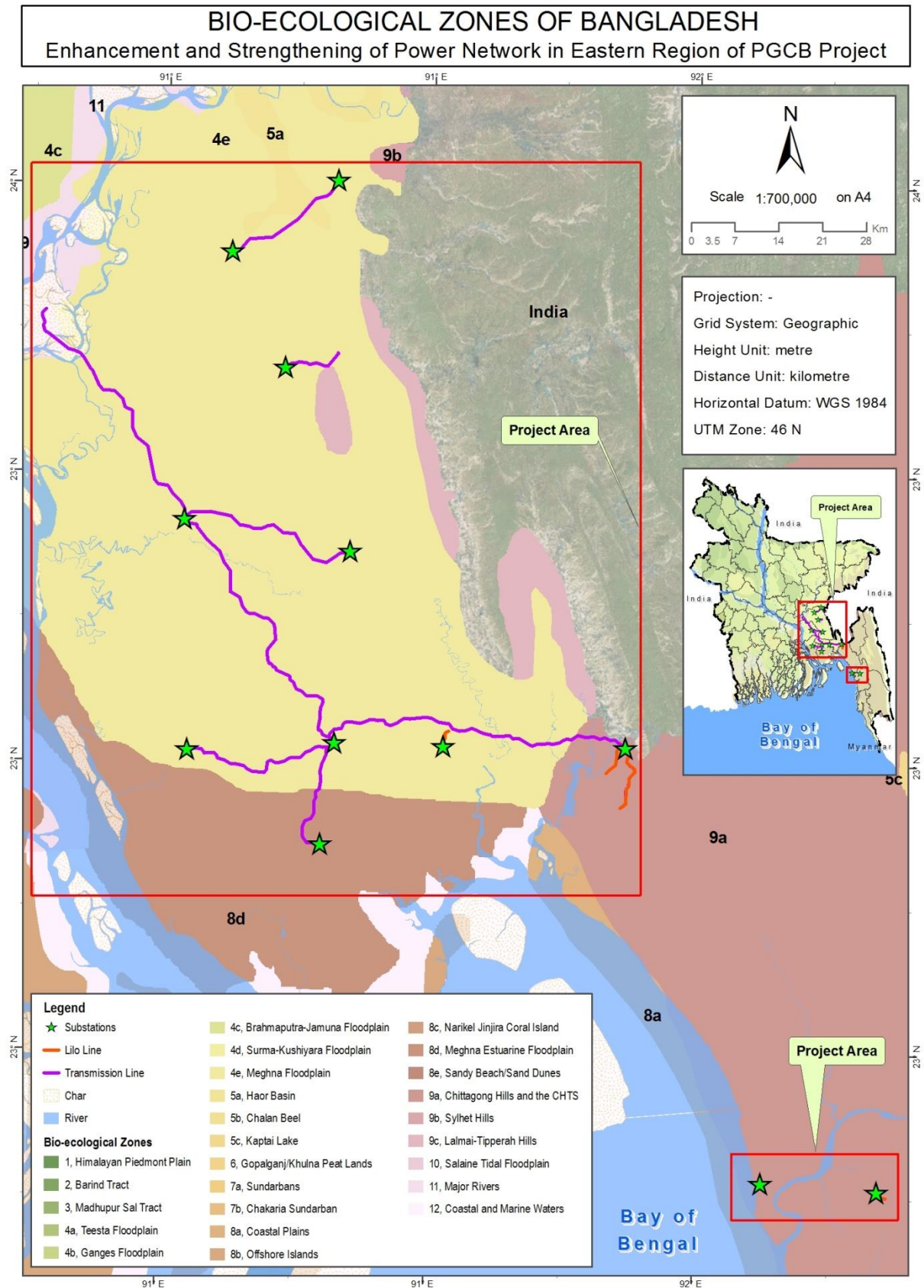
4.4 Biological/Ecological Environment

4.4.1 Bio-ecological Zones

Within a relatively small geographic boundary, Bangladesh enjoys a diverse array of ecosystems. Being a low-lying deltaic country, seasonal variation in water availability is the major factor, which generates different ecological scenarios of Bangladesh. Temperature, rainfall, physiographic variations in soil and different hydrological conditions play vital roles in the country's diverse ecosystems. The ecosystems of Bangladesh could be categorized into two major groups, i.e. (i) land based and (ii) aquatic. The land-based ecosystems include forest and hill ecosystems, agro-ecosystems and homestead ecosystems; while seasonal and perennial wetlands, rivers, lakes, coastal mangroves, coastal mudflats and chars, and marine ecosystems fall into the aquatic category.

Each of the ecosystems has many sub-units with distinct characteristics as well. IUCN Bangladesh in 2002 classified the country into twenty five bio-ecological zones (Figure 4.22). The project area falls below the bio-ecological zone.

- I. **Meghna Floodplain:** A major part of the Meghna floodplain was created by the deposition of sediments brought in by the old Brahmaputra River, before it changed its course. The rest of the sediments were laid down principally by the Meghna River itself and by some minor rivers draining from Tiperrah hills. The floodplain is characterized by many broad meandering channels, char and low lying landscape and is mostly affected by seasonal flooding while river bank erosion is occurred commonly. The luxuriant growth of palm trees is the dominant characteristic feature of the vegetation type of this zone. The Betel nut "Supari" (*Areca catechu*) is most visible as the dominant species in the western portion of this region. This zone also abundance in several varieties of cane, a good deal of bamboo and thatching grass. Faunal diversity is richer in here than other part of the country. In mammalian species, different species of cats, bats, otters, pangolins, and raptorial birds are found (IUCN, 2002f).
- II. **The Coastal Plains:** The coastal plains are underlain by heavy marine or tidal clays but these have been buried under by more sand or silty deposits near the foot of the hills and along the courses of rivers and streams, which run across the plains. The eastern coastline, extending from the mouth of the Feni River to the southern tip of mainland along Chittagong, is regular and unbroken and protected along the sea by mud-flats and submerged sands. This zone is important for a wide variety of waterfowls (IUCN, 2002f).
- III. **Meghna Estuarine Floodplains:** A huge newly accreted mudflat is the main physiographic feature of the Meghna estuarine floodplains, which is situated at the southern part of the Southeast region. Deposition and erosion are constantly taking place on the land margins. In many places during the dry season, part of the zone and surface becomes saline in varying degrees. Urighash (*Porteresia coarctata*) is the pioneer plant species in the new land formation whereas the luxuriant growths of Palms are the dominant. All the accreted inter-tidal lands are important wintering grounds for migratory waterfowls.



- I. **Chittagong Hills and the CHTs:** The south-eastern hill range of the country is composed of tropical evergreen and semi evergreen forest, which are important watershed areas of the

country. The majority of the species in the lower canopy are evergreen, and the upper canopy of the forest is deciduous type. Tropical evergreen forest is found in the valleys of this zone. Knowledge on the diversity of reptiles and amphibians of this zone is rather rudimentary, as few surveys of these animals have been made. This zone possesses richest avifauna population of the country mostly marine and shore birds (IUCN, 2002f).

4.4.2 Diversity of Floral and Faunal Species

The sub-project influence area (SPIA) is mixed with different vegetation. Crops, vegetables are cultivated at the surrounding mainly include rice, wheat, rabi crops and variety of homestead vegetables. A sizeable number of fruit trees with economic value have been observed in the SPIA. The fruit trees include jackfruit, mangoes, litchi, banana, coconut, blackberry etc. and timber trees include mehegoni, neem, epil-epil, koroi etc. Considerable number of trees and bushes in the SPIA site provide habitat for birds and other animals. The composition of plant community includes low growing grasses, trees, herbs and shrubs. The data collected from the field survey and suggests that the predominant species are those of cultivated vegetables and trees. A detailed list of terrestrial floral species found in the project area is shown in Form 1a of Appendix B (Substations), Appendix C (Transmission Line), and Appendix D (LILU Line).

The Project will require removal of trees of various sizes and species. The census and IOL survey during 2017 found varieties of trees on acquisition and transmission line area. Total numbers of affected trees on acquisition and transmission line area together in the Project area by category are presented in the following Table 4.7. Total numbers of affected trees are 23,753. The details of the counted trees are given in Form 1a of Appendix B (Substations), and Appendix C (Transmission Line). The highest number of trees is found under timber (9305) category followed by fruit trees (7503) and bamboo (6836) in the Project area. Out of the total number of affected trees, 12055 are large, 5900 are medium, 4641 are small, and 1157 are saplings. Size of trees has been determined based on the girth category by considering species but the Forest Department (FD) will further assess it during land acquisition process. All the PAPs will receive compensation for the trees and fruits. Also they will be able to take away the timber. PAPs will get also additional compensation for fruit bearing trees.

Table 4.7: Lose of trees by category

Type of trees	No	Percentage	Large	Medium	Small	Sapling	Total
Fruit bearing	7503	31.59	4437	1517	939	610	7503
Timber	9305	39.17	2257	3408	3093	547	9305
Firewood	97	0.41	68	13	16	0	97
Medicinal	12	0.05	9	0	3	0	12
Bamboo	6836	28.78	5284	962	590	0	6836
Total:	23753	100	12055	5900	4641	1157	23753

A detailed list of terrestrial floral species found in the SPIA of sub-projects is given in the following Table 5.8.

Table 4.8: List of Terrestrial Flora available in the SPIA

Scientific Name	Local Name (English Name)	Habit	Habitat	Status
• Timber/Wood Trees				
<i>Swietenia mahagoni</i>	Mehogoni	T	RS, HS	C
<i>Azadirachta indica</i>	Neem	T	HS	C
<i>Albizia procera</i>	Koroi	T	RS, HS	C
<i>Eucalyptus citriodora</i>	U-caliptas	T	RS, HS	C
<i>Dalbergia sisoo</i>	Shishu	T	RS, HS	C
<i>Bambosa spp.</i>	Bash (Bamboo)	S	HS	C
<i>Samanea saman</i>	Raintree	T	RS, HS	C
<i>Bombax ceiba</i>	Shimul (Cotton Tree)	T	RS, HS	LC
<i>Ficus infectoria</i>	Pakur	T	HS	LC
<i>Polyalthia longifolia</i>	Debdaru	T	RS	LC
<i>Acacia auriculiformis</i>	Akashmoni	T	RS, HS	C
<i>Tectona grandis</i>	Shegun	T	RS, HS	LC
<i>Teominalia arjunna</i>	Arjun	T	HS,RS	LC
• Fruit Trees				
<i>Musa sapientum</i>	Kalagash (Banana)	H	HS	C
<i>Psidium guajava</i>	Piara (Guava)	T	HS	LC
<i>Cocos nucifera</i>	Narikel (Coconut)	T	HS	C
<i>Moringa oleifera</i>	Sajna	T	HS	LC
<i>Zizyphusm auritiana</i>	Boroi	T	HS	LC
<i>Citrus grandis</i>	Jambura/Badam	S	HS	C
<i>Aegle marmelos</i>	Bel	T	HS	C
<i>Feronia limonia</i>	Kodbel	T	HS	LC
<i>Phoenix sylvestris</i>	Date Tree (Khejur)	T	HS,RS	C
<i>Areca catechu</i>	Supari (Betel Nut/Nut)	T	HS	C
<i>Carica papaya</i>	Pepe (Papaya)	T	HS	C
<i>Citrus aurantifolia</i>	Labu (Lemon)	S	HS	C
<i>Annona reticulate</i>	Atafal	T	HS	C
<i>Averrhoa carambola</i>	Kamranga	T	HS	C
<i>Punica granatum</i>	Dalim	S	HS	LC
<i>Manilkara sapota</i>	Sobeda	T	HS	LC
<i>Dellenia indica</i>	Chalta	T	HS	LC
• Fruit cum Timer Trees				
<i>carpus heterophyllus</i>	Kathal (Jackfruits)	T	HS	LC
<i>Mangifera indica</i>	Aam(Mango)	T	HS	C
<i>Syzygiumcumini</i>	Jam(Blackberry)	T	HS	C
<i>Tamerindusindica</i>	Tetul (Tamarind)	T	HS	C
<i>Borassusflabellifer</i>	Tal (Palm Tree)	T	RS	LC
<i>Elaeocarpus robustus</i>	Jolpai (Olive)	T	HS	LC
<i>Diospyros peregrina</i>	Gub	T	HS,RS	LC
• Medicinal Trees				
<i>Azadirachta indica</i>	Neem	T	HS	C
<i>Teominalia arjunna</i>	Arjun	T	HS,RS	LC
	Bohera	T	HS	LC

Scientific Name	Local Name (English Name)	Habit	Habitat	Status
	Tejpata	T	HS	LC
<i>Ocimum canum</i>	Tulshi	H	HS	LC
<i>Coccinea cordifolia</i>	Telakachu	S	HS	C
• Fuel Trees				
	Paiya	T	HS	C
<i>Ficus benghalensis</i>	Bot(Banyan Tree)	T	RS	LC
<i>Acacia nilotica</i>	Babla	T	HS	C
<i>Ricinus communes</i>	Venna	T	HS	C
<i>Lannea coromandelica</i>	Ziga	T	HS, RS	C
	Bonziga	T	HS	C
<i>Ficushispida</i>	Dumoor	T	RS	C
<i>Anthocephalus cadamba</i>	Kadom	T	HS	C
	Shewra	T	HS	C
	Bakul	T	HS	LC
• Aesthetic				
<i>Delonix regia</i>	Krisnochura	T	HS	LC
<i>Cassia fistula</i>	Sonalu	T	HS	LC
<i>Codiaeum variegatum</i>	Patabahar	S	HS	LC
<i>Lawsenia inermis</i>	Mehendi	S	HS	C
<i>Gardenia coronaria</i>	Gandha raj	S	HS	C
<i>Casuarina littorea</i>	Jaw	T	HS	LC
<i>Nymphaea nouchalli</i>	Shapla	H	WL	C

Source: Field level survey, 2017. **Note:** C-Common, LC- Less Common, UC- Uncommon, CU- Cultivated Habit: T=Tree, H= Herb, S=Shrub, G=Grass; Habitat: HS=Homestead, RS-Road side

While most of the aquatic plant species of the subproject areas are subject to seasonal water level fluctuations, the abundance of wetlands supports a wide variety of aquatic biota. The common aquatic plants are Helencha (Enhydrofluctuans) Kalmi (Ipomoea aquatica), DholKalmi (Ipomoea fistulosa), Cheicha (Scirpus articulatus), Kochuripana (Eichornia crassipes), Shapla (Nymphaea nouchalli), Duckweed (Spirodella sp.), Khudipana (Lemna minor), and Topapana (Pistia stratiotes).

The diversified habitat and ecosystem in the project area support various types of wildlife as given in Table 4.1 and in Form 1a of Appendix B (Substations), Appendix C (Transmission Line) and Appendix D (LILO Line). Primary and secondary mode was adopted for identification of fauna. Most of the faunal species such as (Avians, Amphibians, Reptiles and Mammals) were identified in the SPIA of the subproject areas by using books and description of the local people during the field survey which are given in the following Table 4.9.

Table 4.9: List of Faunal Species Available in the SPIA of the Subprojects

Scientific Name	English Name	Local Name	Local Status
Class: Amphibia			
<i>Bufo melanostictus</i>	Common Toad	Kuno bang	NO
<i>Rana temporalis</i>	Bull Frog	Kola bang	NO
<i>R. pipens</i>	Grass Frog	Sona bang	NO

Scientific Name	English Name	Local Name	Local Status
Class: Reptilia			
<i>Hemidactylus flaviviridis</i>	Common House Lizard	Tiktiki	NO
<i>Calotes versicolor</i>	Common Garden Lizard	Rokto-chosha	NO
<i>Varanus bengalensis</i>	Bengal monitor	Gui shap	VU
<i>Varanus salvator</i>	Ring lizard	Kalo gui	EN
<i>Xenochrophis piscator</i>	Checkered keelback	Dhora shap	NO
<i>Amphiesma stolata</i>	Stripped keelback	Dora shap	NO
<i>Enhydryis enhydryis</i>	Common smooth water snake	Paina shap	NO
<i>Coluber mucosus</i>	Rat snake	Daraj shap	VU
<i>Ahaetulla nasutus</i>	Common vine snake	Laodoga shap	VU
<i>Atretium schistosum</i>	Olive keelback	Maitta shap	NO
<i>Naja naja</i>	Monocellate cobra/ Spectacled cobra	Khoia gokhra	EN
Class: Aves			
<i>Ardeola grayii</i>	Indian pond heron	Kani bok	NO
<i>Casmerodius albus</i>	Great egret	Sada bok	NO
<i>Egretta intermedia</i>	Intermediate egret	Mazla bok	NO
<i>Egretta garzetta</i>	Little egret	Choto bok	NO
<i>Nycticorax nycticorax</i>	Black-crowned night heron	Nishi bok	NO
<i>Ixobrychus cinnamomeus</i>	Cinnamon Bittern	Lal bok	NO
<i>Anastomus oscitans</i>	Asian Openbill	Shamuk-khol	NO
<i>Haliastur indus</i>	Brahminy kite	Shankho chil	NO
<i>Milvus migrans</i>	Black kite	Bhubon chil	NO
<i>Actitis hypoleucos</i>	Common sandpiper	Kada Khocha	--
<i>Streptopelia chinensis</i>	Spotted dove	Tila Ghughu	NO
<i>Streptopelia decaocto</i>	Eurasian collared dove	Raj Ghughu	NO
<i>Psittacula krameri</i>	Rose-ringed parakeet	Tia	NO
<i>Amaurornis phoenicurus</i>	White-breasted waterhen	Dahuk	NO
<i>Eudynamis scolopacea</i>	Asian cuckoo	Kokil	NO
<i>Centropus sinensis</i>	Greater coucal	Kanakua	NO
<i>Cuculus micropterus</i>	Indian cuckoo	Bou-kotha-kao Pakhi	NO
<i>Athene brama</i>	Spotted owlet	Khuruley Pencha	NO
<i>Alcedo atthis</i>	Common kingfisher	Choto Maachranga	NO
<i>Halcyon smyrnensis</i>	White-throated kingfisher	Sada buk Maachranga	NO
<i>Ceryle rudis</i>	Pied kingfisher	Pakra Maachranga	NO
<i>Megalaima haemacephala</i>	Coppersmith barbet	Choto Basanta Bauri	NO
<i>Oriolus xanthornus</i>	Black-headed oriole	Holdey Pakhi	NO
<i>Corvus splendens</i>	House crow	Pati Kak	NO
<i>Dicrurus macrocercus</i>	Black drongo	Fingey	NO
<i>Copsychus saularis</i>	Oriental magpie robin	Doel	NO
<i>Acridotheres fuscus</i>	Jungle myna	Jhuti Shalik	NO
<i>A. tristis</i>	Common myna	Bath Shalik	NO
<i>A. ginginianus</i>	Bank myna	Gang Shalik	NO
<i>Sturnus contra</i>	Asian pied starling	Gobrey Shalik	NO
<i>S. malabaricus</i>	Chestnut-tailed starling	Kath Shalik	NO
<i>Pycnonotus cafer</i>	Red-vented bulbul	Bulbuli	NO

Scientific Name	English Name	Local Name	Local Status
<i>Turdoides striatus</i>	Jungle babbler	Satbhai	NO
<i>Orthotomus sutorius</i>	Common tailorbird	Tuntuni	NO
<i>Passer domesticus</i>	House sparrow	Charui	NO
<i>Ploceus philippinus</i>	Baya weaver	Babui	NO
<i>Upupa epops</i>	Eurasian Hoopoe	Hudhud Pakkhi	
Class: Mammalia			
<i>Pteropus giganteus</i>	Flying Fox	Badur	NO
<i>Pipistrellus coromandra</i>	Indian Pipistrelle	--	NO
<i>Megaderma lyra</i>	Greater False Vampire	Badur	NO
<i>Herpestes edwarsi</i>	Common Mongoose	Bara benji	VU
<i>H. auropunctatus</i>	Small Indian Mongoose	Benji	NO
<i>Vulpes bengalensis</i>	Bengal Fox	Khek shial	VU
<i>Rattus rattus</i>	Common House Rat	Indur	NO
<i>Bandicota indica</i>	Bandicoot Rat	Bara indur	NO
<i>B. bengalensis</i>	Lesser Bandicoot Rat	Indur	NO
<i>Mus musculus</i>	House Mouse	Nengri indur	NO
<i>Suncus murinus</i>	House Shrew	Chicka	NO

Source: Baseline Environmental Survey, August 2017 and Literature Review and IUCN Red Data Book (2003).

Notes: EN – Endangered, VU – Vulnerable, NO – Not Threatened

Fish is the most important aquatic fauna of the subproject areas, along with other groups. The aquatic fauna includes Prawns (*Macrobrachium* spp.), crabs, snails (*Pila*, *Vivipara*, *Lymna* etc.), freshwater mussels (*Lamellidens* sp.) etc. Kolabang (*Rana tigrina*); Guishap (*Varanus bengalensis*) and Matia sap (*Enhydrysenhydryis*) are common. The aquatic birds are – Pancowri (*Phalacrocorax carbo*), Kanibok (*Ardeola grayii*), Sadabok (*Egretta garzetta*), Borobok (*Egretta alba*), Machranga (*Halcyon pileata*), Dahuk (*Gallinago cinerea*), and winter migratory birds – Balihash (*Dendrocygna javanica*) and Chakha (*Tadorna ferruginea*).

Table 4.10: Common Fish Species in the SPIA of the Subprojects

Sl. No.	Local Name	Scientific Name	English Name	Local Status
1	Tengra	<i>Batasio batasio</i>	Tista Batasio	NO
2	Pabda	<i>Ompok pabo</i>	Pabo catfish	EN
3	Puti	<i>Puntius sophore</i>	Spotfin Swamp Barb	NO
4	Darkina	<i>Esomus danricus</i>	Flying barb	DD
5	Dhela	<i>Osteobrama cotio</i>	Cotio	EN
6	Chela	<i>Salmostoma acinaces</i>	Silver Razorbelly Minnow	DD
7	Rui	<i>Labeo</i> sp.		DD
8	Catla	<i>Catla catla</i>	Catla	NO
9	Mrigal	<i>Cirrhinus mrigala</i>	Mrigal	NO
10	Ayre	<i>Aorichthys aor</i>	Longwhiskered Catfish	VU
11	Chital	<i>Notopterus chitala</i>	Humped Featherback	EN
12	Boyal	<i>Wallago attu</i>	Freshwater	NO
13	Pungus	<i>Pangasius pangasius</i>	Pungas	CR
14	Elish	<i>Tenualosa ilisha</i>	Hilsha	NO
15	Bele	<i>Awaous gutum</i>		NO
16	Foli	<i>Notopterus notopterus</i>	Grey featherback	VU
17	Koi	<i>Anodontosoma chachunda</i>	Chachunda	NO
18	Mola	<i>Amblypharyngodon mola</i>	Pale carplet	NO

19	Chapila	Gonialosa manmina	Ganges River	NO
20	Baim	Mactacembalus armatus	Tire truck spineel	EN
21	Gajar	Channa marulius	Giant snakehead	EN
Note: EN= Endangered, VU= Vulnerable, CR= Critically Endangered, NO= Not Threatened, DD= Data Deficient				

Source: Baseline Environmental Survey, August 2017 and Literature Review and IUCN Red Data Book (2003)

4.4.3 Biodiversity/Environmentally Sensitive and Protected Areas

Many wildlife species are in stress in Bangladesh. The status of faunal species in Bangladesh has been published by IUCN (2000). According to the IUCN findings this country has lost 10% of its mammalian fauna, 3% avifauna and 4% reptiles over the last 100 years. More than 50 species are presently critically endangered in Bangladesh of which 23 species are already declared as endangered in the Red Data Book of IUCN. In addition, 83 species are commercially threatened and are included in the appendices of Convention on International Trade in Endangered Species (CITES). Among the most endangered species are: elephant, tiger, wild Cat, Leopard or wild goat, serao, dolphin; birds: white-winged duck, comb duck, stork, carne, pheasant, partridge, and crocodile, python, monitor, lizard, tiger terrapin, roofed turtle, soft turtle, and marine turtles.

In the 1 km SPIA, some wildlife species were identified as locally vulnerable. The name of these vulnerable species are Bengal monitor, Rat snake, Common vine snake, Crested Serpent-eagle, Yellow-footed green pigeon, Common mongoose, Bengal fox, Small Indian Civet. Some species were also identified as locally endangered and these are Ring lizard, Monocellate cobra, and Jungle cat. Any construction must consider impacts on the rate of deforestation, loss of habitat, habitat fragmentation, and interruption of wildlife migration patterns. Figure 4.23 shows the environmental sensitive/protected areas (EPA) within Chittagong division. From the Table 4.1, Figure 4.23 and local people, it is known that no EPA is located within ROW, SPIA and even within 10km from the subprojects.

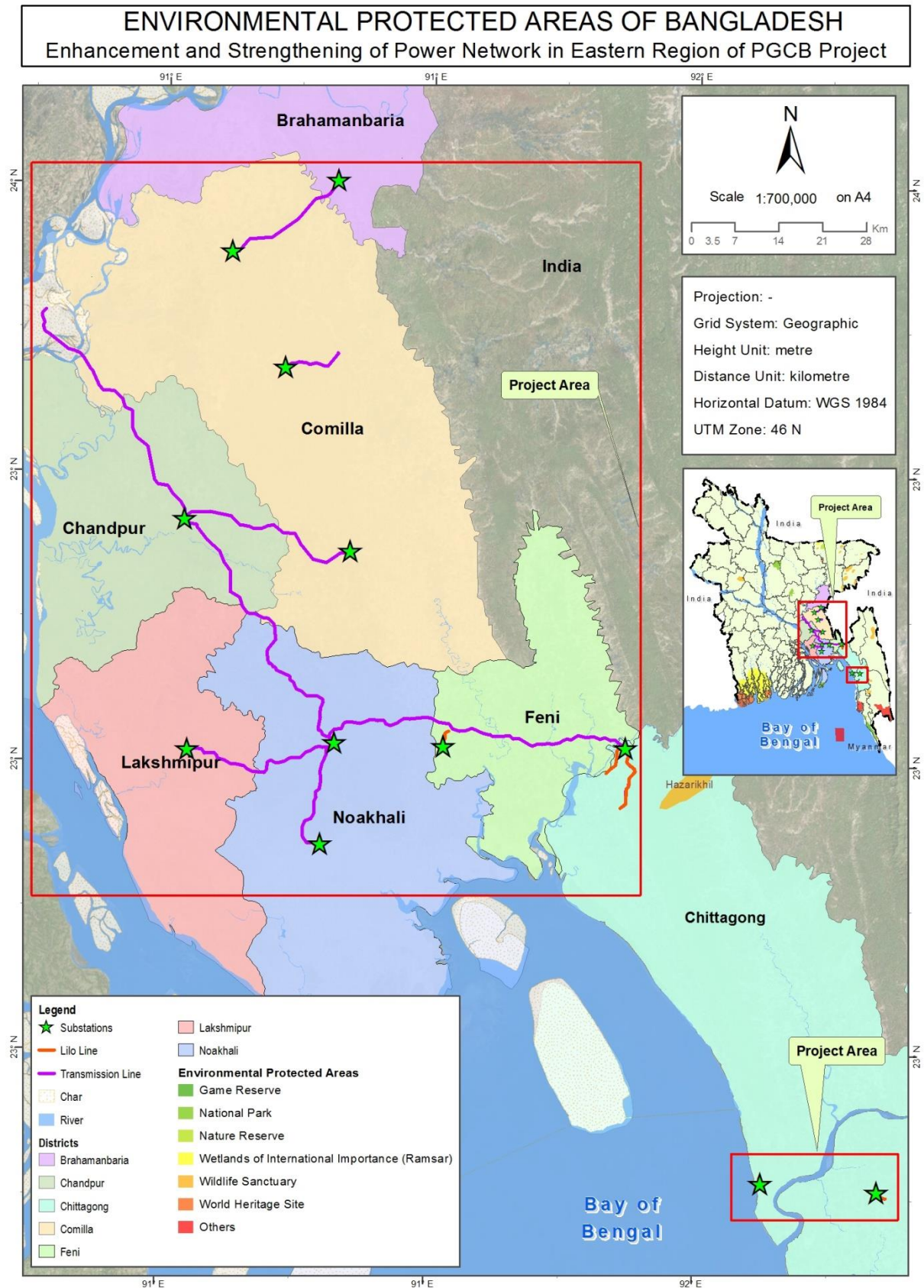


Figure 4.23: Environmental Protected Areas of Bangladesh and the Project Area

4.5 Socio-Economic Environment

4.5.1 Demography

According to socio-economic survey (SES) during 18 June-27 July 2017, the total household (HH) number is 650 who have lands (mainly agricultural lands) within the ROW of the sub-projects. The total number of PAPs is 2027 out of which 1309 persons (64.58%) are male and 718 persons (35.42%) are female. This ratio is much lower than the national male-female ratio (109:100) because the social survey couldn't always reach the residence of the affected households since they are losing agricultural lands and /or trees. In some cases land owners are not readily available at ground and neighbors have provided information of the HHs. The household size among the PAPs is 3.12. It is noted that there is no ethnic minority in the project area. Besides, all of the affected households in the project area recognized as Bengali. No housing structures will be affected due to the ROW of the subprojects. Affected households and population within the ROW of the sub-project areas is given in the following Table 4.11

Table 4.11: Affected Households and Population within the ROW of the sub-project areas

Area	HH	Male		Female		Total Population		HH Size	Sex Ratio
	No	No.	%	No.	%	No.	%		
Total Alignment	650	1,309	64.58	718	35.42	2,027	100	3.12	548

Source: SES during 18 June-27 July 2017.

Percentage of male headed households (92%) is higher than that of female headed households (7%). In Bangladesh men are predominantly the head of the household. Female-headed households will be eligible for a special grant as per the policy of the RAP.

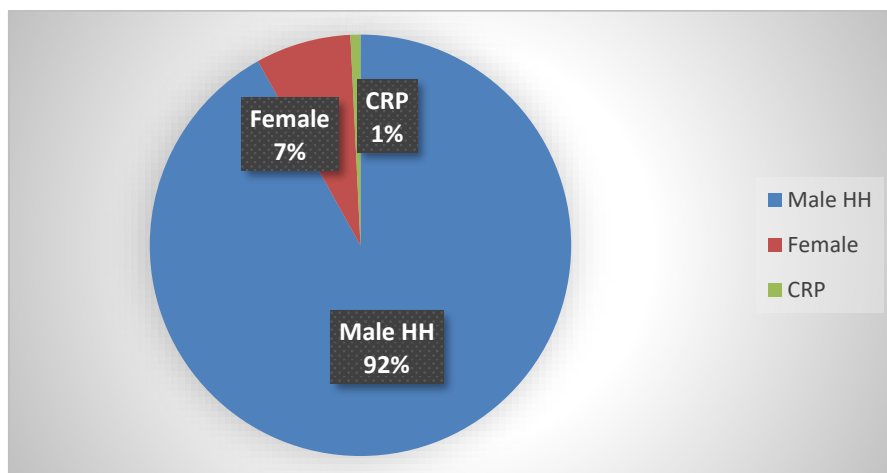


Figure 4.24: Sex-wise distribution of household heads

4.5.2 Age Composition

According to national demography there are 109 males for every 100 females in Bangladesh (BBS 2011). This area is also following the regular trend of Bangladesh and male population is higher in

almost all age groups. Eight percent of the people (7.10% male and 1.23% female) were recorded as being over 60 years old, which is higher than the national percentage of 5.74% (BBS 2011).

Table 4.12: PAPs Age Composition by Sex

Age Group	Male		Female		Total	
	No	%	No	%	No	%
Age (1 - 10)	94	4.64	86	4.24	180	8.88
Age (10 - 20)	235	11.59	158	7.79	393	19.39
Age (21 - 30)	231	11.40	123	6.07	354	17.46
Age (31 - 40)	207	10.21	145	7.15	352	17.37
Age (41 - 50)	215	10.61	116	5.72	331	16.33
Age (51 - 60)	183	9.03	65	3.21	248	12.23
Age (60+)	144	7.10	25	1.23	169	8.34
Total	1309	64.58	718	35.42	2027	100

Source: SES during 18 June-27 July 2017

4.5.3 Marital Status

The following figure (Figure 4.25) shows the marital status of population (HH members) 18 years old & above. It is found that 64% are married, 35% are unmarried and only 1% are widow/widower. The marriage rate of female is higher than male.

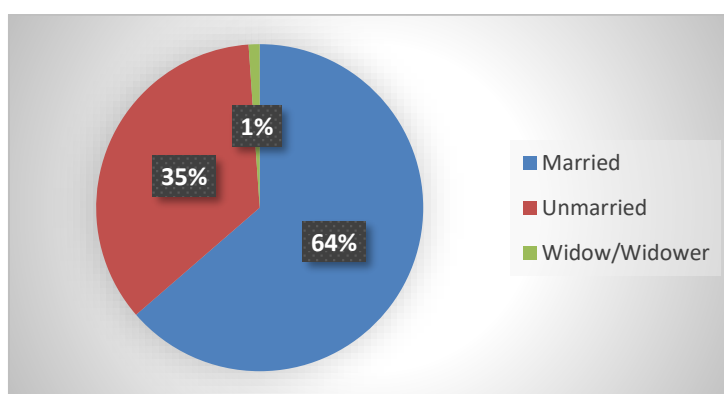


Figure 4.25: Marital status of population (HH members) 18 years old & above

4.5.4 Household by Religion

The following table (Figure 4.26) shows the distribution of households by religious category. It is found that Islam is the predominant religion in the study area (98%). The percentages of Hindu households are minimal (2%).

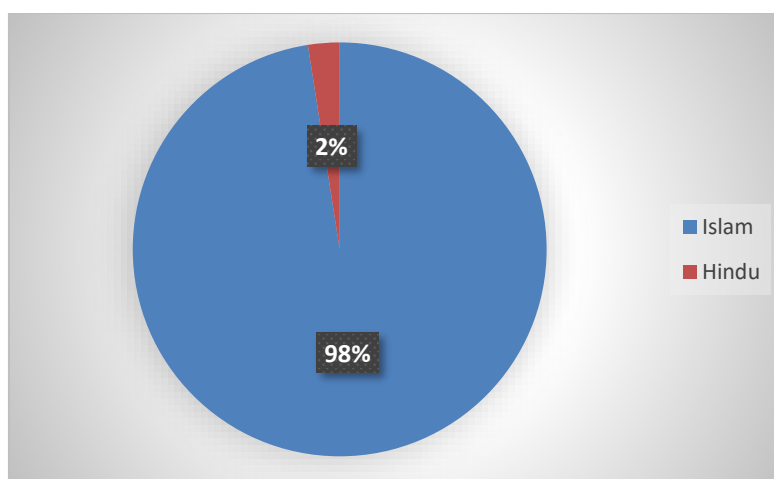


Figure 4.26: Affected households and population by religion

4.5.5 Education

The education level in the sub-project affected area is higher than the national average (62.7, Bangladesh Economic review, 2017). The SE survey suggested that only 4.74% (male 2.27% and female 2.47%) of all PAPs were illiterate. The survey also identified that the education level at and above the basic university (graduate) level is very minimal.

Table 4.13: Education level of the PAPs

Education	Male		Female		Total	
	No	%	No	%	No	%
Illiterate	46	2.27	50.00	2.47	96	4.74
Can sign only	33	1.63	55.00	2.71	88	4.34
Can read and write	34	1.68	23.00	1.13	57	2.81
Primary School	292	14.41	209.00	10.31	501	24.72
Below SSC	355	17.51	196.00	9.67	551	27.18
SSC	204	10.06	102.00	5.03	306	15.10
HSC	181	8.93	48.00	2.37	229	11.30
Graduate	134	6.61	18.00	0.89	152	7.50
Above	30	1.48	17.00	0.84	47	2.32
Total	1309	64.58	718.00	35.42	2027	100

Source: SES during 18 June-27 July 2017

4.5.6 Income and Expenditure of HHs

Based on Bangladesh Bureau of Statistics (BBS, 2011) and yearly inflation (average 6.50% per year) as of 2017, the poverty line income of the affected HHs has been considered up to BDT 6391 per month for the HHs size of 3.12 people. There are only six HHs are below the poverty in terms of income. These HHs will be eligible for special support as per RPF of the project.

Table 4.14: Income and expenditure ration of HHs

Income Range (Monthly)	Income		Expenditure		Remarks
	Income	Percent	Frequency	Percent	
Upto 10000	102	15.7	105	16.2	Only 6 HHs are below poverty line (6391 BDT)
10001 - 20000	312	48.0	382	58.8	

Income Range (Monthly)	Income		Expenditure		Remarks
	Income	Percent	Frequency	Percent	
20001 - 30000	145	22.3	118	18.2	
30001 - 40000	49	7.5	15	2.3	
40001 - 50000	14	2.2	3	.5	
Above 50000	28	4.3	27	4.2	
Total	650	100.0	650	100.0	

Source: SES during 18 June-27 July 2017

4.5.7 Occupation Pattern

Among the affected people, businesses and services appear to be the main occupations (26.74%). Among the male population, most of the eligible and capable members are involved in income generating activities. Female are mostly housewife and also involved in allied activities focusing on maintaining the home and families. As per the survey 2.27 % male and 1.23 % female are found to be totally unemployed. Income and livelihood restoration program can enhance capacity of the people particularly female and vulnerable people for doing more income generating activities.

Table 4.15: Principal occupation of the affected population in the Project area

Sl. No	Occupation	Male		Female		Total		Employed	Unemployed
		No	%	No	%	No	%		
1	Service	241	11.89	-	-	241	11.89	241	-
2	Business	301	14.85	-	-	301	14.85	301	-
3	Day Labor	56	2.76	-	-	56	2.76	56	-
4	Agriculture	137	6.76	-	-	137	6.76	137	-
5	Boatman	-	-	-	-	-	-	-	-
6	Motor driver	25	1.23	-	-	25	1.23	25	-
7	Carpenter	3	0.15	-	-	3	0.15	3	-
8	Mason	5	0.25	-	-	5	0.25	5	-
9	Electrician	1	0.05	-	-	1	0.05	1	-
10	Housewife	-	-	468	23.09	468	23.09	-	468
11	Unemployed	46	2.27	25	1.23	71	3.50	-	71
12	Student	337	16.63	101	4.98	438	21.61	-	438
13	Medical practitioner	3	0.15	-	-	3	0.15	3	-
14	Layer	1	0.05	-	-	1	0.05	1	-
15	Others	65	3.20	-	-	65	3.20	65	-
16	Child	80	3.94	124	6.14	204	10.08	-	204
17	Disabled	8	0.39	-	-	8	0.39	-	8
	Total	1,309	64.56	718	35.44	2,027	100.00	838	1,189
								41.34	58.66

Source: SES during 18 June-27 July 2017

4.5.8 Economic Activities of HHs

The survey identified that business/shop keeping and agriculture are the main economic sources of the HHs. On the other hand the figure below shows that share cropping and agriculture are the allied/secondary economic income sources of HH as women mostly connected to such activities along with household activities.

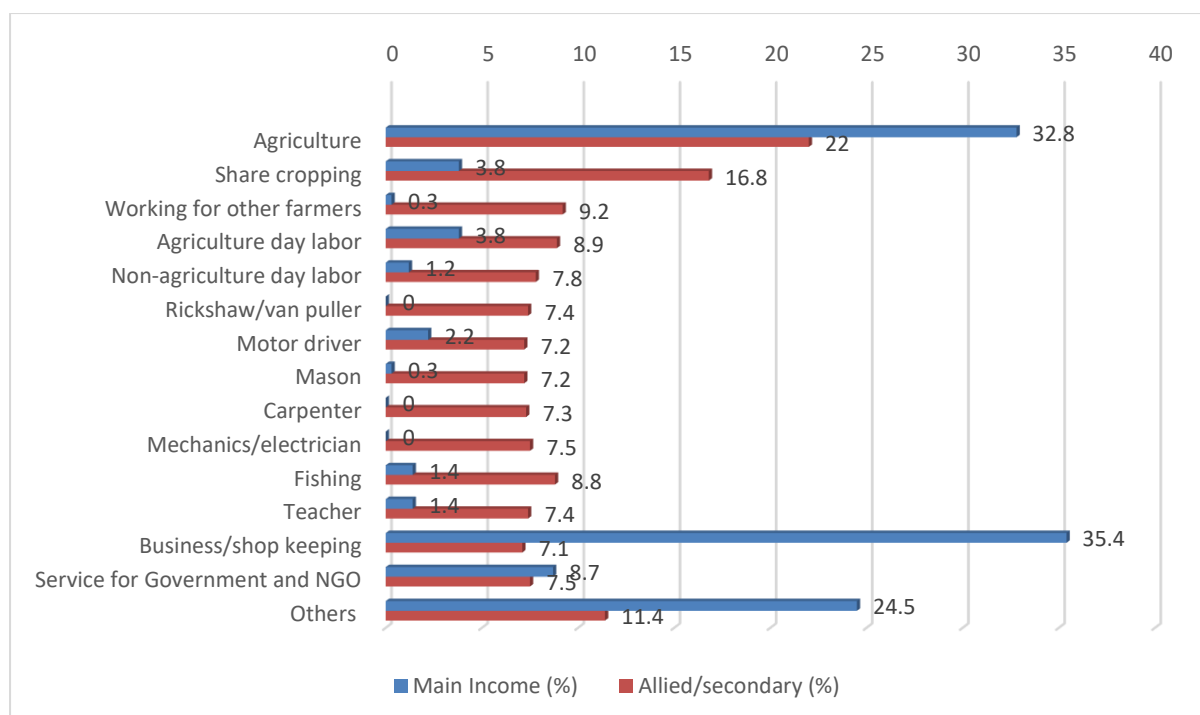


Figure 4.27: Economic Activities of Eligible PAPs

4.5.9 Poverty and Gender

4.5.9.1 Overview

The socioeconomic survey revealed that no women is engaged in any ingenerating activities particularly rather allied activities. Housewife is the main occupation in case of capable women (more than 18 years). Since the project alignment crosses mostly rural area, the income opportunities of women are very low. It was found during survey that male household members remain reluctant to have adult female household members engage in outside work and services.

4.5.9.2 Vulnerable Groups

The census data show that 184 households and 8 people with disability are within the vulnerable category. Out of vulnerable households, 48 are particularly female headed HHs, 130 are elderly (>60 yrs.) male-headed HHs, six are under poverty line of male HHs. As defined in this RAP, the vulnerable HHs will be eligible for special resettlement benefits in order to help maintain their livelihoods once the project work begins.

Table 4.16: Type of Vulnerability

Type of Vulnerable household	Number	Percentage
Female headed household	48	25.00
Elderly age 60+ Male headed household	130	67.71
Male headed under poverty line	6	3.13
Number of people with disability	8	4.17
Total	192	100.00

4.5.10 Land Acquisition and Requisition

4.5.10.1 Overview

Census and IOL were conducted to determine the overall impact of the project. Private lands are to be acquired mainly for the 12 substation subprojects of the project. For the erection of total 884 no. towers of the eight TLs & eight LLs of the project, lands also will be required but temporarily. The project avoided physical displacement during planning of the project. In case of impact on premises, local PAPs were consulted to find alternative place to elude avoid physical displacement and impacts on any structures.

4.5.10.2 Land Acquisition & Temporary Requirement

According to SES, the project will require acquisition of 86 acres of private land for the 12 substations. The proposed lands for acquisition are longed in null category as are being used for agricultural purpose. Compensation of the private land and government land has been provisioned in the Resettlement Action Plan (RAP). By law, the Deputy Commissioner (DC) will pay compensation for all categories of land to be permanently acquired or temporarily taken for the project following the ARIPO 1982. A Property Valuation Advisory Team (PVAT) will determine the final replacement value for acquired land during implementation of the RAP. The RAP includes replacement costs based on tax roll data and market survey, for the amounts shown in Table 4.17.

According to SES, a total 804 acres of land for the erection of the total 884 towers of the eight TLs & 8 LLs will be taken temporarily and only crop compensation will be provided for the standing crops (if any) of cropping period if the civil construction makes a bar to cultivate the land during cropping time.

Table 4.17: Land by GIS Locations; permanently acquired (in Acre)

Sl. No.	District Name	Substation Name	Area (Acre)	Percentage
1	Noakhali	230/132 kV: Chowmuhoni GIS 3x250/350 MVA	5	6%
2	Chandpur	230/132 kV: Kachua GIS 2x250/350 MVA	5	6%
3	Comilla	132/33 kV: Muradnagar AIS 2x50/75 MVA	5	6%
4	Comilla	132/33 kV: Lakhsam GIS 2x50/75 MVA	2	2%
5	Noakhali	132/33 kV: Maijdee GIS 2x50/75 MVA	5	6%
6	Chittagong	132/33 kV: Patiya GIS 2x50/75 MVA	5	6%
7	Comilla	132/33 kV: Chandina GIS 2x50/75 MVA	2	2%
8	Chittagong	132/33 kV: Anandabazar (New Mooring) GIS 3x80/120 MVA (Future 400kV Provision)	20	23%
9	Noakhali	132/33 kV: Basurhat GIS 2x50/75 MVA	2	2%
10	Laxmipur	132/33 kV: Laxmipur GIS 2x50/75 MVA	5	6%
11	Brahmanbaria	132/33 kV: Kosba GIS 2x50/75 MVA	5	6%
12	Chittagong	400 kV Korerhat	25	29%
Total			86	

Note: Mirsharai Substation is located in newly raised char land which is still not included into government records.

4.5.10.3 Cultural Sites

From the toposurvey, SES and environmental survey of the project, it is understood that no EPA and cultural sites (such as mosque, school, madrasa, graveyard, monument and eidgah) are located within the ROW of the SS, TL & LL. But from the Table 5.1 & Appendix –B, it is known that a mosque

at 200m far away at east side of the Kachua substation and a mosque at 100m far away at east side of Bashurhat substation are located within the SPIA and from the Table 4.1 & Appendix –C, it is known that a mosque at 20m faraway at ch 48+300 and a school at 40m faraway 49+250 from the boundary line of Korerhat-Chowmuhi TL are located within SPIA.

5 ANALYSES OF ALTERNATIVES

5.1 Analyses of Alternatives for TL & LILO Route Selection - (Assessment & Management Process)

Activities like construction of transmission lines and its subsequent operation and maintenance are non-polluting in nature and its environmental impact are also negligible and are restricted to Right of Way (ROW) only. Another feature which is also very crucial in making this statement is the inherent flexibility available in routing of power transmission lines and locating substations, which help to the great extent in avoiding environmentally sensitive areas such as fragile ecosystems with their inherent biodiversity, and also dense human habitats and areas of cultural significance.

Generally, speaking all the potential environmental impacts of transmission lines can be avoided or mitigated through careful route and site selection as explained above. Keeping this aspect in mind due consideration has been provided in deciding the route alignment including study of different alternatives for proposed transmission lines under the scope of two projects. During route alignment all possible efforts are made to avoid the forest area involvement completely or to keep it to the barest minimum, whenever it becomes unavoidable due to the geography of terrain or heavy cost involved in avoiding it.

5.2 Study of Alternatives

5.2.1 Environmental Criteria for TL and LILO Route Selection

For selection of optimum route, the following points are taken into considerations:

- i) The route of the proposed transmission lines does not involve any human rehabilitation.
- ii) Any monument of cultural or historical importance is not affected by the route of the transmission line.
- iii) The proposed route of transmission line does not create any threat to the survival of any community with special reference to Tribal Community.
- iv) The proposed route of transmission line does not affect any public utility services like playgrounds, schools, other establishments etc.
- v) The line route does not pass through any sanctuaries, National Park etc.
- vi) The line route does not infringe with area of natural resources.

In order to achieve this, different alternatives were studied for all the major transmission lines with understanding that ***minor alterations often added to avoid environmentally sensitive areas and settlements at execution stage.***

- As a rule, alignments are generally cited 10-15 km away from major towns, whenever possible, to account for future urban expansion.
- Similarly, forests are avoided to the extent possible, and when it is not possible, a route is selected in consultation with the local Divisional Forest Officer, that causes minimum damage to existing forest resources.
- Alignments are selected to avoid wetlands and unstable areas for both financial and environmental reasons.

In addition, care is also taken to avoid National parks, sanctuaries, eco-sensitive zones, and conservation reserves etc. Keeping above in mind the routes of proposed lines under the project has been so aligned that it takes care of above factors. As such different alternatives were studied with the help of Google Earth and Survey of Bangladesh (SOB) Topographical survey sheets etc. to arrive at most optimum route which can be taken up for detailed survey and assessment of environmental & social impacts for their proper management.

5.2.1.1 Evaluation of Alternative Route Alignments of 230kV D/C Korerhat – Chowmuhoni Transmission Line

Three different alignments were studied (refer Map 5. 1) with the help of published data/Google maps and walkover survey to arrive at most optimum route for detailed survey. The comparative details of these three alternatives in respect of proposed line are as follows:

Sl.	Description	Alternative-I	Alternative-II	Alternative-III
1.	Route particulars			
	i) Length in Kms	52.727	53.778	52.900
	ii) Terrain(Km)- Plain/ Hilly	Plain	Plain	Plain
2.	Environmental impact			
	i) Towns in alignment	Chowmuhoni	Chowmuhoni	Chowmuhoni
	ii) Forest involvement	Nil	Nil	Nil
	iii) Historical/Cultural monument	Nil	Nil	Nil
	iv) Endangered species, if any	Nil	Nil	Nil
3.	Major Crossings:			
	i) River (Nos.)	2	2	2
	ii) Power line (Nos.)	4	4	5
	iii) Railway line(Nos.)	1	1	1
	iv) National Highway(Nos.)	1	1	1
	v) Khal (Nos.)	11	14	13
4.	Construction problems	Shortest line length and line route passing mostly through agricultural field. Better approachability with lesser number of khal crossings	Longest line length and involvement more number of khal crossings	Longer line length and involvement of more number of khal crossings & Power line crossings. Also closer to habitation area.
5.	O&M problems	O&M shall be comparatively easier due to better accessibility of line route	Moderate accessibility to line route	Moderate accessibility to line route

Conclusion and Recommendation:

- **Khal Crossing:** The alternative -1 is most optimum as it has minimum number of khal crossing and river crossings having minimum span as compared to other alternatives.
- **Forest:** The forest involvement in all three alternatives is nil.

- **Terrain Condition & Accessibility:** All the three alternatives are passing through plain area. However, Alternate-1 has full accessibility (Roads, cart-tracks) for construction and maintenance purpose in comparison to other routes.

Based on above analysis, **Alternative-I** has been found to be most optimum alignment and recommended for detailed survey.



Map 5.1: Three alternative route alignments for 230 kV D/C Korerhat – Chowmuhani TL

5.2.1.2 Evaluation of Alternative Route Alignments of 230kV D/C Chowmuhoni- Kachua Transmission Line

Three different alignments were studied (refer Map 5.2) with the help of published data/Google maps and walkover survey to arrive at most optimum route for detailed survey. The comparative details of these three alternatives in respect of proposed line are as follows:

Sl.	Description	Alternative-I	Alternative-II	Alternative-III
1.	Route particulars			
	i) Length in Kms	49.05	48.58	50.12
	ii) Terrain (Km)- Plain/ Hilly	Plain	Plain	Plain
2.	Environmental impact			
	i) Towns in alignment	Chowmuhoni	Chowmuhoni	Chowmuhoni
	ii) Forest involvement	Nil	Nil	Nil
	iii) Historical/Cultural monument	Nil	Nil	Nil
	iv) Endangered species, if any	Nil	Nil	Nil

Sl.	Description	Alternative-I	Alternative-II	Alternative-III
3.	Major Crossings:			
	i) River (Nos.)	1	1	3
	ii) Power line (Nos.)	1	2	1
	iii) Railway line(Nos.)	Nil	Nil	Nil
	iv) National Highway(Nos.)	2	2	2
	v) Khal (Nos.)	33	36	37
4.	Construction problems	Though relatively longer line length than Alt. 2, but the route passing mostly through agricultural field avoiding habitation areas and involving fewer khal crossings.	Shortest line length but involves more khal crossings and line route passing close to habitation area.	Longest line length & involving relatively more khal crossings.
5.	O&M problems	O&M shall be comparatively easier due to better accessibility of line route as compared to other two alternatives.	Moderate	Moderate



Map 5:2: Three alternative route alignments for 230 kV D/C Chowmuhani - Kachua TL

Conclusion and Recommendation:

- **Khal Crossing:** The alternative -1 is most optimum as it has minimum number of khal crossing in comparison to other alternatives ;

- **Forest:** There is no forest involvement in all three alternatives studied;
- **Terrain Condition & Accessibility:** All the three alternatives are passing through plain area. However, Alternate-1 mostly passing through agricultural paddy field and easy accessibility (through roads, cart-tracks) for construction and maintenance purpose in comparison to other routes.

Based on above analysis, **Alternative-I** has been found to be most optimum alignment and recommended for detailed survey.

5.2.1.3 Evaluation of Alternative Route Alignments of 230kV D/C Gazaria – Kachua Transmission Line

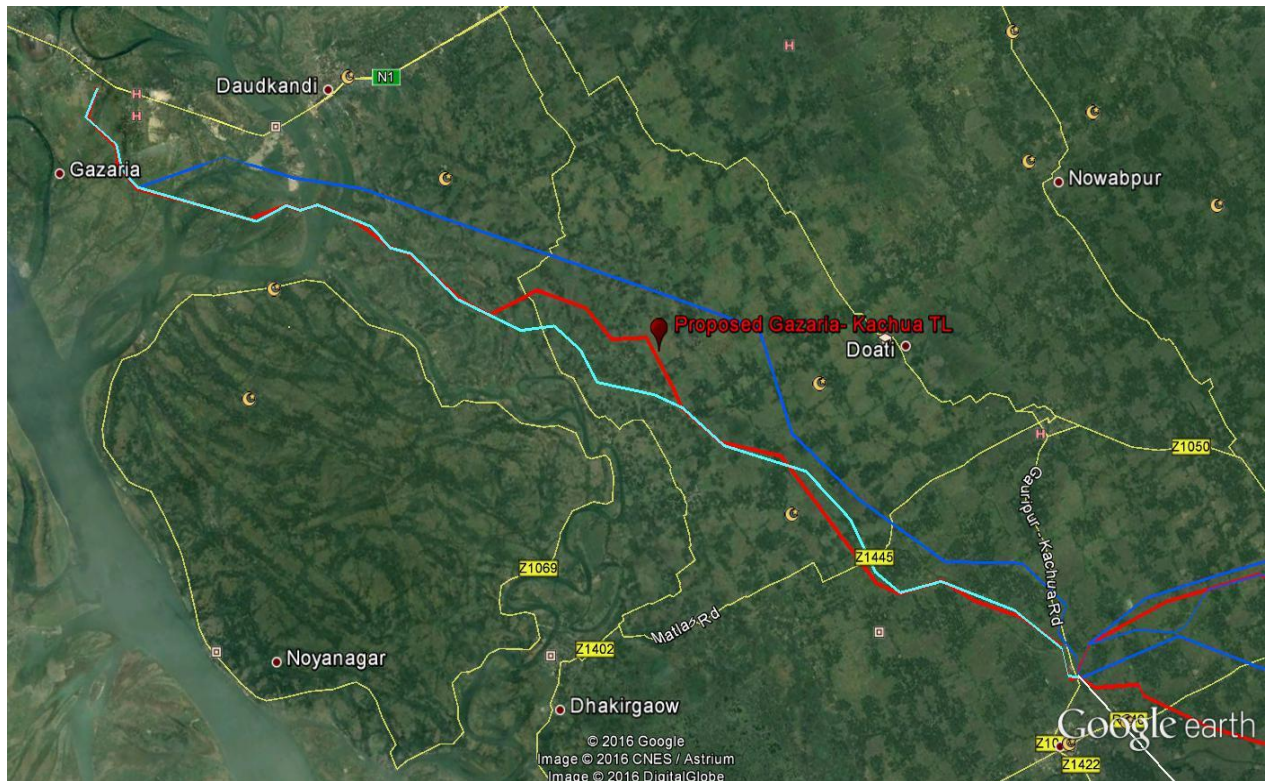
Three different alignments were studied (refer Map 5.3) with the help of published data/Google maps and walkover survey to arrive at most optimum route for detailed survey. The comparative details of these three alternatives in respect of proposed line are as follows:

Sl.	Description	Alternative-I	Alternative-II	Alternative-III
1.	Route particulars			
	i) Length in Kms	45.088	44.264	45.30
	ii) Terrain (Km)- Plain/Hilly	Plain	Plain	Plain
2.	Environmental impact			
	i) Towns in alignment	Gazaria, Suhilpur	Gazaria, Suhilpur	Gazaria, Suhilpur
	ii) Forest involvement	Nil	Nil	Nil
	iii) Historical/Cultural monument	Nil	Nil	Nil
	iv) Endangered species, if any	Nil	Nil	Nil
3.	Major Crossings:			
	i) River (Nos.)	3	3	3
	ii) Power line (Nos.)	1	2	1
	iii) Railway line(Nos.)	Nil	Nil	Nil
	iv) National Highway(Nos.)	2	2	4
	v) Khal (Nos.)	30	30	35
4.	Construction problems	Though relatively longer line length than Alt. 2, but line route has easy approachability and involves lesser tree felling as compared to other alternatives.	Shortest line length but involves more tree felling	Longest line length & involving relatively more khal crossings and river crossing span is more.
5.	O&M problems	O&M shall be comparatively easier due to better accessibility of line route as compared to other two alternatives.	Moderate	Moderate

Conclusion and Recommendation:

- **River & Khal Crossing:** The alternative -1 is most optimum as it has minimum number of khal crossing and river crossing span is minimum as compared to other alternatives;
- **Forest:** There is no forest involvement in all three alternatives studied;
- **Terrain Condition & Accessibility:** All the three alternatives are passing through plain area. However, Alternate-1 mostly passing through agricultural paddy field involving less tree felling and easy accessibility (through roads, cart-tracks) for construction and maintenance purpose in comparison to other routes.

Based on above analysis, **Alternative-I** has been found to be most optimum alignment and recommended for detailed survey.



Map 5:3: Three alternative route alignments for 230 kV D/C Gajaria - Kachua TL

5.2.1.4 Evaluation of Alternative Route Alignments of 230 kV D/C Chowmuhoni - Maijdee Transmission Line

Three different alignments were studied (refer Map 5.4) with the help of published data/Google maps and walkover survey to arrive at most optimum route for detailed survey. The comparative details of these three alternatives in respect of proposed line are as follows:

Sl.	Description	Alternative-I	Alternative-II	Alternative-III
1.	Route particulars			
	i) Length in Kms	20.55	20.43	21.23
	ii) Terrain Plain/Hilly	Plain	Plain	Plain
2.	Environmental impact			
	i) Towns in alignment	Chowmuhoni	Chowmuhoni	Chowmuhoni
	ii) Forest involvement	Nil	Nil	Nil
	iii) Historical/Cultural	Nil	Nil	Nil

Sl.	Description	Alternative-I	Alternative-II	Alternative-III
	monument			
	iv) Endangered species, if any	Nil	Nil	Nil
3.	Major Crossings:			
	i) River (Nos.)	Nil	Nil	Nil
	ii) Power line (Nos.)	Nil	Nil	Nil
	iii) Railway line (Nos.)	Nil	Nil	Nil
	iv) NH (Nos.)	1	2	1
	v) Khal (Nos.)	11	15	13
4.	Construction problems	Though relatively longer line length than Alt. 2, but involves lesser nos. of khal crossings and lesser nos. of tree felling as compared to other alternatives.	Shortest line length but involves more tree felling and also more nos. of khal crossings	Longest line length & involving relatively more nos of khal crossings.
5.	O&M problems	O&M shall be comparatively easier due to better accessibility of line route as compared to other two alternatives.	Moderate	Moderate



Map 5-4: Three alternative route alignments for 230 kV D/C Chowmuhoni - Majdee TL

Conclusion and Recommendation:

- **Khal Crossing:** The alternative -1 is most optimum as it has minimum number of khal crossings as compared to other alternatives;
- **Forest:** There is no forest involvement in all three alternatives studied;
- **Terrain Condition & Accessibility:** All the three alternatives are passing through plain area. However, Alternate-1 is passing through mostly agricultural paddy field involving lesser extent of tree felling and easy accessibility (through roads, cart-tracks) for construction and maintenance purpose in comparison to other routes.

Based on above analysis, **Alternative-I** has been found to be most optimum alignment and recommended for detailed survey.

5.2.1.5 Evaluation of Alternative Route Alignments of 132kV D/C Kachua-Laksham Transmission Line

Three different alignments were studied (refer Map 5.5) with the help of published data/Google maps and walkover survey to arrive at most optimum route for detailed survey. The comparative details of these three alternatives in respect of proposed line are as follows:

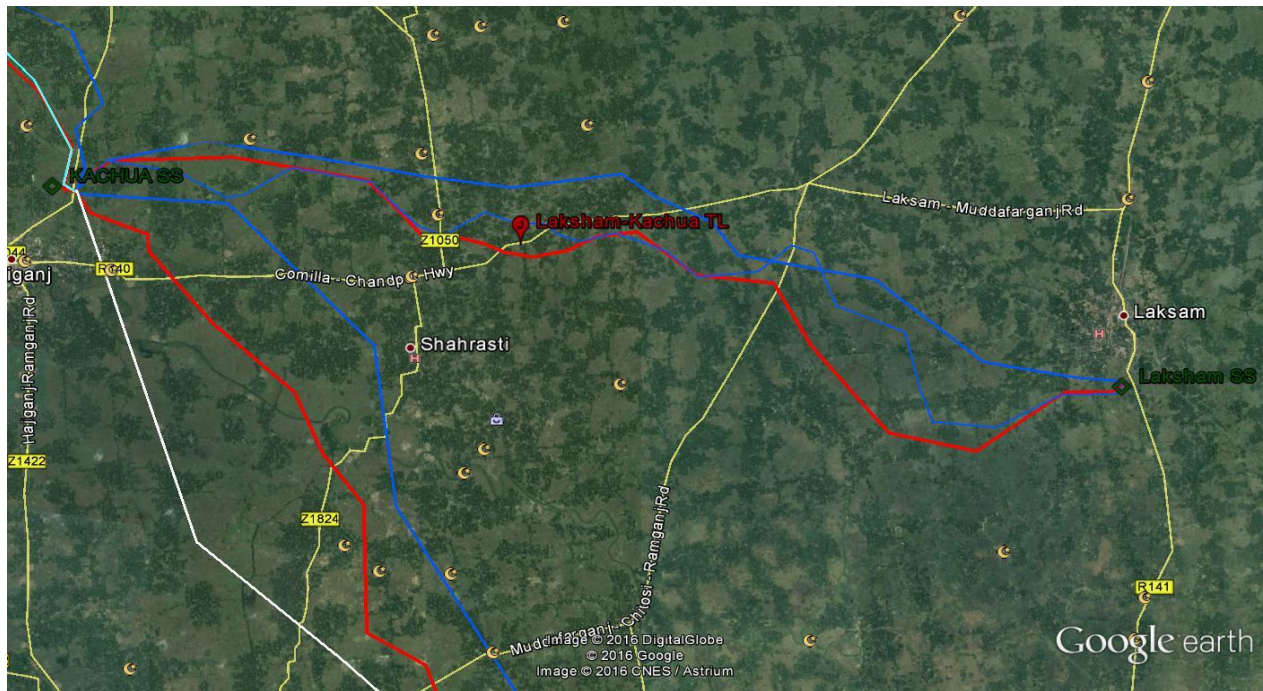
Sl.	Description	Alternative-I	Alternative-II	Alternative-III
1.	Route particulars			
	i) Length in Kms	30.933	32.19	29.30
	ii) Terrain– Plain/Hilly	Plain	Plain	Plain
2.	Environmental impact			
	i) Towns in alignment	Nearby township is Laksham	Nearby township is Laksham	Nearby township is Laksham
	ii) Forest involvement	Nil	Nil	Nil
	iii) Historical/Cultural monument	Nil	Nil	Nil
	iv) Endangered species, if any	Nil	Nil	Nil
3.	Major Crossings:			
	i) River (Nos.)	Nil	Nil	Nil
	ii) Power line (Nos.)	2	3	2
	iii) Railway line(Nos.)	Nil	Nil	Nil
	iv) NH(Nos.)	1	2	1
	v) Khal (Nos.)	22	26	29
4.	Construction problems	Though relatively longer line length than Alt. 3, but involves fewer khal crossings and lesser tree felling as the route is passing mostly through paddy fields compared to other alternatives.	Longest line length, involves more tree felling and more nos. khal crossings.	Shortest line length but line route is passing mostly through vegetation area requiring more tree felling. The route also involves more khal crossings.
5.	O&M problems	O&M shall be comparatively easier	Moderate	High

		due to better accessibility of line route as compared to other two alternatives.		
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Conclusion and Recommendation:

- **Khal Crossing:** The alternative -1 is most optimum as it has minimum number of khal crossings as compared to other alternatives;
- **Forest:** There is no forest involvement in all three alternatives studied;
- **Terrain Condition & Accessibility:** All the three alternatives are passing through plain area. However, Alternate-1 mostly passing through mostly agricultural paddy field which involve less tree felling and easy accessibility (through roads, cart-tracks) for construction and maintenance purpose in comparison to other routes.

Based on above analysis, Alternative-I has been found to be most optimum alignment and recommended for detailed survey.



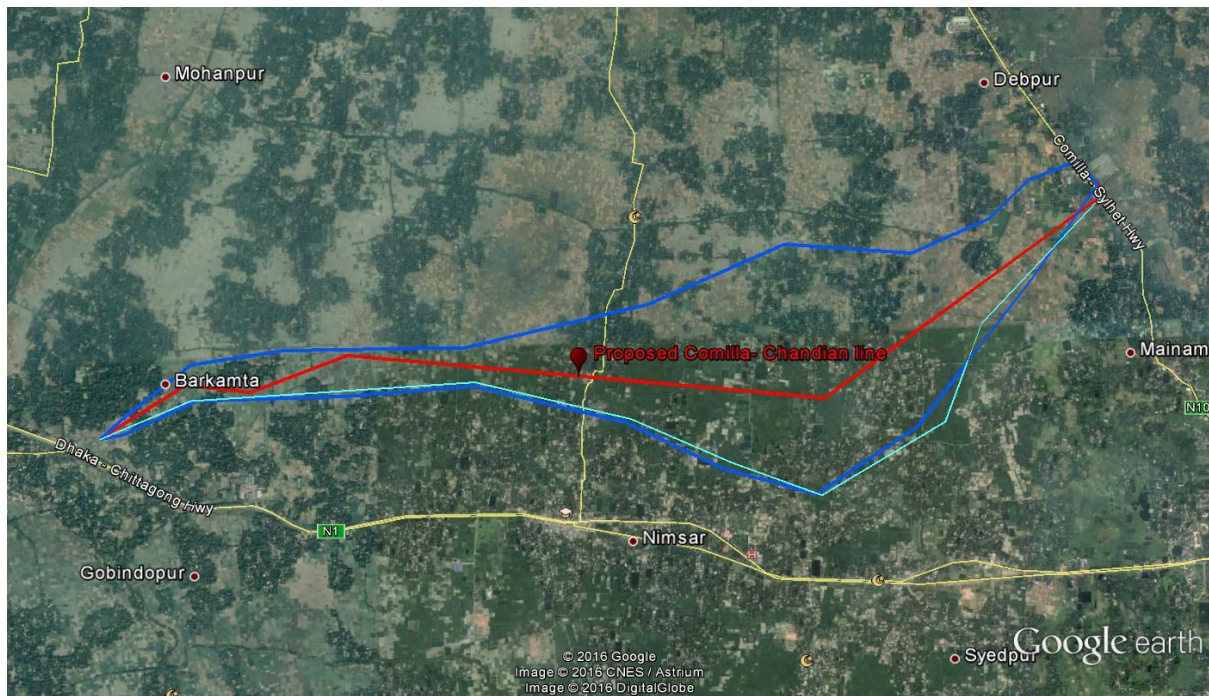
Map 5:5: Three alternative route alignments for 132 kV D/C Kachua - Laksham TL

5.2.1.6 Evaluation of Alternative Route Alignments of 132kV D/C Comilla North- Chandina Transmission Line

Three different alignments were studied (refer Map 5.6) with the help of published data/Google maps and walkover survey to arrive at most optimum route for detailed survey. The comparative details of these three alternatives in respect of proposed line are as follows:

Sl.	Description	Alternative-I	Alternative-II	Alternative-III
1.	Route particulars			
	i) Length in Kms	9.14	9.03	9.90

Sl.	Description	Alternative-I	Alternative-II	Alternative-III
	ii) Terrain (Km)- Plain/ Hilly	Plain	Plain	Plain
2.	Environmental impact			
	i) Towns in alignment	Nearby town is Chandina	Nearby town is Chandina	Nearby town is Chandina & Nimsar
	ii) Forest involvement	Nil	Nil	Nil
	iii) Historical/Cultural monument	Nil	Nil	Nil
	v) Endangered species, if any	Nil	Nil	Nil
3.	Major Crossings:			
	i) River (Nos.)	Nil	Nil	Nil
	ii) Power line (Nos.)	Nil	Nil	Nil
	iii) Railway line (Nos.)	Nil	Nil	Nil
	iv) NH (Nos.)	1	2	1
	v) Khal (Nos.)	1	2	1
4.	Construction problems	Though relatively longer line length than Alt. 2, but line route is passing mostly through paddy field avoiding habitation area.	Shortest in line length but line route is passing mostly through vegetation area causing more tree felling	Longest line length and the route also involves more khal crossings.
5.	O&M problems	O&M shall be comparatively easier due to better accessibility of line route as compared to other two alternatives.	Moderate	High



Map 5:6: Three alternative route alignments for 132 kV D/C Comilla North - Chandina TL

Conclusion and Recommendation:

- **Khal Crossing:** The alternative -1 is most optimum as it has minimum number of khal crossings as compared to other alternatives;
- **Forest:** There is no forest involvement in all three alternatives studied;
- **Terrain Condition & Accessibility:** All the three alternatives are passing through plain area. However, since, Alternate-1 is passing mostly through agricultural field; it involves fewer tree felling and easy accessibility (through roads, cart-tracks) for construction and maintenance purpose in comparison to other routes.

Based on above analysis, **Alternative-I** has been found to be most optimum alignment and recommended for detailed survey.

5.2.1.7 Evaluation of Alternative Route Alignments of 132kV D/C Muradnagar – Kosba Transmission Line

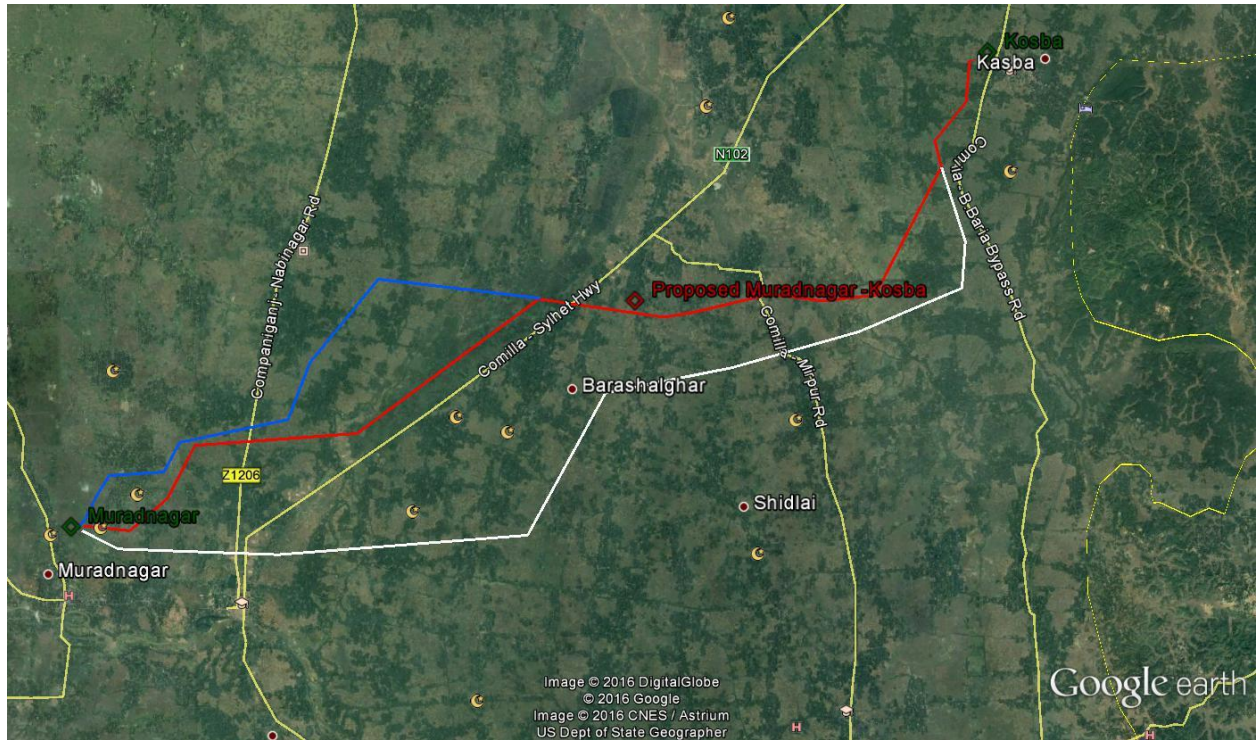
Three different alignments were studied (refer Map 5.7) with the help of published data/Google maps and walkover survey to arrive at most optimum route for detailed survey. The comparative details of these three alternatives in respect of proposed line are as follows:

Sl.	Description	Alternative-I	Alternative-II	Alternative-III
1.	Route particulars			
	i) Length in Kms	26.24	27.02	27.27
	ii) Terrain-Plain/ Hilly	Plain	Plain	Plain
2.	Environmental impact			
	i) Towns in alignment	Nearby towns are Muradnagar & Kasba	Nearby towns are Muradnagar & Kasba	Nearby towns are Muradnagar & Kasba
	ii) Forest involvement	Nil	Nil	Nil
	iii) Historical/Cultural	Nil	Nil	Nil

Sl.	Description	Alternative-I	Alternative-II	Alternative-III
	monument			
	iv) Endangered species, if any	Nil	Nil	Nil
3.	Major Crossings:			
	i) River (Nos.)	Nil	Nil	Nil
	ii) Power line (Nos.)	Nil	Nil	Nil
	iii) Railway line(Nos.)	Nil	Nil	Nil
	iv) NH (Nos.)	1	1	1
	v) Khal (Nos.)	24	23	26
4.	Construction problems	Shortest line length and line route is passing mostly through paddy field avoiding habitation area and easy accessibility from existing road network.	Relatively longer line length and line route is passing close to habitation area.	Longest line length and line route is passing close to habitation area.
5.	O&M problems	O&M shall be comparatively easier due to better accessibility of line route as compared to other two alternatives.	Moderate	High

Conclusion and Recommendation:

All the three alternatives are passing through plain area. However, Alternate-1 is shortest in line length and passing mostly through paddy field and has easily accessibility from the existing road networks as compared to other alternatives. Moreover, Alt.-1 avoids habitation area and vegetation area and therefore, has negligible environmental & social impacts like tree felling, RoW issues etc. Hence, Alternative - I is considered as the most optimized route and recommended for detailed survey.



Map 5.7: Three alternative route alignments for 132 kV D/C Muradnagar - Kosba TL

5.2.1.8 Evaluation of Alternative Route Alignments of 132kV D/C Chowmuhoni - Laxmipur Transmission Line

Three different alignments were studied (refer Map 5.8) with the help of published data/Google maps and walkover survey to arrive at most optimum route for detailed survey. The comparative details of these three alternatives in respect of proposed line are as follows:

Sl.	Description	Alternative-I	Alternative-II	Alternative-III
1.	Route particulars			
	i) Length in Kms	27.38	26.60	27.90
	ii) Terrain-Plain/ Hilly			
2.	Environmental impact			
	i) Towns in alignment	Chowmuhoni	Chowmuhoni	Chowmuhoni
	ii Forest involvement	Nil	Nil	Nil
	iii) Historical/Cultural monument	Nil	Nil	Nil
	iv) Endangered species, if any	Nil	Nil	Nil
3.	Major Crossings:			
	i) River (Nos.)	Nil	Nil	Nil
	ii) Power line (Nos.)	Nil	Nil	Nil
	iii) Railway line(Nos.)	Nil	Nil	Nil
	iv) National Highway	1	1	1
	v) Khal (Nos.)	22	20	24
4.	Construction problems	Though relatively longer line length than Alt. 2 but the line route avoids	Shorter in line length line route is passing through some	Longer line length and line route is passing through

Sl.	Description	Alternative-I	Alternative-II	Alternative-III
		habitation area as well as also vegetation area as compared other alternatives.	habitation area.	vegetation area and also very closed to habitation area.
5.	O&M problems	O&M shall be comparatively easier due to better accessibility of line route as compared to other two alternatives.	Moderate	High



Map 5:8: Three alternative route alignments for 132 kV D/C Chowmuhoni - Laxmipur TL

Conclusion and Recommendation:

All the three alternatives are passing through plain area without involvement of any forest & protected area. Alternative-1 is having relatively longer line length than Alt.-2 but line route is passing mostly through agricultural field with minimum vegetation and away from habitation area and hence minimum tree felling & RoW issues anticipated as compared to other two alternatives. Hence, **Alternative - I** is considered as the most optimum route and recommended for detailed survey.

5.2.1.9 Evaluation of Alternative Route Alignments of LILO of 132 kV D/C Comila (N) - Daudkandi Transmission Line

The line length of the proposed transmission line is 0.5 Km, which is quite short. Due to the short line length, the associated environmental and social impacts will be negligible. Hence, the evaluation of alternative route alignment for this line was not conducted.

5.2.1.10 Evaluation of Alternative Route Alignments of LILO of 132 kV D/C Dohazari - Sikalbaha Transmission Line at Ratiya

The line length of the proposed transmission line is 0.586 Km, which is quite short. Due to short line length, the associated environmental and social impacts will be negligible. Hence, the evaluation of Alternative Route Alignment for this line was not conducted.

5.2.1.11 Evaluation of Alternative Route Alignments of Two Ckt LILO of 132kV D/C Feni - Chowmuhoni Transmission Line at Basurhat

The line length of the proposed transmission line is 2.74 Km, which is quite short. Due to short line length, the associated environmental and social impacts will be negligible. Hence, the evaluation of Alternative Route Alignment for this line was not conducted.

5.2.1.12 Evaluation of Alternative Route Alignments of LILO of 132 kV D/C Halishahr- Khulsi Transmission Line

The line length of the proposed transmission line is 0.63 Km, which is quite short. Due to short line length, the associated environmental and social impacts will be negligible. Hence, the evaluation of Alternative Route Alignment for this line was not conducted.

5.2.1.13 LILO of 400 kV D/C Modhunaghat- Meghnaghat Transmission Line at Korerhat

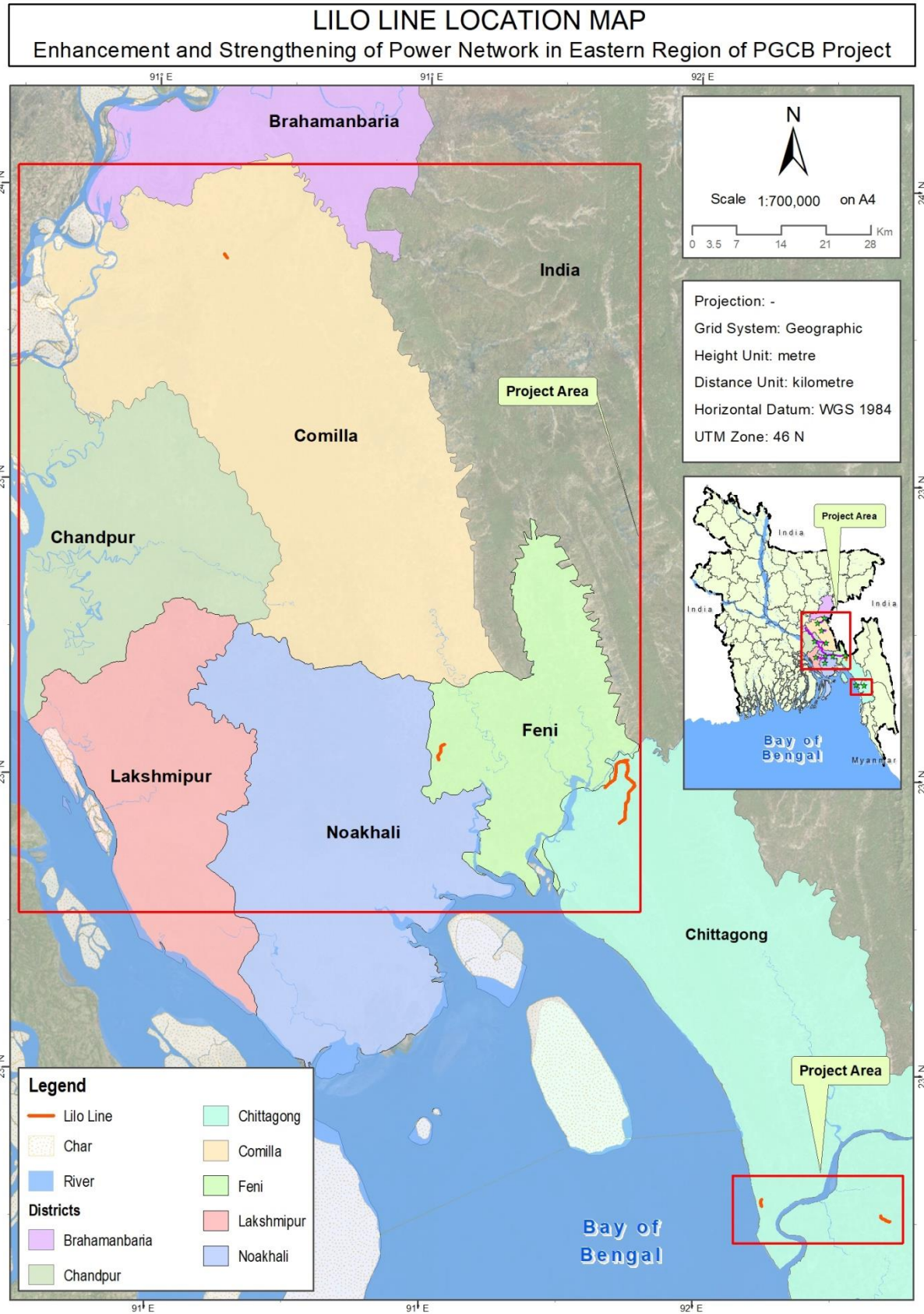
The line length of the proposed transmission line is 0.4 Km, which is quite short. Due to short line length, the associated environmental and social impacts will be negligible. Hence, the evaluation of Alternative Route Alignment for this line was not conducted.

5.2.1.14 LILO of 230 kV D/C Comilla (N) - Hathazari Transmission Line

The line length of the proposed transmission line is 5.73 Km, which is quite short. Due to short line length, the associated environmental and social impacts will be negligible. Hence, the evaluation of Alternative Route Alignment for this line was not conducted.

5.2.1.15 LILO of 132 kV D/C Feni- Hathazari Transmission Line

The line length of the proposed transmission line is 2.80 Km, which is quite short. Due to short line length, the associated environmental and social impacts will be negligible. Hence, the evaluation of Alternative Route Alignment for this line was not conducted.



5.2.1.16 Extension of Alternative LILO of 400 kV D/C Mirsharai – BSRM Transmission Line to Korerhat

The line length of the proposed transmission line is 11.33 Km. this line will cross some hilly areas and need to trim few forest trees on the hill slopes. However, the associated environmental and social impacts will be insignificance. Hence, the evaluation of Alternative Route Alignment for this LILO line was not conducted.



Map 5:10: Route of LILO of 400 kV D/C Mirsharai – BSRM Transmission Line to Korerhat

5.2.2 Analyses of Alternative for Selection of Substations

For substation site selection, initially PGCB has been selected 3 alternatives sites has usually carried out based on environment and social aspects and technical requirements. Such analysis considers various site specific parameters that include availability of infrastructure facilities such as access roads, water, distance from railheads, type of land (Government/private land); social impacts such as number of families getting affected; Common Property Resources (CPR) including feasibility of acquisition.

For proper environmental assessment, it is important that each substation sub-project is clearly described by the project proponent (PGCB). The key information required for describing a particular subproject would vary depending on the type of sub-project (i.e., substation). According to ECR 1997, a project proponent is required to apply to the Department of Environment (DoE) for environment clearance or site clearance certificate in a prescribed form (Form 3 of ECR 1997), furnishing key project information. Following the format of the “DoE Form 3”, Sub-project Description “Form 1a” (for substations) has been developed (**Appendix A**) for documenting description of sub-projects to be implemented under the proposed project. Once a sub-project description is prepared by the PGCB using Form 1a/1b, it will be easier to carry out environmental/social screening of the sub-project and to subsequently complete the “DoE Form 3” during submitting application for environmental/ site clearance certificate.

By considering certain issues during project formulation, it is often possible to reduce or eliminate some of the possible negative environmental impacts during both construction and operational phases of a project. For example, efforts to avoid, where possible, critical homestead areas or crossing of rivers/hills/bamboo groves on the substation subprojects could greatly reduce negative impacts during construction and operational phases. Such considerations at the project formulation stage could greatly reduce negative impacts and facilitate proper environmental management of a project. A number of such environmental and social issues to be considered for substation subprojects are identified and given below as bullet form. These issues should be adequately addressed during the project formulation stage, as a part of overall environmental management.

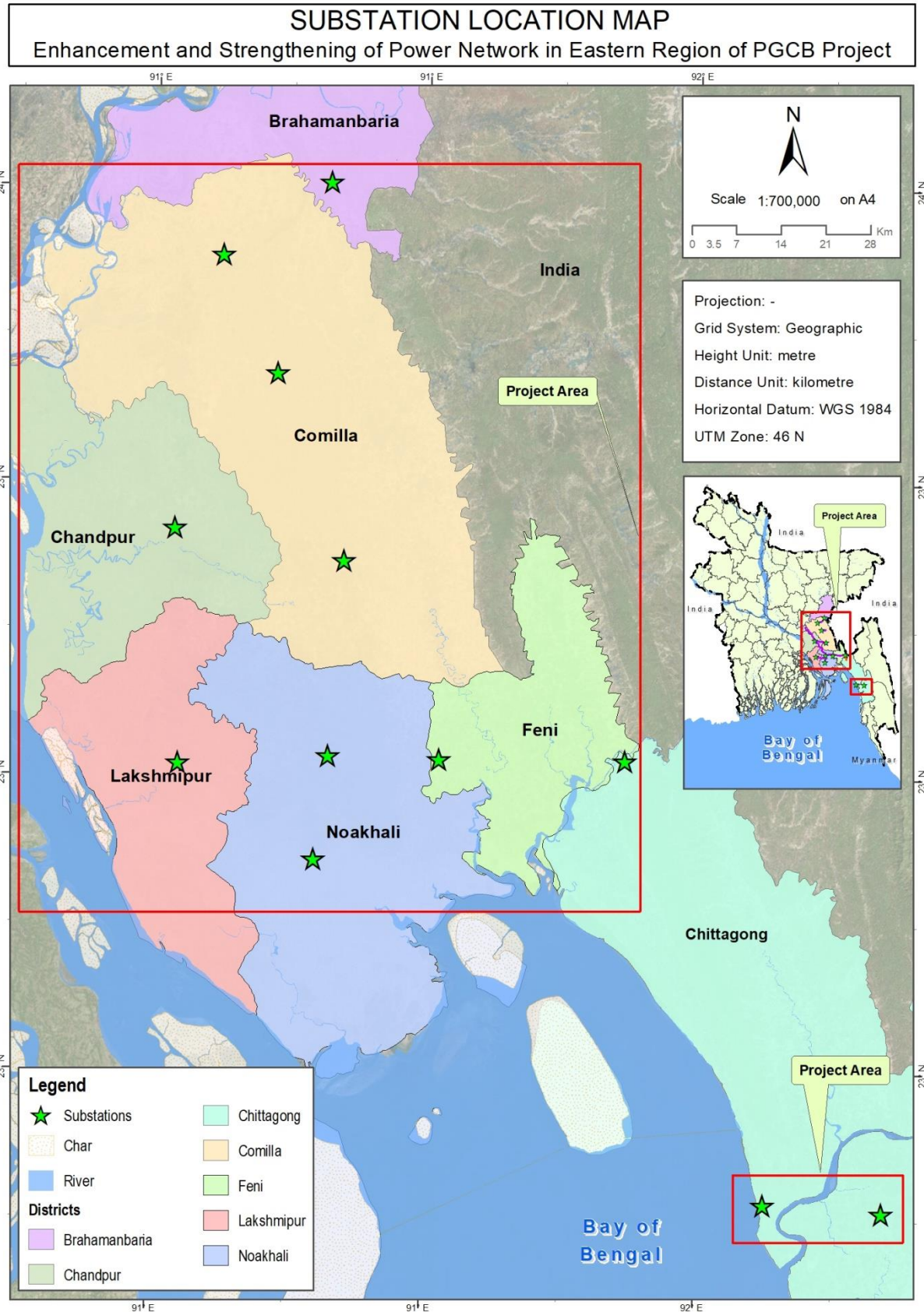
- Use of government-owned land or vacant/fallow (non-productive) land for construction of substation, where possible.
- Use of land located at close proximity to existing power lines/load centers, and road network (for easier transportation of material and equipment), where available.
- Avoiding lands that are susceptible to inundation/ storm surge.
- Avoiding ecologically and socially critical areas while selecting land for substations.
- Use of Gas Insulated Switchgear (GIS) instead of Air Insulated Switchgear (AIS), in order to reduce land requirement for substation and avoid possible generation of toxic fumes in control building due to flashover inside AIS (especially under high humidity and saline conditions).
- Ensuring purchase and installation of PCB free new transformers.
- Treating PCB contained in old transformers available technologies; namely, super critical oxidation, electro-chemical oxidation, solvated electron technology, chemical reduction method, dehalogenation process, and thermal desorption using pyrolysis, catalyzed dehalogenation and vitrification before disposal.
- Designing substations considering maximum flood level, and considering wind speed and earthquake load suggested in the Bangladesh National Building Code (BNBC).

Considering the above issues and site inspection/verification, the proposed substation subproject land has been selected and finalized.. The selected location for the substation subprojects is given in below Map 5.11. The social aspects are provided due weightage after technical requirement in decision making for selection/finalization of land for substation. The details of the selected site for proposed substations along with are given below in tabular form (Table :

Sl. No.	Name of Substation	Area (acre)	Location	Current Land use	Remarks
1	230/132 kV GIS at Chowmuhoni, Noakhali	5	Nazirpur 22°56'47.93"N 91°06'11.02"E	Agriculture	Fellow land not available, but nearby road & no houses on or nearby the SS.
2	230/132 kV GIS at Kachua, Chandpur	5	Toraghat 23°21'21.75"N 90°53'11.93"E	Agriculture	Same as above
3	132/33 kV GIS at Muradnagar, Comilla	5	Paschim Bhabanipur 23°39'13.62"N 90°56'02.75"E	Agriculture	Same as above
4	132/33 kV GIS at Laksham, Comilla	2	Gaziramura 23°13'22.01"N	Agriculture	Same as above

Sl. No.	Name of Substation	Area (acre)	Location	Current Land use	Remarks
			91°07'35.44"E		
5	132/33 kV GIS at Maijdee, Noakhali	5	Noakhali 22°47'57.88"N 91°04'59.06"E	Agriculture	Same as above
6	132/33 kV GIS at Patiya, Chittagong	5	Allai 22°17'56.55"N 91°57'56.23"E	Agriculture	Same as above
7	132/33 kV GIS at Chandina, Comilla	2	Asora 23°29'14.16"N 91°01'11.45"E	Agriculture	Same as above
8	132/33 kV GIS at New Mooring/Anand Bazar, Chittagong	20	Madha Halishar 22°18'57.67"N 91°46'21.46"E	Agriculture	Same as above
9	132/33 kV GIS at Bashurhat, Daganbhuiyan, Feni	2	Sekandarpur 22°56'23.72"N 91°16'22.70"E	Agriculture	Same as above
10	132/33 kV GIS at Laksmipur, Lksmipur	5	Atiatalai 22°56'05.03"N 90°52'25.62"E	Agriculture	Same as above
11	132/33 kV GIS at Kosba, Brahmanbaria	5	Kaliara 23°44'57.72"N 91°08'06.34"E	Agriculture	Same as above
12	400/230 kV GIS at Korerhat, Chittagong	25	Baria 22°56'34.91"N 91°33'26.84"E	Agriculture	Same as above

Source: ESMF report,2013 of Power Cell & Site Inspection in 2017.



Map 5:11: Location Map of the Substation Subprojects

6 ENVIRONMENTAL SCREENING/ASSESSMENT OF THE SUBPROJECTS

6.1 General

The location and scale of the works are very important in predicting the environmental impacts. This process of impact prediction is the core of the EIA process and it is critical that the recommendations and mitigation measures are carried out according to the conditions on the ground in the affected areas in the spirit of the environmental assessments process. In this chapter, the potential environmental impacts are reviewed. If impacts are predicted to be significant enough to exceed accepted environmental standards, mitigation is proposed in order to reduce residual impact to acceptable levels and achieve the expected outcomes of the project being implemented. Therefore, it is essential that a proper analysis is carried out during the project planning period. In this regard, the impact prediction plays a vital role as these predictions are used for developing mitigation measures and any alternative options, if appropriate. When the detailed designs are completed the impacts and mitigation measures will need to be further reviewed to take account of how the contracts are set up and in the light of any fine tuning of the sub-projects.

6.2 Screening of Environmental Impacts for Substations (SS)

The environmental impacts due to implementation of the proposed substations during pre-construction/construction and operation stages have been identified through baseline environmental survey including environmental quality survey, public consultations and literature review. During the field visits, Environmental Screening/Assessment Checklist (Appendix-B: Substation, Form 1a, illustrated in the ESMF Guidelines, 2013) has been filled up for the initially selected site of each proposed substation to identify the environmental impacts. From the three alternative sites (discussed in chapter 4), environmentally suitable site has been finally selected based on the impacts and given in the following Table 6.1 and in the Chapter 'Analysis of Alternatives'. The Judgment of the environmental specialist along with the environmental screening/assessment checklist Form 2a of ESMF has also been applied to select environmentally suitable site for the proposed substations. The local people including PAPs and the different stakeholders in the area were consulted to identify the environmental impacts and their opinions regarding the possible mitigation measures have been noted and incorporated in the EIA report. Based on the identified environmental impacts from the Appendix-B (Form 1a), possible mitigation measures for the substation have been proposed.

Table 6.1: Environmental Impacts of the Selected Substation (SS) Subprojects

Sl. No.	Subproject Site/Route	Selected Site Common	Common/General Impacts	Subproject Specific Impacts
1	230/132 kV GIS at Chowmuhoni, Noakhali	Site-1	Pre-construction/Construction Phase: xvi. Land Acquisition xvii. Clearing of Vegetation xviii. Disturbance of Fauna (wildlife) xix. Loss of Top Soil xx. Hydrology/Drainage Congestion xxi. Surface and Ground/Drinking Water Pollution	
2	230/132 kV GIS at Kachua, Chandpur	Site-1		
3	132/33 kV GIS at Muradnagar, Comilla	Site-1		

Sl. No.	Subproject Site/Route	Selected SiteCommon	Common/General Impacts	Subproject Specific Impacts
4	132/33 kV GIS at Laksham, Comilla	Site-1	xxii. Noise Pollution xxiii. Air and Dust Pollution xxiv. Soil Pollution	
5	132/33 kV GIS at Maijdee, Noakhali	Site-1	xxv. Pollution due to Wastes xxvi. Traffic Congestion/Road Accident xxvii. Siting of Construction Camps xxviii. Occupational Health and Safety xxix. Community Health and Safety xxx. Employment Generation/Income	Surface Water Pollution (perennial pond at about 50m far away).
6	132/33 kV GIS at Patiya, Chittagong	Site-1		
7	132/33 kV GIS at Chandina, Comilla	Site-1	Operation Stage: vii. Hydrology/Drainage Congestion viii. Landscape ix. Community Health and Safety x. Occupational Health and Safety xi. Improvement of Social & Economic Life xii. Short Circuit/Accident	Construction Stage: i. 420 Trees Cutting. ii. Loss of Terrestrial Habitat . iii.Surface Water Pollution (perennial pond at about 150m far away) .
8	132/33 kV GIS at New Mooring/Anand Bazar, Chittagong	Site-1		
9	132/33 kV GIS at Bashurhat, Feni	Site-1		Construction Stage: i. 136 Trees Cutting. ii. Loss of terrestrial habitat. iii.Surface Water (Perennial Pond at about 30m faraway) pollution. iv.A Mosque (at 100m far away at east side of the SS).
10	132/33 kV GIS at Laxmipur, Laksmipur	Site-1		
11	132/33 kV GIS at Kosba, Brahmanbaria	Site-1		
12	400/230 kV GIS at Korerhat, Chittagong	Site-1		Construction Stage: i. 2945 Trees Cutting. ii. Loss of terrestrial habitat.

6.3 Screening of Environmental Impacts for Transmission Lines (TL)

The environmental impacts due to implementation of the TL during pre-construction/construction and operation stages have been identified through baseline environmental survey including environmental quality survey, public consultations and literature review. During the field visits, Environmental Screening/Assessment Checklist (Appendix-C: Power Line, Form 2b, illustrated in the ESMF Guidelines, 2013) has been filled up for the initially selected site of each proposed TL to identify the environmental impacts. From the three alternative sites (discussed in chapter 4), environmentally suitable site has been finally selected based on the impacts and given in the following Table 6.2. The Judgment of the environmental specialist along with the environmental

screening/assessment checklist Appendix-C (Form 2b) has also been applied to select environmentally suitable site for the proposed TL. The local people including PAPs and the different stakeholders in the area were consulted to identify the environmental impacts and their opinions regarding the possible mitigation measures have been noted and incorporated in the EIA report. Based on the identified environmental impacts from the Appendix-B (Form 2b), possible mitigation measures for the TL have been proposed.

Table 6.2: Environmental Impacts of the Selected TL Subprojects

Sl. No.	kv	Subproject Site/Route	Selected Route	Common/General Impacts	Subproject Specific Impacts
1	230	Chowmuhoni – Kachua 230 kV Double Circuit TL	Route-01	Pre-construction/Construction Phase: <ul style="list-style-type: none"> i. Clearing of Vegetation (specially due to Tower) ii. Disturbance of Wildlife (specially Birds) iii. Noise Pollution iv. Air and Dust Pollution v. Soil Pollution vi. Pollution due to Wastes vii. Aquatic Habitat viii. Traffic Congestion/Road Accident ix. Siting of Construction Camps x. Occupational Health and Safety xi. Community Health and Safety xii. Employment Generation/Income Operation Stage: <ul style="list-style-type: none"> i. Landscape ii. Community Health and Safety iii. Occupational Health and Safety iv. Improvement of Social & Economic Life v. Short Circuit/Accident vi. Electro-Magnetic Fields (EMF). 	Construction Stage: <ul style="list-style-type: none"> i. 2806 Trees (only Trimming). ii. Loss of Terrestrial Habitat
2	230	Kachua-Gazaria 230 kV TL	Route-01		Construction Stage: <ul style="list-style-type: none"> i. Surface Water Pollution ii. 1740 Trees(only Trimming). ii. Loss of terrestrial habitat v. Disruption of Boat Movement in the Meghna-Gumti River during installation of the TL over the river and construction of tower at river banks.
3	132	Kachua-Laksham 132 kV TL	Route-01		Construction Stage: <ul style="list-style-type: none"> i. 299 Trees (only Trimming). ii. Loss of Terrestrial Habitat
4	230	Chowmuhoni – Maijdee 230 kV Double Circuit TL	Route-01		Construction Stage: <ul style="list-style-type: none"> i. 1795 Trees (only Trimming). . i. Loss of Terrestrial Habitat
5	132	Comilla (North) –Chandina 132 KV DC TL	Route-01		
6	132	Chowmuhoni – Laxmipur 132 kV Double Circuit TL	Route-01		Construction Stage: <ul style="list-style-type: none"> i. 2544 Trees (only Trimming). ii. Loss of Terrestrial Habitat
7	132	Muradnagar – Kosba 132 KV DC TL	Route-01		Construction Stage: <ul style="list-style-type: none"> i. 377 Trees (only Trimming). ii. Loss of Terrestrial Habitat

Sl. No.	kv	Subproject Site/Route	Selected Route	Common/General Impacts	Subproject Specific Impacts
8	230	Korerhat- Chowmuhoni 230KV MC TL	Route-01		Construction Stage: i. Surface Water Pollution ii. 8010 Trees (only Trimming) ii. Loss of Terrestrial Habitat v. Disruption of Boat Movement in the Feni River during installation of TL and construction of the tower at river banks. v. A mosque at 20m far away at R/S of the TL. vi. A grave yard at 25m faraway at L/S of the TL.

6.4 Screening of Environmental Impacts for the Lilo Lines

All Lilo lines (as mentioned in Appendix-D) have more or less same environmental impacts except Lilo line of 400 KV DC Korerhat-BSRM and therefore screening of impacts has been done for the 8 Lilo lines in the following same table except the Lilo of 400 KV DC Korerhat-BSRM and given in the following Table 6.3.

Table 6.3: Environmental Impacts of the Selected LILO Line Subproject

LILO Line	Chainage (Location)	Common/General Impacts	Subproject Specific Impacts
1.LILO of 132 KV DC Feni-Chowmuhani, L=2.915km,	0+000-2+915	Pre-construction/Construction Phase: <ul style="list-style-type: none"> i. Clearing of Vegetation (due to Towers' base) ii. Loss of Top Soil due to towers iii. Noise Pollution iv. Pollution due to Wastes v. Trimming of Trees vi. Loss of terrestrial habitat vii. Occupational Health and Safety viii. Community Health and Safety ix. Employment Generation/Income Operation Stage: <ul style="list-style-type: none"> i. Landscape ii. Community Health and Safety iii. Occupational Health and Safety iv. Improvement of Social & Economic Life v. Short Circuit/Accident vi. EMF 	
2.LILO of 230 KV DC Karerhat – Comilla, L=5.735	0+000-5+191		
3. LILO of 132 KV DC Karerhat-Hathazari-Feni	0+000-3+327		
4.LILO of 132 KV DC Dohazari-Shikalbaha	0+000-0+750		
5.LILO of 132 KV DC Haliashar-Kulshi	0+000-1+105		
6..LILO of 132 KV DC Modhunaghat-Meghnaghat	000-0+775		
7..LILO of 400 KV DC Comilla(N)-Daudkandi)	0+000-0+424		<u>Pre-construction/Construction Phase:</u> <ul style="list-style-type: none"> i.Trimining of Forest Trees (pocket hills with small to medium size forest trees (but not densely) from ch 3+450 – 11+700. ii.Disturbance of wildlife (specially birds) iv.Loss of terrestrial habitat (specially for birds)
8.LILO of 400 KV DC Korerhat-BSRM	0+000-11+850		

6.5 Impact Assessment

Based on the environmental baseline data, given in chapter 4 (Appendix-B: Form 1a: Substation and Form 1b: Power line) and environmental screening, given in chapter 5 (Appendix-C: Form 2a: Substation and Form 2b: Power Line), impacts assessment for the above finally selected subprojects (Substations, Transmission Lines and LILO lines) have been done and presented in the following subchapters. Potential environmental impacts have been categorized into: (a) general/common impacts, which are typical common impacts to be experienced in all the subprojects and (b) subproject specific impacts.

6.5.1 General/Common Impacts due to Substation Subprojects

6.5.1.1 Pre-construction/Construction Phase

Land Acquisition: As mentioned earlier in chapter 4, due to construction of the proposed substations, a total of 86 acre (around 34.82 ha for total 12 substations) of private agricultural land will be acquired. As a result, permanent land loss and crop loss will be occurred. In addition, a small quantity of land will be required temporarily for the construction camp of each substation site.

Clearing of Vegetation: Prior to start construction, the substations sites need to be cleared and as a result, standing vegetation (e.g. crops, grass, bushes etc.) loss will be occurred.

Disturbance of Wildlife(Specially Birds): As mentioned in Chapter 4 due to project activities such as earthworks, movement of project heavy equipment & transports with noise especially during night time, wildlife specially birds will be disturbed.

Loss of Top Soil: Filling of the proposed substations area will cause loss of top clay silt soil of the site (thickness about 0.5m) which is suitable for the boundary slope protection of the substation site. There are possibilities of soil erosion occurring during the construction of the proposed substations especially during rainy and windy seasons. The impact will however be minimal as SS area to be acquired, is very small.

Hydrology/Drainage Congestion: During monsoon period due to filling of the substation subproject sites by earth and construction of temporary earth embankment surrounding the site to keep the site dry as well as reduction of flood prone area, rising of local flood level and drainage congestion will be occurred. Changes in surface hydrology alter the flow of water through the landscape. Construction of impervious surfaces such as parking lots, roads and buildings increase the volume and rate of runoff, resulting in habitat destruction, increased pollutant loads, and flooding. During monsoon period due to intensive rainfall, drainage congestion will be occurred around the substation areas if adequate drainage facilities are not provided in the connecting access road in between exiting roads and substations.

Ground Water Pollution: Contaminated soil or ground water in the path of the project could be disturbed by excavation resulting in a potential transfer of the contamination to surface water. Oil spills during construction could introduce contaminants into subsurface which may end-up into ground water. Development activities such as substations development as well as the spill-over effects of development such as increased demand for water use and increased auto use can impact

water quality by contributing sediment, nutrients, and other pollutants to limit water supplies, increasing the temperature of the water, and increasing the rate and volume of runoff.

Noise Pollution: The proposed areas are relatively rural areas. Generation of noise pollution will be occurred from the construction activities for the substation sites such as earth filling, crushing of bricks and stones, concrete mixing plant, movement of heavy construction vehicles, functioning of generators and as result, local community, project workers, wildlife and other lives will be affected specially during night time.

Air and Dust Pollution: Exhaust emissions are likely to be generated by the construction equipment during the construction phase of proposed substations. Motor vehicles that will be used to carry construction materials would cause air quality impact by emitting pollutants through exhaust emissions. But the impacts will not be significant.

Particulate matter pollution is likely to occur during the site clearance, excavation and spreading of the topsoil during construction of proposed substations. There is a very small possibility of PM₁₀ suspended and settleable particles affecting the site workers and even neighbors' health, it is minimal given the construction method of minimum excavation and nil cart away of soil.

Soil Pollution: The carried river bed materials (if contain heavy metals) from the nearby river for the filling of the substation site will contaminate the soil of the nearby agricultural land and as a result, crop production and biodiversity will be affected. In addition, during construction, due to accidental spillage and leakage of oil and toxic chemical (if falls on the soil surface) will also pollute the local soil.

Pollution due to Wastes: Generation of construction wastes (such as solid wastes: electric wire, pipes, stones, woods, rods etc., and liquid waste: paint, oil, bitumen etc.,) from the construction camp and general wastes (solid wastes: papers, containers, residues of food, fruits etc., and liquid waste: waste water from bathroom and kitchen etc.) from workers' camp will impact on H&S of the local community and workers as well as on aesthetic beauty of the area, air and soil if inadequate arrangements exist for the disposal of wastes.

Traffic Congestion/Road Accident: The heavy construction vehicles will be required for carrying of construction materials and equipment. Vehicles such as trucks, buses, jeeps, microbuses, cars, rickshaw vans, votvoti, motor bikes, bicycles as well as students and local people walk on the roads and as a result, traffic jams occur specially during morning and evening times as observed during field survey. The construction vehicles will add more traffic and as a result, traffic congestion and road accident will be increased. Traffic congestion also will be occurred, if the stock piling of construction materials will be at the road sides.

Siting of Construction Camps: The precise locations for construction camps for the proposed substations will be decided by the PGCB in consultation with the project contractors. However, the siting of the camps may cause a number of issues such as loss of plantation and vegetation, permanent physical and visual impact on the area, siltation and pollution risks if construction materials are collected from the river bed. The construction process will take minimum 3 years, with the result that the camps will take on a semi-permanent appearance. The people and the changes they bring can have significant impacts on the local communities and social structures. Substantial

numbers of workers will inhabit the area in temporary camps loading local infrastructure and causing ambient social influence. Most important aspects are: pollution risk of soil and surface water due to sanitation of the labour camps and wastes from the camps.

Occupational Health and Safety: Construction workers are more likely to face occupational health hazards such as minor or major injuries due to lack of general safety requirements and precautions applicable while working at construction sites, and handling with machines and equipment, use of equipment and driving vehicles and so on. Poorly designed temporary labour camp and sanitation facilities may pose a health threat and nuisance to the workers. Uncontrolled vending of food and drinking water at the work site may also pose a risk with respect to the transmission of contagious diseases like Typhoid, Diarrhea, Malaria, and Dengue in particular. Although presently, total ratio of the affected people in Bangladesh by HIV/AIDS is far less than 0.1%, however this % is slowly being increased due to injection drug users and overseas migrant workers returned to Bangladesh. Construction workers will be required to handle hazardous materials such as cement, bitumen, chemicals, fuels, and so on which will increase health risks of the workers if personal protective equipment are not used.

Community Health and Safety: Improper health and safety policy maintained at the site may lead to outbreak of different diseases to the surrounding communities/public through the sick construction workers. From the traffic survey, it is known that all types of motorized transports such as trucks, buses, oil tankers, jeeps, pick up, cars, auto rickshaws, tempo and motor cycles move on the roads and as a result, traffic jams occur frequently specially during 8:00 to 10:00 and 17:00 to 21:00 on these roads which will affect the health of the local community.

Employment Generation/Income: During construction a considerable quantities of workers (both male & female) will be required for the construction of the substation. Conflict between male & female may be arisen if women workers are deprived. Some local people may also involve themselves in small businesses (e.g. tea stall, grocery shop etc.). Local people can be involved in the project construction work as per their skill.

6.5.1.2 Operation Stage

Drainage Congestion: During monsoon period due to intensive rainfall, drainage congestion will be occurred inside the substation area if proper drainage facilities are not provided. Drain will be blocked due to disposal of solid waste in to the drain if proper maintenance is not done regularly.

Landscape: Due to construction of substation in the rural areas, the natural landscape in rural areas will be changed but not significantly.

Community Health and Safety: A total of 41 people are killed per year in Bangladesh due to short circuit. Short circuit may be occurred if large trees come in contact with the substation during storm and as a result, accident may be happened.

Occupational Health and Safety: Workers specially engaged with the operation of transformers and other electrical equipment will be affected. Short circuit may be occurred if large trees come in contact with the substation during storm and as a result, accident may be happened.

Improvement of Social & Economic Life: Due to increase of power generation and the reliability of power supply, social life and economic condition of the people will be improved.

Short Circuit/Accident: Due to short circuit of the substation, disruption of power and accident will be occurred.

6.5.2 Substation Subproject Specific Impacts

6.5.2.1 Pre-construction/Construction Stage

Subproject specific impacts are as follows:

Substation	Potential Impacts
400 kV Korerhat Substation, Mirsarai, Chittagong	Tree Cutting: At the selected location 2945 different sizes trees are present. During the construction period site clearance will be required and these trees will need to be felled.
132/33 kV: Basurhat GIS 2x50/75 MVA Substation, Daganbhuiyan, Feni	Tree Cutting: At the selected location 136 different sizes trees are present. During the construction period site clearance will be required and these trees will need to be felled. SW Pollution: Due to disposal of general and construction wastes into the nearby pond water, water will be contaminated. Due to washing of project vehicles, equipment etc. pond water also will be polluted. Cultural Site: Due to earth work, a mosque at about 100m far away will be affected specially by dust and noise.
132/33 kV: Chandina GIS 2x50/75 MVA Substation, Debidwar, Comilla	Tree Cutting: At the selected location 420 different sizes trees are present. During the construction period site clearance will be required and these trees will need to be felled. SW Pollution: Due to disposal of general and construction wastes into the nearby pond water, water will be contaminated. Due to washing of project vehicles, equipment etc. pond water also will be polluted.
132/33 kV GIS at Majdee Substation, Noakhali.	SW Pollution: Due to disposal of general and construction wastes into the nearby khal water, water will be contaminated. Due to washing of project vehicles, equipment etc. khal water also will be polluted.

6.5.3 General/Common Impacts due to TL and Lilo Lines Subprojects

6.5.3.1 Pre-construction/ Construction Phase

Clearing of Vegetation: As mentioned earlier in Appendix-C, a total of 20,252 trees will be partially affected by trimming during construction of the eight TLs. The proposed TLs stretch approximately 210.762 Km will require clearance of ROW and will result in temporarily loss of vegetation. Out of the 8 LILO lines, only 11.334 Korerhat –BSRM line is passing over the pocket of hilly area (upto 6m ht) with forest trees from ch 3+450-11+700 which need to be trimming (if required). However, most of the trees need to be trimmed instead of cutting and thus the impact will be medium significant. In general vegetation destruction shall result in reduction of biodiversity as valuable trees such as those of medicinal importance, wild fruits, and endangered species may be negatively impacted upon. Fauna (wildlife) providing habitat for most birds, snakes and other predators may also be affected, as vegetation cover of the understory is reduced. Disturbing to flora will lead to reduction in biodiversity.

Disturbance of Fauna: As mentioned in Chapter 5 due to project activities such as earthworks for towers of the TL & LIL lines, movement of project heavy equipment & transports with noise especially during night time, wildlife specially birds will be disturbed.

The way leave for the proposed TL & LL lines could open or truncate some migratory routes for wild animals. However, open areas under the way leave could provide new browsing grounds for various animals. The presence of the construction workers in the project area may induce poaching. Leftover aluminum conductors from construction works may give rise to snare wire that poachers eventually use to trap animals. Tower foundation works could disturb habitats for smaller mammals such as rodents and rats.

Negative impacts may arise, from erected transmission lines, through accidental ramming of large birds into the power lines during their normal or regional and seasonal migratory flights. All vegetation layers, emergent, canopy and under-storey, allows for birds' habitat and nesting and therefore, the removal of vegetation may impact negatively on these activities.

Loss of Top Soil: For the construction of tower base for the TL & LIL lines approximately 804 acres (325.50 ha) land will be temporarily used. Construction of the lines might open up areas that could be exposed to soil erosion. The variability in soil texture in the study area entails that certain sections of the route could be exposed without any serious threat to water induced erosion. For instance, clayey top soils are highly prone to water induced erosion once exposed. The impact will however be minimal as the area to be disturbed is small.

Noise Pollution: The proposed areas are relatively tranquil. Noise shall be created during construction especially since heavy-duty equipment shall be used in excavating, stringing and tower erection. Noise pollution shall, however, be limited to the construction and routing maintenance period. As a result, local community, project workers, wildlife and other lives will be affected specially during night time.

Air and Dust Pollution: Exhaust emissions are likely to be generated by the construction equipment during the construction phase of proposed transmission line. Motor vehicles that will be used to ferry construction materials would cause air quality impact by emitting pollutants through exhaust emissions. The impacts will not be significant.

Particulate matter pollution is likely to occur during the site clearance, excavation and spreading of the topsoil during construction of proposed substations. There is a very small possibility of PM10 suspended and settleable particles affecting the site workers and even neighbors' health, it is minimal given the construction method of minimum excavation and nil cart away of soil.

Soil Pollution: Due to accidental spillage and leakage of oil and toxic chemical (if falls on the soil surface) will pollute the local soil.

Pollution due to Wastes: Generation of construction wastes (such as solid wastes: electric wire, pipes, stones, woods, rods etc., and liquid waste: paint, oil, bitumen etc.,) from the construction camp and general wastes (solid wastes: papers, containers, residues of food, fruits etc., and liquid waste: waste water from bathroom and kitchen etc.) from workers' camp will impact on H&S of the local community and workers as well as on aesthetic beauty of the area, air and soil if inadequate arrangements exist for the disposal of wastes.

Traffic Congestion/Road Accident: The heavy construction vehicles will be required for carrying of construction materials and equipment. Vehicles such as trucks, buses, jeeps, microbuses, cars, rickshaw vans, votvoti, motor bikes, bicycles as well as students and local people walk on the roads and as a result, traffic jams occur specially during morning and evening times as observed during field survey. The construction vehicles will add more traffic and as a result, traffic congestion and road accident will be increased. Traffic congestion also will be occurred, if the stock piling of construction materials will be at the road sides.

Siting of Construction Camps: The precise locations for construction camps for the proposed project will be decided by the PGCB in consultation with the project contractors. However, the siting of the camps may cause a number of issues such as loss of plantation and vegetation, permanent physical and visual impact on the area. The construction process will take several years, with the result that the camps will take on a semi-permanent appearance. The people and the changes they bring can have significant impacts on the local communities and social structures. Substantial numbers of workers will inhabit the area in temporary camps loading local infrastructure and causing ambient social influence. Most important aspects are: pollution risk of soil and surface water due to sanitation of the labour camps and wastes from the camps.

Occupational Health and Safety: Construction workers are more likely to face occupational health hazards such as minor or major injuries due to lack of general safety requirements and precautions applicable while working at construction sites, and handling with machines and equipment, use of equipment and driving vehicles and so on. Poorly designed temporary labour camp and sanitation facilities may pose a health threat and nuisance to the workers. Uncontrolled vending of food and drinking water at the work site may also pose a risk with respect to the transmission of contagious diseases like Typhoid, Diarrhea, Malaria, and Dengue in particular. Although presently, total ratio of the affected people in Bangladesh by HIV/AIDS is far less than 0.1%, however this % is slowly being increased due to injection drug users and overseas migrant workers returned to Bangladesh. Construction workers will be required to handle hazardous materials such as cement, bitumen, chemicals, fuels, and so on which will increase health risks of the workers if personal protective equipment are not used.

Community Health and Safety: Improper health and safety policy maintained at the site may lead to outbreak of different diseases to the surrounding communities/public through the sick construction workers. From the traffic survey, it is known that all types of motorized transports such as trucks, buses, oil tankers, jeeps, pick up, cars, auto rickshaws, tempo and motor cycles move on the roads and as a result, traffic jams occur frequently specially during 8:00 to 10:00 and 17:00 to 21:00 on these roads which will affect the health of the local community.

Employment Generation/Income: During construction a considerable quantities of workers (both male & female) will be required for the construction of the substation. Conflict between male & female may be arisen if women workers are deprived. Some local people may also involve themselves in small businesses (e.g. tea stall, grocery shop etc.). Local people can be involved in the project construction work as per their skill.

6.5.3.2 Operation Stage

Landscape: Due to construction of transmission line in the rural areas, the natural landscape will be changed but not significantly.

Collision of Birds with Overhead Earth Wire: Collision of birds with overhead earth wire has been identified as one of the most significant impacts on avifauna for the project. Mitigation in the form of route selection and earth wire marking will reduce the impact to Medium. The preferred route passes through habitat areas should be avoided in order to reduce the chances of collisions. The open patches of grassland however would attract species such as storks, which could be at risk of collisions.

Community Health and Safety: A total of 41 people are killed per year in Bangladesh due to short circuit. Short circuit may be occurred if large trees come in contact with the substation during storm and as a result, accident may be happened.

Occupational Health and Safety: Workers specially engaged with the operation of transformers and other electrical equipment will be affected. Short circuit may be occurred if large trees come in contact with the substation during storm and as a result, accident may be happened.

Improvement of Social & Economic Life: Due to increase of power generation and the reliability of power supply, social life and economic condition of the people will be improved.

Short Circuit/Accident: Due to short circuit of the substation, disruption of power and accident will be occurred.

EMF: Health concerns over exposure to EMF are often raised when a new TL is proposed. To date the research has not been able to establish a cause and effect relationship between exposure to magnetic fields and human disease, nor a plausible biological mechanism by which exposure to EMF could cause disease. Rehabilitation of existing power lines is unlikely to increase EMF but new lines may induce EMF. Although any TL/Lilo lines do not pass over the housing areas/populated areas however health may be affected however inspection of existing EMF along the selected routes of the existing and new Transmission and Distribution lines and around the Substation sites would be necessary, as a part of carrying out IEE/EIA (by the consultant engaged for this purpose).

6.5.4 TL/Lilo Line Subproject Specific Impacts

6.5.4.1 Preconstruction/Construction Stage

Subproject specific impacts are as follows:

Subproject	Potential Impacts
230kV D/C Korerhat – Chowmuhoni Transmission Line	<p>Disruption of boats (such as non engine and engine country boats and trallers) movement in the Feni River (perennial water body) during installation of TLs over the river and construction of the TL's tower on both the river banks .</p> <p>SW Pollution: Due to disposal of general and construction wastes into the nearby pond water, water will be contaminated. Due to washing of project vehicles, equipment etc. pond water also will be polluted.</p>
230kV D/C Gazaria –	Disruption of boats (such as non engine and engine country boats, trallers,

Subproject	Potential Impacts
Kachua Transmission Line	launches, bulkhead sand boats, speed boats and vessels) movement in the Meghna-Gumti River(perennial water body) during installation of TLs over the river and construction of the TL's tower on both the river banks . SW Pollution: Due to disposal of general and construction wastes into the nearby pond water, water will be contaminated. Due to washing of project vehicles, equipment etc. pond water also will be polluted.
Korerhat-BSRM LILO Line	Pocket hilly area (upto 6m ht) with small to medium forest tress from ch 3+450-11+700 will be affected. Wildlife specially birds will be disturbed due to installation of LILO lines and construction of tower base for the LILO lines.

6.6 Category of Subproject

Based on the environmental screening/assessment (Appendix-B: Form 2a: Substation and Appendix-C: Form 2b: Transmission Line) as well as ESMF, DoE and WB guidelines, the category of the subprojects has been established and given in the following Table 6.4 and 6.5.

Table 6.4: Category of the Substation Subprojects

Sl. No.	Name of the Subproject	Category	
		DoE Guideline	WB Guideline
1	230/132 kV: Chowmuhoni GIS 3x250/350 MVA, Begumganj, Noakhali	Red Category	B Category
2	230/132 kV: Kachua GIS 2x250/350 MVA, Haziganj, Chandpur	Red Category	B Category
3	132/33 kV: Muradnagar AIS 2x50/75 MVA, Muradnagar, Comilla	Red Category	B Category
4	132/33 kV: Lakhsam GIS 2x50/75 MVA, Lakhsam, Comilla	Red Category	B Category
5	132/33 kV: Maijdee GIS 2x50/75 MVA, Noakhali Sadar, Noakhali	Red Category	B Category
6	132/33 kV: Patiya GIS 2x50/75 MVA, Patiya, Chittagong	Red Category	B Category
7	132/33 kV: Chandina GIS 2x50/75 MVA, Debidwar, Comilla	Red Category	B Category
8	132/33 kV: Anandabazar (New Mooring) GIS 3x80/120 MVA (Future 400kV Provision), Bandar, Chittagong	Red Category	B Category
9	132/33 kV: Basurhat GIS 2x50/75 MVA, Daganbuiyan, Feni	Red Category	B Category
10	132/33 kV: Laksmipur GIS 2x50/75 MVA, Laksmipur, Laksmipur	Red Category	B Category
11	132/33 kV: Kosba GIS 2x50/75 MVA, Kasba, Brahmanbaria	Red Category	B Category
12	400 kV Korerhat, Mirsarai, Chittagong	Red Category	B Category

Table 6.5: Category of the Transmission Line Subprojects

Sl. No.	Name of the Subproject	Category	
		DoE Guideline	WB Guideline
1	230kV D/C Korerhat – Chowmuhoni Transmission Line	Red Category	B Category
2	230kV D/C Chowmuhoni- Kachua Transmission Line	Red Category	B Category

Sl. No.	Name of the Subproject	Category	
		DoE Guideline	WB Guideline
3	230kV D/C Gazaria – Kachua Transmission Line	Red Category	B Category
4	230 kV D/C Chowmuhoni - Maijdee Transmission Line	Red Category	B Category
5	132kV D/C Kachua-Laksham Transmission Line	Red Category	B Category
6	132kV D/C Comilla North- Chandina Transmission Line	Red Category	B Category
7	132kV D/C Muradnagar – Kosba Transmission Line	Red Category	B Category
8	132kV D/C Chowmuhoni - Laxmipur Transmission Line	Red Category	B Category

Table 6.6: Category of the LILO Line Subprojects

Sl. No.	Name of the Subproject	Category	
		DoE Guideline	WB Guideline
1	Feni-Chowmuhini	Red Category	B Category
2	Korerhat-Hathazari-Comilla	Red Category	B Category
3	Korerhat-Hathazari-Feni	Red Category	B Category
4	Dohazari-Sikalbaha	Red Category	B Category
5	Halishahar-Khulshi	Red Category	B Category
6	Korerhat-BSRM	Red Category	B Category
7	Modhunaghat-Meghnaghat	Red Category	B Category
8	Comilla-Daudkandi	Red Category	B Category

7 PUBLIC CONSULTATION

7.1 Objectives

The Public Consultation (PC) was undertaken as a part of the EIA in order to obtain the views of members of the immediate community and interested and project affected persons (PAPs) within the site's immediate area of influence. The consultations were done with randomly selected people in the neighborhood of the proposed sites and involved use of a semi-structured public participation form. In general, the project is acceptable and no objections were raised concerning the development as proposed by the local people.

The Public Consultation has been conducted during August 2017 through Stakeholder Consultations (SC), & individual during the environmental study of the proposed project in conformity with the WB's and DOE's environmental guidelines to achieve the following objectives:

- To share information on the subprojects (SS, TL and LILO lines) of the proposed project;
- To understand stakeholders' including PAPs' concerns regarding various aspects of the proposed project including existing power supply facilities/system and expected potential environmental impacts along with possible mitigation measures during construction & operation stages of the proposed project;
- To identify the conflict issues in advance & to find acceptable solutions; and
- To gather local knowledge before decision making of the proposed project;

7.2 Categories of Stakeholders

Consultations have been carried out with the following stakeholders at different venues:

- Project related government and non government officials (such as PC, PGCB, Union Parishad Office, WB etc.);
- Project Affected Persons (PAPs):
 - People (direct PAPs) who will lose their lands permanently and temporarily due to implementation of the proposed project;
 - Shopkeepers who have even temporarily shops within the ROW of the project
 - People (indirect PAPs) living in the proposed subproject influence area (SPIA).
- Local beneficiaries;
- Villagers;
- Urban people;
- Businessmen; and
- General public.

These public consultations have been provided key inputs for the identification of the potential environmental impacts along with possible mitigation measures for the negative impacts and enhancement for the positive impacts due to implementation of the subprojects of proposed project.

7.3 Consultation Process

The consultation locations at the subproject sites were selected based on the criterias which are as follows:

- The environmental, social and cultural importance of the subproject area;
- All the selected locations are at the human settlement areas, at the local authority (such as union parishad) which are located nearby the subproject sites; particularly at the junction of substation and transmission line and in some cases Lilo line also. So, the consultants were able to discuss on the project features, environmental and social impacts due to the implementation of the subprojects along with mitigation measures with the local people specially PAPs. Moreover, the selected locations are rich in terms of availability of surface water sources, vegetation, agricultural land, cultural sites etc.

The consultants held meeting with the stakeholders. The stakeholder consultations were held at the PC, PGCB, Union Parishad office and WB offices, subprojects' sites and SPIA (within about 1km far from the subproject sites). A map, showing the locations of consultations is given in Figure 7.1.

At the starting of the consultations, the consultants described about the subproject & its activities including environment & following these, detailed discussions were held. In the meetings, the participants shared their valuable questions, opinions & suggestions with the consultants which were noted & incorporated in the report. The consultation with Individual person in the subproject areas were also held.

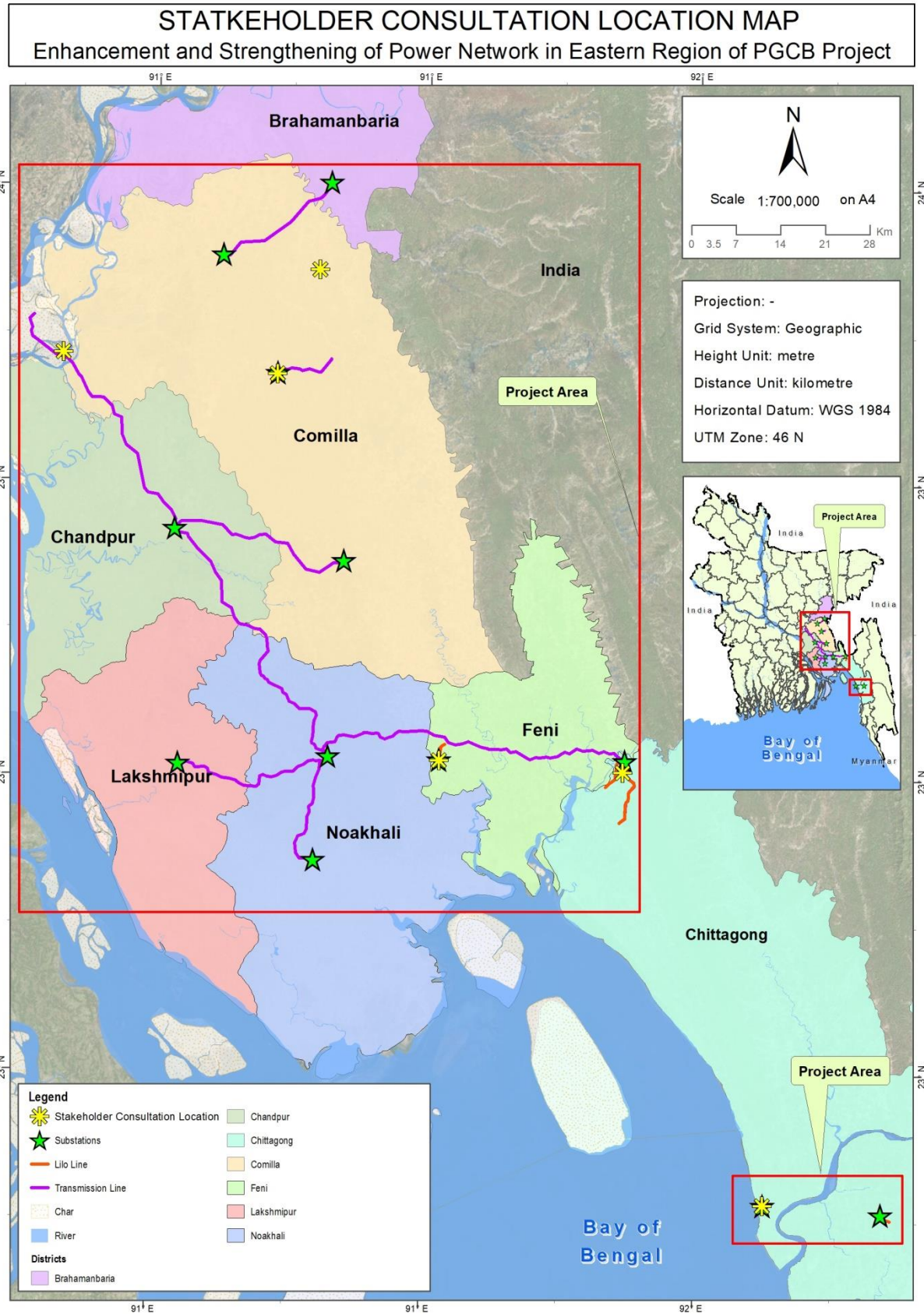


Figure 7.1: Stakeholder Consultations Location Map

7.4 Details of the Consultations

The findings of these consultations are summarized below in chapter 7.5. Questions discussed in the consultation meetings, original list of participants in scanned format and photographs are presented in Appendix – F.



Figure 7.2: Photographs of Stakeholder Consultations at Different Subproject Sites (such as at Anandabazar SS, CTG, Basurhat SS, Noakhali, Chandina SS and Gajaria-Kachua TL at Meghna-Gumti River Crossing Site.

7.5 Findings of the Consultations

The following issues were raised by the proposed project neighbours who were interviewed during public participation of the proposed rural electrification, transmission and distribution project. Most comments were of a similar nature.

7.5.1 Positive Issues

7.5.1.1 Employment Opportunities

Most neighbours close to the proposed project sites especially expected the project to create casual and permanent employment opportunities during the proposed project construction work, operation and decommissioning phases. The employment opportunities could be either directly in the project or indirectly through associated businesses. One of the main positive impacts during projects construction phase will be the availability of job opportunities especially to casual workers and several other specialized workers.

Employment opportunities are of benefit both economically and in a social sense. In the economic sense it means abundant unskilled labour will be used in construction hence economic production and circulation of money. In the social sense the young and energetic labour force will be engaged in productive employment other than remaining idle which may lead them into social ills such as drug abuse and criminology. Several workers including casual labourers, masons, carpenters, joiners, electricians and plumbers are expected to work on the site for a period that the project will start to the end. Apart from casual labour, semi-skilled and unskilled labour and formal employees are also expected to obtain gainful employment during the period of construction.

7.5.1.2 Improvement of Local and National Economy

Through the use of locally available materials during the construction phase of the proposed subprojects will contribute towards growth of the economy by contributing to the gross domestic product. The procurement of substation construction materials and the eventual increased consumption of electricity will attract taxes including VAT which will be payable to the government hence increasing government revenue while the cost of raw materials will be payable directly to the producers.

7.5.1.3 Boosting of the Informal Sector

During the construction, operational and decommissioning phase of the proposed subprojects, it is expected that the other businesses in the informal sector will flourish. These include activities such as food vending who will be benefiting directly from the construction, operational and decommissioning staff members who will be buying food and other commodities from them. This will promote the informal sector in securing some temporary revenue and hence livelihood.

7.5.1.4 Improvement of Security

Security within the proposed project site will be enhanced by employment of guards so as to make the subprojects equipment and facilities more secure from theft/vandalism. Security lights will be installed at the Sub-stations, thus lighting up the general area.

7.5.1.5 Improved of Electricity Supply

The project aims to provide improved distribution and retail of electricity. The neighbours were optimistic that power outages will be minimized and that they will not be subjected to power rationing. They were also optimistic that power fluctuation/surges will be a thing of the past. With this additional reliable electricity in the national grid, the country and the local area are expected to attract more investments.

7.5.2 Negative Issues

7.5.2.1 Loses of lands(permanently & Temporary) and Existing Vegetation

The construction of the proposed subprojects will involve the loses of land permanently (SS) and temporary (TL/Lilo lines) and clearing of the existing vegetation cover.

7.5.2.2 Increasing of Emissions (Air Pollution)

During construction and decommissioning phase of the proposed subprojects, there will be undesirable emissions that will be emitted especially from heavy machines that could be used for construction and decommissioning. Dust will be emitted during construction and decommissioning phases. Neighbours asked for air pollution control measures to be put in place, especially during construction.

7.5.2.3 Increasing of Noise Level and Vibration

There was concern over the possibility high noise and vibration levels in the project site as a result of construction works. However, the proponent will have to take appropriate steps to minimize noise production by ensuring that all construction equipment is well maintained.

7.5.2.4 Accidents during Construction

Some neighbours thought that there workplace accidents could occur during construction, implementation and decommissioning of the project. However, they expected accident prevention measures to be put in place. During construction there could be road accidents on the adjacent road as vehicles entering or leaving the site area could experience blind corner spots. The transporters to the project sites will be encouraged to adhere to road safety measures and to be more vigilant.

7.5.3 Information Disclosure

All the subprojects, environmental impacts due to the subprojects along with proposed possible mitigation/enhancement measures and EMP for the management of mitigation/enhancement measures of the project as document or report should be publicly available in readable format to the local people. The respective authority of the project (e.g. PGCB) should ensure information disclosure to the local people and to the respective stakeholders of the respective subproject under the proposed project.

8 ENVIRONMENTAL MANAGEMENT PLAN

8.1 General

The primary objective of the Environmental Management Plan (EMP) is to avoid or eliminate or reduce the negative environmental impacts by possible mitigation measures and to enhance the positive impacts by enhancement measures. It would also address any unexpected or unforeseen impacts that may arise during construction and operation stages of the subprojects. The aim of the EMP is to ensure implementation of the recommended mitigation and enhancement measures effectively. The mitigation measures are designed either to prevent impacts or by mitigating those to reduce the negative impacts to an acceptable level that complies with the environmental guidelines of the DOE and WB.

The EMP is an integrated part of the project planning and implementation. The EMP should be a part of the contract document for all subprojects (substations and TLs/LILO lines) under the project. The main components of the EMP are:

- Mitigation Plan;
- Monitoring Plan;
- EMP budget; and
- Institutional arrangement for implementation of the EMP.

8.2 Environmental Mitigation Plan

As mentioned earlier in chapter 6, the overall impact assessment of the subprojects (of the SS and TLs/LILO lines) shows that most of the negative impacts could be eliminated or minimized by adopting appropriate mitigation measures as well as positive impacts could be enhanced by taking enhancement measures. The mitigation/enhancement measures for the potential impacts due to subprojects (substations and TL/Lilo lines) have been formulated and given in the following tables 8.1-8.4. Responsible agency for the implementation and supervision of each of the environmental issues/impacts has also been given in this table. Mitigation measures have been suggested based on the knowledge of the environmental specialist, suggestions of the stakeholders including PAPs, gathered during public consultation as well as opinions from the other relevant specialists.

The mitigation measures will be considered as successful when it comply with the Environmental Quality Standards (EQS), policies, legal requirements set by DOE and other relevant GOB organizations and WB. In absence of DOE's own EQS, other relevant international or other recognized organization's quality standard will have to be followed:

Table 8.1: Mitigation Measures for the General/Common Impacts of the Substation Subprojects

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
(c) Preconstruction/Construction Stage				
Land acquisition/requisition	<ul style="list-style-type: none"> Loss of 86 acres land (mainly agricultural) permanently for twelve substation sites. Temporarily loss of land (requisition) for construction camps etc. 	<ul style="list-style-type: none"> Prior to commence construction activities, the owner of the affected land must be noticed and provided proper compensation in time as per GOB and WB guidelines; As per GOB & WB guidelines, RAP should be prepared for land acquisition/requisition/compensation and follow it. Use GIS instead of AIS in order to reduce land requirement. 	DC	DSC/PGCB
Top soil	<ul style="list-style-type: none"> Top soil loss (about 0.5m thick) due to construction of substation sites 	<ul style="list-style-type: none"> Prior to start filling the site, collect and storage top soils (minimum 0.5m thick) for using on the surface of the site boundary and access road side slopes for protection from side slope erosion. The topsoil, excavated from the proposed construction sites should be re-spread in areas to be landscaped. Follow ECOP-8 	Contractor	DSC/PGCB
Clearing of vegetation	<ul style="list-style-type: none"> Loss of standing crops (if any), grass and bushes of substation sites and construction camp sites 	<ul style="list-style-type: none"> Prior to start clearing of vegetation; provide adequate compensation to the owners in time. Follow ECOP-18 	Contractor	DSC/PGCB
Fauna (Wildlife)	<ul style="list-style-type: none"> Disturbance of wildlife specially birds due to project activities such as earthworks, moving of project equipment & transports especially during night time. 	<ul style="list-style-type: none"> Prepare construction management plan (CMP) by the contractor and follow it properly. Follow GOB rules and regulations on noise. Project workers should not disturb or kill any wildlife. Follow ECOP-18 	Contractor	DSC/PGCB
Construction Waste	<ul style="list-style-type: none"> Generation of construction wastes from the construction materials. 	<ul style="list-style-type: none"> Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time Provision of facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements 	Contractor	DSC/PGCB

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
		<ul style="list-style-type: none"> ▪ Purchase of perishable construction materials such as paints incrementally to ensure reduced spoilage of unused materials ▪ Use of building materials that have minimal packaging to avoid the generation of excessive packaging waste ▪ Use of construction materials containing recycled content when possible and in accordance with accepted standards. ▪ Adequate collection and storage of waste on site and safe transportation to the disposal sites and disposal methods at designated area shall be provided. 		
Drainage congestion and flooding	<ul style="list-style-type: none"> ▪ Reducing floodplain storage area and increase local flooding ▪ Due to earth filling of substation sites and access roads above highest flood level (HFL). ▪ Drainage congestion if the surrounding the sites are blocked by the earth embankment. 	<ul style="list-style-type: none"> ▪ Provide culvert in the access road of the substation; ▪ Ensure adequate monitoring, especially if construction works are carried out during the monsoon period. ▪ Provision for pumping of congested water, if needed; ▪ Consider of HFL during design of substations to avoid inundation. ▪ Follow ECOP-1. 	Contractor	DSC/PGCB
Noise level	<ul style="list-style-type: none"> ▪ Noise pollution due to construction activities, generators and construction vehicle movement. 	<ul style="list-style-type: none"> ▪ Use of noise plug in heavy construction equipment; ▪ It is recommended that no construction should be allowed during night time (9 PM to 6 AM) ▪ Avoid using of construction equipment producing excessive noise at night; ▪ Construction activities should not be during night time ▪ Avoid prolonged exposure to noise (produced by equipment) by workers; and ▪ Regulate use of horns and avoid use of hydraulic horns in project vehicles. ▪ Generator should be placed within room (concrete walls with roof). 	Contractor	DSC/PGCB

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
		<ul style="list-style-type: none"> Monitoring of noise level at construction site, construction camp as and when required. 		
Air quality & dust	<ul style="list-style-type: none"> Air pollution and dust generation due to construction activities, generators and construction vehicle movement. 	<ul style="list-style-type: none"> All vehicles (e.g., trucks, equipment, and other vehicles that support construction works) shall be well maintained and not emit dark or smoky emissions in excess of the limits described in the EQS. Specific training will be focused on minimizing dust and exhaust gas emissions from heavy construction vehicles. Drivers of vehicles used during construction will be under strict instructions to minimize unnecessary trips and minimize idling of engines. Dust suppression facilities (back pack water sprayer) shall be available where earth and cement works are required. Spray water on dry & loose surface of the construction sites regularly; Maintain adequate moisture content of soil during transportation, compaction and handling; Construction materials (sand, gravel, and rocks) and spoil materials will be transported trucks covered with tarpaulins. Sprinkle and cover stockpiles of loose construction materials (e.g., fine aggregates, sand); Avoid use of equipment such as stone crushers at site, which produce significant amount of particulate matter. Dust masks should be provided to all personnel in areas prone to dust emissions throughout the period of construction. 	Contractor	DSC/PGCB
Soil quality	<ul style="list-style-type: none"> Soil pollution 	<ul style="list-style-type: none"> Laboratory analysis of the river bed materials to be confirmed prior to start collection from the river; and Prevention of spillage and leakage of hazardous liquid at construction site & camp. Ensure not to use transformer containing PCB to avoid soil & air pollution. 	Contractor	DSC/PGCB
Sitting of construction	<ul style="list-style-type: none"> Removal of vegetation such as 	<ul style="list-style-type: none"> Prior to start clearing of vegetation; provide adequate compensation 	Contractor/DSC	PGCB

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
camps	grass, standing crops (if any) and bushes. ▪ Environmental pollutions (such as air/dust, noise, water, wastes & soil) affecting nearby the settlements,	to the owners in time. ▪ Locate construction camp away from residential settlements, cultural sites, water bodies etc (minimum 0.5km). ▪ Try to use fallow land to avoid crops damage ▪ Just after completion of the construction, hand over the camp sites to the owners as in earlier condition . ▪ Follow ECOP-7		
Traffic congestion/road accident	▪ Traffic congestion and road accident due to movement of construction vehicles.	▪ Follow Bangladesh Road Traffic Authority (BRTA) traffic rules and regulations; ▪ Schedule deliveries of materials/ equipment during off-peak hours ▪ Engage flagman specially at the entry of the substation sites and construction camps for traffic control ▪ Engage experienced drivers to drive project vehicles ▪ Arrange for signal light at night ▪ Prepare and follow proper traffic management; and ▪ Avoid stockpiling of materials specially at the road sides that could disturb traffic movement. ▪ Follow ECOP-14	Contractor	DSC/PGCB
Pollution due to wastes	▪ Pollution due to wastes (construction wastes from construction activities & general wastes from workers' camps)	▪ Solid wastes collection system will be essential, which should include separation and collection of solid wastes in the dustbins/waste containers throughout the work site, construction yard/labour camp. ▪ The wastes such as piece of rods and woods, newspapers, containers etc. can be sold to the vendors and rest wastes can be dumped into the nearby road side waste containers/ waste bins from where will send these wastes to the nearest land fill dumping site by the Contractors. ▪ A log of the disposal of toxic and other waste materials is to be kept by the Contractors. ▪ Prior to start construction, contractor should prepare waste	Contractor	DSC/PGCB

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
		management plan (WMP) based on the EMP ▪ Follow ECOP-10		
Community health and safety (H&S)	▪ Community H&S nearby the substation site	▪ Safety barrier and warning sign surrounding the construction site; ▪ Generators should be placed in the closed room ▪ Formulate and implement emergency risk management plan by the contractor ▪ Follow ECOP-20.	Contractor	DSC/PGCB
Occupational health and safety (H&S)	▪ Health & safety risks of construction workers.	▪ An experienced Health & Safety (H&S) Manager must be engaged by the contractor prior to start construction ▪ Only permitting trained and certified workers to work with any electrical equipment. ▪ Safety induction by the H&S Manager should be provided for the workers ▪ Prior to start work, tool box meeting should be arranged by the H&S Manager for the workers ▪ First Aid Box and personal protective equipment, PPE (such as safety helmets, safety shoes, eye protection glasses, ear plugs/muffs, waist belts, masks, hand gloves, body protective aprons and insulating boots) must be provided to the workers and ensure to use these PPE by the workers; ▪ Safety signs, health signs, prohibition sign, warning sign, mandatory sign, emergency escape sign, first-aid sign, information sign, signboard, supplementary signboard, safety collar, symbol, pictogram, illuminated sign, acoustic signal, verbal communication and hand signal must be fitted at the designated sites of the subproject areas. ▪ Follow ECOP-19.	Contractor	DSC/PGCB
Employment generation/income	▪ Employment opportunities for the local people especially for PAPs.	▪ Employ local people specially PAPs for the project activities as much as possible.	Contractor	DSC/PGCB

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
(b) Operation Stage:				
Tree replantation	<ul style="list-style-type: none"> ▪ A total of 7000 various local tree species can be replanted at the access road side slope @ 2.50m interval. ▪ Among the planted saplings, some (about 10%) may be dead. 	<ul style="list-style-type: none"> ▪ Plantation of 7000 saplings to replace felled trees on the side slopes of the access roads during monsoon period. ▪ The dead saplings should be replaced by new saplings ▪ Nursing period of planted sapling should not less than 2 years. ▪ Follow ECOP-17. 	FD	PGCB
Drainage congestion	<ul style="list-style-type: none"> ▪ Drainage congestion will be occurred in the surface drains within the substation area if O&M is not done regularly. 	<ul style="list-style-type: none"> ▪ Clean the drains, specially during monsoon regularly; ▪ Ensure adequate monitoring. 	PGCB	PGCB
Community health and safety	<ul style="list-style-type: none"> ▪ Community H&S nearby the substation site 	<ul style="list-style-type: none"> ▪ Safety barrier and warning sign surrounding the construction site; ▪ Generators should be placed in the closed room; ▪ Follow ECOP-20 	PGCB	PGCB
Safety & Security of workers	<ul style="list-style-type: none"> ▪ Risk to continuous power supply and even damage of substation 	<ul style="list-style-type: none"> ▪ Ensure security of substation in collaboration with law enforcing agencies. ▪ Keep complain book in the substation for recording of people's complains. ▪ Ensure availability of adequate safety gears for substation operations 	PGCB	PGCB
Power Supply	<ul style="list-style-type: none"> ▪ Due to adequate reliability of power supply, social life and economic condition of the people will be improved 	<ul style="list-style-type: none"> ▪ O&M of the substations should be done in time for adequate power generation. ▪ Follow ECOP-7 	PGCB	PGCB
Short Circuit/Accident	<ul style="list-style-type: none"> ▪ Due to short circuit of the substation, disruption of power and accident will be occurred. 	<ul style="list-style-type: none"> ▪ O&M of substations should be done in time by experienced personnel. 	PGCB	PGCB

Table 8.2: Mitigation Measures for the Specific Impacts of the Substation Subprojects

Substations	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
(a) Preconstruction/Construction Stage				
400 kV Korerhat Substation, Mirsarai, Chittagong	<ul style="list-style-type: none"> Site clearance will be required and 2945 trees will need to be felled. 	<ul style="list-style-type: none"> Try to avoid tree cutting as many as possible; Replantation of minimum 5900 numbers of various local saplings along the access road slopes and other private land during monsoon period of operation stage . Follow ECOP-18 & 19 	Contractors	DSC/PGCB
132/33 kV: Basurhat GIS 2x50/75 MVA Substation, Daganbhuiyan, Feni	<ul style="list-style-type: none"> Site clearance will be required and 136 trees will need to be felled. Water of nearby pond will be polluted in case of dumping of project wastes into pond and washing of project vehicles. Due to earth work, a mosque at about 100m far away will be affected specially by dust and noise. 	<ul style="list-style-type: none"> Try to avoid tree cutting as many as possible; Replantation of minimum 272 numbers of various local saplings along the access road slopes during monsoon period of the operation stage Follow ECOP-18 & 19 Need to prepare waste management plan & follow it. All project vehicles must be washed in the designated project garage but not in the nearby pond. Dust should be controlled by watering regularly. Noise should be reduced by noise barrier (by tin/polythene fence). 	Contractors	DSC/PGCB
132/33 kV: Chandina GIS 2x50/75 MVA Substation, Debidwar, Comilla	<ul style="list-style-type: none"> Site clearance will be required and 420 trees will need to be felled. Nearby pond water will be polluted in case of dumping of project wastes into the pond and washing of project vehicles 	<ul style="list-style-type: none"> Try to avoid tree cutting as many as possible; Replantation of minimum 840 numbers of various local saplings along the access road slopes during monsoon period of operation stage . Follow ECOP-18 & 19 Need to prepare waste management plan & follow it. All project vehicles must be washed in the designated project garage. 	Contractors	DSC/PGCB
Maijdee Substation, Noakhali	<ul style="list-style-type: none"> Nearby khal water will be polluted in case of dumping of project wastes into the khal and washing of project vehicles 	<ul style="list-style-type: none"> Need to prepare waste management plan & follow it. All project vehicles must be washed in the designated project garage. 	Contractors	DSC/PGCB

Substations	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
(d) Operation Stage:				
400 kV Korerhat Substation, Mirsarai, Chittagong	<ul style="list-style-type: none"> A total of 2945 various local tree species can be replanted at the access road side slope @ 2.50m interval. Among the planted saplings, some (about 10%) may be dead. 	<ul style="list-style-type: none"> Plantation of minimum 5900 saplings to replace felled trees on the side slopes of the access roads during monsoon period. The dead saplings should be replaced by new saplings Nursing period of planted sapling should not less than 2 years. Follow ECOP-17. 	FD	PGCB
132/33 kV: Basurhat GIS 2x50/75 MVA Substation, Daganbhuiyan, Feni	<ul style="list-style-type: none"> A total of 136 various local tree species can be replanted at the access road side slope @ 2.50m interval. Among the planted saplings, some (about 10%) may be dead. 	<ul style="list-style-type: none"> Plantation of minimum 272 saplings to replace felled trees on the side slopes of the access roads during monsoon period. The dead saplings should be replaced by new saplings Nursing period of planted sapling should not less than 2 years. Follow ECOP-17. 	FD	PGCB
132/33 kV: Chandina GIS 2x50/75 MVA Substation, Debidwar, Comilla	<ul style="list-style-type: none"> A total of 420 various local tree species can be replanted at the access road side slope @ 2.50m interval. Among the planted saplings, some (about 10%) may be dead. 	<ul style="list-style-type: none"> Plantation of minimum 840 saplings to replace felled trees on the side slopes of the access roads during monsoon period. The dead saplings should be replaced by new saplings Nursing period of planted sapling should not less than 2 years. Follow ECOP-17. 	FD	PGCB

Table 8.3: Mitigation Measures for the General/Common Impacts of TL & LILO Line Subprojects

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
(b) Preconstruction/Construction Stage				
Clearing of vegetation	<ul style="list-style-type: none"> 20252 trees will be partially affected by trimming as well as standing crops (if any) and bushes along the ROW also will 	<ul style="list-style-type: none"> Prior to start clearing of vegetation; provide adequate compensation to the owners. Follow ECOP-17 	Contractor	DSC/PGCB

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
	be affected.			
Land Requisition (Temporary loss of 804 acres land for the construction period of about 3 years)	<ul style="list-style-type: none"> Loss of 804 acres land temporarily for the 884 nos. of tower bases of the TL/LILO lines 	<ul style="list-style-type: none"> Prior to commence construction activities, the owner of the temporarily affected land must be noticed and provided proper compensation as per GOB and WB guidelines; As per GOB & WB guidelines, RAP should be prepared for land acquisition/requisition/compensation and follow it. Use GIS instead of AIS in order to reduce land requirement. 	DC	DSC/PGCB
Fauna (Wildlife)	<ul style="list-style-type: none"> Disturbance of wildlife specially birds due to project activities such as moving of project equipment & transports especially during night time. 	<ul style="list-style-type: none"> Prepare construction management plan by the contractor and follow it. Follow GoB rules and regulations on noise. Project workers should not disturb or kill the birds. Follow ECOP-18 	Contractor	DSC/PGCB
Construction Waste	<ul style="list-style-type: none"> Generation of construction wastes from the construction materials. 	<ul style="list-style-type: none"> Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time Provision of facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements Purchase of perishable construction materials such as paints incrementally to ensure reduced spoilage of unused materials Use of building materials that have minimal packaging to avoid the generation of excessive packaging waste Use of construction materials containing recycled content when possible and in accordance with accepted standards. Adequate collection and storage of waste on site and safe transportation to the disposal sites and disposal methods at designated area shall be provided. 	Contractor	DSC/PGCB
Noise level	<ul style="list-style-type: none"> Noise pollution due to 	<ul style="list-style-type: none"> Use of noise plug in heavy construction equipment; 	Contractor	DSC/PGCB

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
	construction activities, generators and construction vehicle movement.	<ul style="list-style-type: none"> It is recommended that no construction should be allowed during night time (9 PM to 6 AM) Avoid using of construction equipment producing excessive noise at night; Construction activities should not be during night time Avoid prolonged exposure to noise (produced by equipment) by workers; and Regulate use of horns and avoid use of hydraulic horns in project vehicles. Generator should be placed within room (concrete walls with roof). Monitoring of noise level at construction site, construction camp as and when required. 		
Air quality & dust	<ul style="list-style-type: none"> Air pollution and dust generation due to construction activities, generators and construction vehicle movement. 	<ul style="list-style-type: none"> All vehicles (e.g., trucks, equipment, and other vehicles that support construction works) shall be well maintained and not emit dark or smoky emissions in excess of the limits described in the EQS. Specific training will be focused on minimizing dust and exhaust gas emissions from heavy construction vehicles. Drivers of vehicles used during construction will be under strict instructions to minimize unnecessary trips and minimize idling of engines. Dust suppression facilities (back pack water sprayer) shall be available where earth and cement works are required. Spray water on dry & loose surface of the construction sites regularly; Maintain adequate moisture content of soil during transportation, compaction and handling; Construction materials (sand, gravel, and rocks) and spoil materials will be transported trucks covered with tarpaulins. Sprinkle and cover stockpiles of loose construction materials (e.g., fine aggregates, sand); and Avoid use of equipment such as stone crushers at site, which produce 	Contractor	DSC/PGCB

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
		significant amount of particulate matter. ▪ Dust masks should be provided to all personnel in areas prone to dust emissions throughout the period of construction.		
Soil quality	▪ Soil pollution	▪ Prevention of spillage and leakage of hazardous liquid at construction site & camp. ▪ Ensure not to use transformer containing PCB to avoid soil & air pollution.	Contractor	DSC/PGCB
Sitting of construction camps	▪ Temporarily loss of land for the construction camps etc. ▪ Clearing of standing crops if (any), grass and bushes ▪ Environmental pollutions (such as air, noise, water, wastes & soil) affecting nearby the settlements,	▪ Prior to commence construction activities, the owner of the temporarily affected land must be noticed and provided proper compensation as per GOB and WB guidelines; ▪ As per GOB & WB guidelines, RAP should be prepared for land acquisition/requisition/compensation. ▪ Prior to start clearing of vegetation; provide adequate compensation to the owners in time. ▪ Locate construction camp away from residential settlements, cultural sites, water bodies etc (minimum 0.5km) . ▪ Try to use fallow land ▪ Just after completion of construction, hand over this camp site to the owners as in earlier condition. ▪ Follow ECOP-7.	Contractor/DSC	PGCB
Traffic congestion/road accident	▪ Traffic congestion and road accident due to movement of construction vehicles.	▪ Follow BRTA traffic rules and regulations; ▪ Schedule deliveries of material/ equipment during off-peak hours ▪ Engage flagman specially at the entry of the substation site and construction camps for traffic control ▪ Engage experienced drivers to drive project vehicles ▪ Arrange for signal light at night ▪ Proper traffic management; and ▪ Avoiding stockpiling of materials specially at the road sides that could hamper traffic movement..	Contractor	DSC/PGCB

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
		<ul style="list-style-type: none"> Follow ECOP-14 		
Pollution due to wastes	<ul style="list-style-type: none"> Pollution due to wastes (construction wastes from construction activities & general wastes from workers' camps) 	<ul style="list-style-type: none"> Solid wastes collection system will be essential, which should include separation and collection of solid wastes in the dustbins/waste containers throughout the work site, construction yard/labour camp. The wastes such as piece of rods and woods, newspapers, containers etc. can be sold to the vendors and rest wastes can be dumped into the nearby road side waste containers/ waste bins from where will send these wastes to the nearest land fill dumping site by the Contractors. A log of the disposal of toxic and other waste materials is to be kept by the Contractors. Contractor should prepare waste management plan based on the EMP Follow ECOP-10 	Contractor	DSC/PGCB
Community health and safety (H&S)	<ul style="list-style-type: none"> Community H&S along the distribution line 	<ul style="list-style-type: none"> Safety barrier and warning sign surrounding the construction site; Generators should be placed in the closed room Formulate and implement emergency risk management plan by the contractor Follow ECOP-20 	Contractor	DSC/PGCB
Occupational health and safety (H&S)	<ul style="list-style-type: none"> Health & safety risks of construction workers. 	<ul style="list-style-type: none"> An experienced H&S Manager must be engaged by the contractor prior to start construction Only permitting trained and certified workers to work with any electrical equipment. First aid box and personal protective equipment, PPE (such as helmet, safety shoes, eye protection glass, ear plugs, waist belt, mask, hand gloves, body protective apron, ear muff and insulating boots) must be provided to the workers and ensure to use these PPE by the workers; Safety signs, health signs, prohibition sign, warning sign, mandatory sign, emergency escape sign, first-aid sign, information sign, 	Contractor	DSC/PGCB

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
		signboard, supplementary signboard, safety collar, symbol, pictogram, illuminated sign, acoustic signal, verbal communication and hand signal must be fitted at the designated sites of the subproject area. ▪ Follow ECOP-19		
Employment generation/income	▪ Employment opportunities for the local people especially for PAPs.	▪ Employ local people specially PAPs for the project activities as much as possible.	Contractor	DSC/PGCB
(b) Operation Stage:				
Community health and safety	▪ Community H&S along the distribution lines	▪ Safety barrier and warning sign surrounding the construction site; ▪ Generators should be placed in the closed room. ▪ Follow ECOP-20	PGCB	PGCB
Safety & Security of workers	▪ Risk to continuous power supply	▪ Ensure security of substation in collaboration with law enforcing agencies. ▪ Keep complain book in the substation for recording of people's complains. ▪ Ensure availability of adequate safety gears for substation operations	PGCB	PGCB
Power Supply	▪ Due to adequate reliability of power supply, social life and economic condition of the people will be improved	▪ O&M of substations should be done in time for adequate power generation.	PGCB	PGCB
Short Circuit/Accident	▪ Due to short circuit of the substation, disruption of power and accident will be occurred.	▪ O&M of substations should be done in time by experienced personnel.	PGCB	PGCB
EMF	▪ Due to EMF, human health may be affected	▪ Once there is no BD guidelines/Standard, so to be followed the Australian standard for the safety of the power lines. For housing structures clearance between TL and roof top is 6.5m-8m and for river crossing it will 14.6m-15.9m. Noted that no houses will be directly affected by the TL/Lilo lines.	PGCB	PGCB

Table 8.4: Mitigation Measures for the Specific Impacts of the TL & LILO line Subprojects

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
Preconstruction /Construction Stage:				
Subproject Name: 230kV D/C Korerhat – Chowmuhoni Transmission Line				
Requirement of land	Crop production at the 163 tower sites will be disrupted.	Adequate compensation will be provided to the affected people in time following RAP.	DC	DSC/PGCB
Disruption of boat movement; and Disruption of 2 cultural sites (such as a mosque at about 20m far away from TL at ch 48+300 at R/S, and a graveyard at ch 10+000 at L/S (witin SPIA). .	Disruptions of water transport movement during construction of transmission line over the Feni River at Ch 2+850. A mosque at about 20m far away from TL at ch 48+300 at R/S, and a graveyard at ch 10+000 at L/S (witin SPIA) may be affected .	<ul style="list-style-type: none"> Follow BITWA rules and regulations on navigation. Transmission line should be about 15m above the HWL. Close monitor the river crossing site of the TL during construction to avoid accident. Try to construct the TL at the river crossing during night to avoid disruption of boat movement. Any waste should not be disposed into the river. River water should be tested quarterly during construction. Mosque and graveyard should not be affected by the project activities (such as by wastes, noise, dust etc.). Adequate size noise barrier/screen should be install at the mosque and graveyard site for protecting noise and dust. No activities should be done during night (6:00 AM – 9:00PM). 	Contractors	DSC/PGCB
Water pollution	Construction of transmission line across rivers, canals and other water bodies (total 15) could pollute water during construction stage;	<ul style="list-style-type: none"> Discharge of fuel, lubricants, chemicals, and wastes into adjacent rivers/ponds will be prevented; and During construction, washing of clothes, bathing and cleaning of project vehicle & equipment in the aquatic habitat (e.g. river, pond) will be prohibited; Surface water quality will be monitored twice in a year (during dry and wet seasons); and ECOP -12 for water bodies and water qualities respectively will be followed. 	Contractor	DSC/PGCB
Aquatic Fauna	Due to water pollution by the construction of TL across the water	<ul style="list-style-type: none"> Discharge of fuel, lubricants, chemicals, and wastes into adjacent rivers/ponds will be prevented; and 	Contractor	DSC/PGCB

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
	bodies , aquatic fauna (fishes, frogs, snakes etc.) will be affected	<ul style="list-style-type: none"> During construction, washing of clothes, bathing and cleaning of project vehicle & equipment in the aquatic habitat (e.g. river, pond) will be prohibited; Project workers should not kill fishes & other fauna from the water bodies. ECOP- 11 and 12 for water bodies and water qualities respectively will be followed. 		
Subproject Name: 230kV D/C Kachua-Gazaria Transmission Line:				
Requirement of land	Crop production at the 134 tower sites will be disrupted.	Adequate compensation will be provided to the affected people in time following RAP.	DC	DSC/PGCB
Disruption of boat communication	Disruptions of water transport movement during construction of transmission line over the Meghna-Gumti River at ch 33+500.	<ul style="list-style-type: none"> Follow BITWA rules and regulations on navigation. Transmission line should be about 15m above the HWL. Close monitor the river crossing site of the TL during construction to avoid accident. Any waste should not be disposed into the river. Try to construct the TL at the river crossing during night to avoid disruption of boat movement. River water should be tested quarterly during construction 	Contractors	DSC/PGCB
Water pollution	Construction of TL (along with tower on both river banks) across the Meghna –Gumti River at ch 33+500 will pollute river water;	<ul style="list-style-type: none"> Discharge of fuel, lubricants, chemicals, and wastes into adjacent rivers/ponds will be prevented; and During construction, washing of clothes, bathing and cleaning of project vehicle & equipment in the aquatic habitat (e.g. river, pond) will be prohibited; Surface water quality will be monitored twice in a year (during dry and wet seasons); and ECOP- 12 for water bodies and water qualities respectively will be followed. 	Contractor	DSC/PGCB
Aquatic Fauna	Due to water pollution by the construction of TL across the water	<ul style="list-style-type: none"> Discharge of fuel, lubricants, chemicals, and wastes into adjacent rivers/ponds will be prevented; and 	Contractor	DSC/PGCB

Environmental Issues/Parameters	Environmental Impacts	Mitigation Measures	Implementation Agency	Supervision Agency
	bodies, aquatic fauna (fishes, frogs, snakes etc.) will be affected	<ul style="list-style-type: none"> During construction, washing of clothes, bathing and cleaning of project vehicle & equipment in the aquatic habitat (e.g. river, pond) will be prohibited; Project workers should not kill fishes & other fauna from the water bodies. ECOP-11 and 12 for water bodies and water qualities respectively will be followed. 		
Subproject Name: Korerhat-BSRM LILO Line:				
Forest tress in the poket hilly area from ch 3+450-11+700	<ul style="list-style-type: none"> Forest trees may be affected by trimming of trees along the ROW Wildlife specially birds will be disturbed 	<ul style="list-style-type: none"> Prior to start construction, written permission should be taken from the FD i(In case of trimming of forest trees), Follow ECOP- 16, 17 and 18. 	Contractor	DSC/PGCB/FD

8.3 Environmental Monitoring Plan

The Environmental Monitoring Plan (MP) is one of the important tools/key components of the EMP for implementing the mitigation plan for the Project. The main objectives of the Monitoring Plan are to:

- Monitor changes in the environment during various stages of the project life cycle with respect to baseline conditions; and
- Manage environmental issues arising from construction works through closely monitoring their actual/potential environmental impacts.

A monitoring mechanism is developed for each identified impact and proposed mitigation measures. It includes:

- Location of monitoring (near the Project activity, sensitive receptors or within the Project influence area);
- Means of monitoring, i.e. methods of monitoring (visual inspection, consultations, interviews, surveys, field measurements, sampling and analysis);
- Frequency of monitoring (daily, weekly, monthly, seasonally, annually or during implementation of a particular activity); and
- Implementing agencies for monitoring.

The monitoring program will also include regular monitoring of construction activities for their compliance with the environmental requirements as per relevant standards, specifications and EMP; The purpose of such monitoring is to assess the performance of the undertaken mitigation measures and to immediately formulate additional mitigation measures and/or modify the existing ones aimed at meeting the environmental compliance as appropriate during the construction stage. The Monitoring Plan is presented in the following Tables 8.5-8.6 and Monitoring Checklist during construction to monitor the implementation of mitigation measures is given in Appendix E.

The environmental parameters that may be qualitatively and quantitatively measured and compared are selected as 'explicit indicators' and recommended for monitoring during project implementation and O/M stages. These monitoring indicators will be continuously monitored (Table 8.5-8.6) to ensure compliance with the national or other applicable standards and comparison with the baseline conditions established during the preconstruction/design stage. The list of indicators and their applicable standards to ensure compliance are given below:

- Air quality (PM₁₀, PM_{2.5}, SPM, SO₂, NO_x, CO) – EQS, Bangladesh;
- Noise levels – EQS, Bangladesh;
- Groundwater Quality (pH, As, Mn, Fe, TC, FC) - EQS, Bangladesh;
- Surface Water Quality (pH, NH₃-N, DO, BOD, COD and PO₄) – EQS, Bangladesh, and
- River-Bed Materials (Sand): Metals (As, Cu, Pb, Hg, Cr, Cd and Zn) – USEPA Standards

8.3.1 Environmental Monitoring System

The aforementioned environmental monitoring plan will be implemented following an Environmental Monitoring System. PGCB as an organization (entrepreneur of the project) is solely responsible to ensure proper environmental monitoring of the project during pre-construction, construction and operation phases. Environmental monitoring system will follow interlinked Plan-

Do-Check-Action procedure. Identified environmental impacts will be mitigated following mitigation measures along with ECOP outlined in the ESMF. The implementation and operation of EMP depends on several factors which are as follows:

- Clear understanding and identification of relevant environmental aspects and impacts;
- Objectives and targets to be achieved;
- Resources (technical, man power, financial etc.);
- Competence, training and awareness;
- Communication (internal & external);
- Documentation; and
- Emergency, preparedness and response.

During the three years construction and one year defect & liabilities period the ESU of PGCB will ensure proper implementation of the environmental monitoring system. Among the resources required competence, training and awareness will be built up following Training Plan among the engaged personnel of PGCB and contractors. Environmental performance will be checked, documented and will be taken corrective actions and communication will be maintained by the responsible personnel of the project. Budget for the environmental monitoring during pre-construction, construction and operation phases has been included in the EMP. Cost of environmental monitoring after operation phase will be provided from the in-house allotted fund of PGCB. Environmental monitoring system and Requirement for the Implementation and Operation of the Environmental Monitoring System are shown in the following Figure 8.1 and 8.2 respectively.

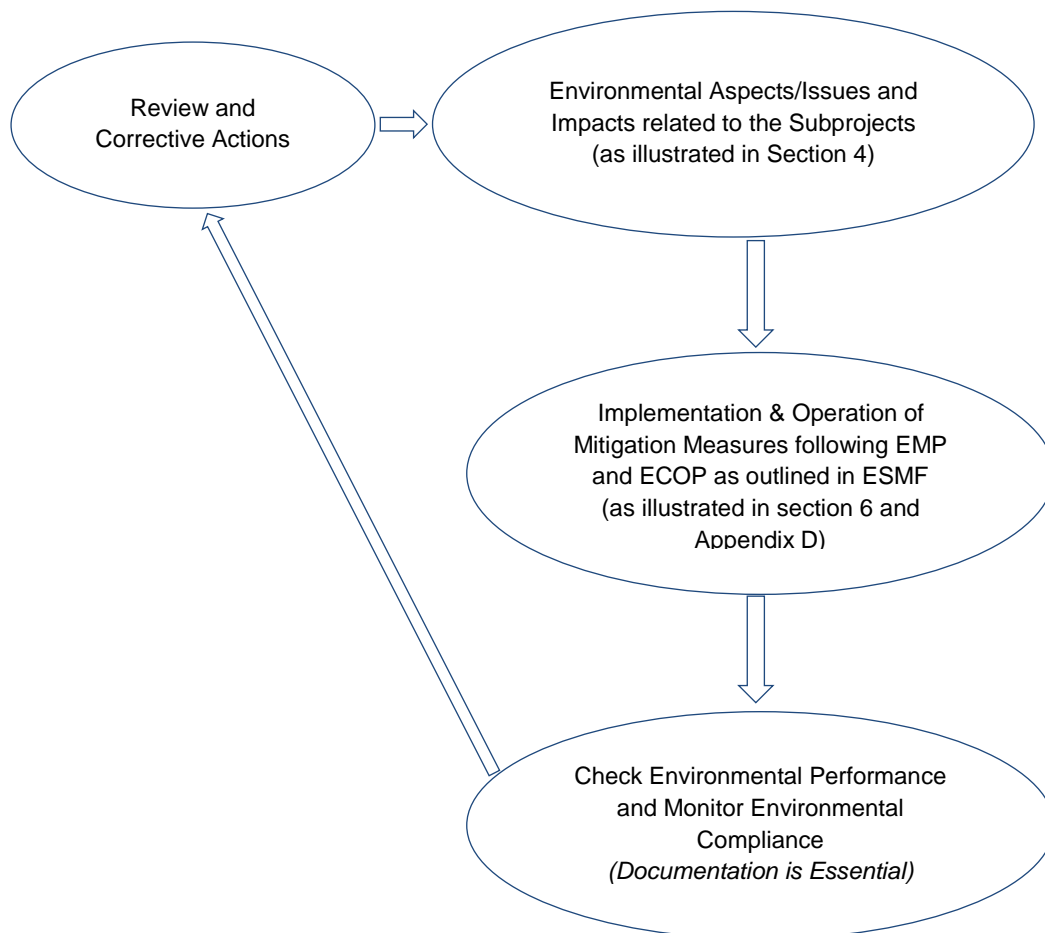


Figure 8.1: Environmental monitoring system

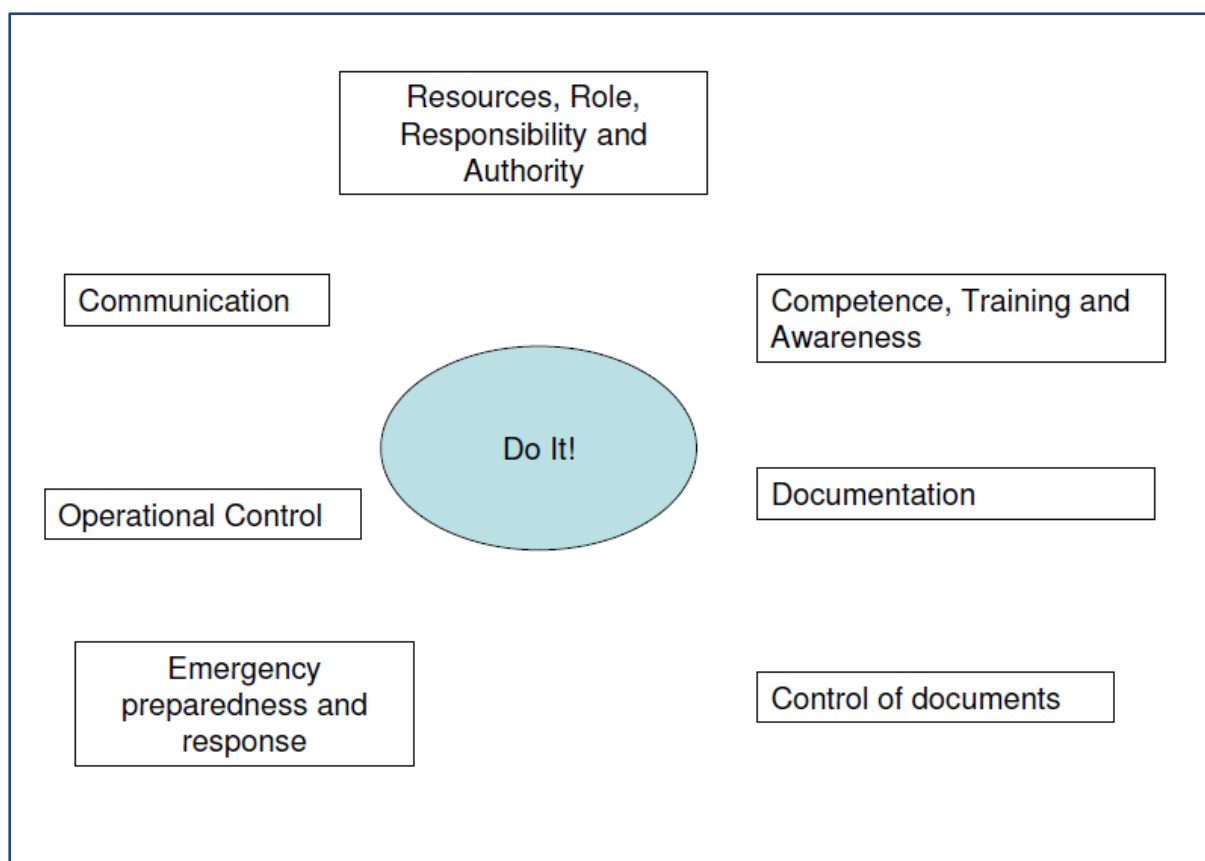


Figure 8.2: Requirement for the Implementation and Operation of the Environmental Monitoring System

Table 8.5: Environmental Monitoring Plan for Substation Subprojects

Environmental Issues/Parameters	Monitoring Parameters	Standards/Guidelines	Means of Monitoring	Frequency	Location	Implementation Agency	Supervision Agency
Preconstruction/Construction Stage							
Felling of trees and clearing of vegetation	<ul style="list-style-type: none"> Checking whether proper compensation as mentioned in RP is received by PAPs. 	DOE/FD	Inspection	Regular during tree felling and site clearing operations	Within ROW of substation & access road sites	Contractor/FD	DSC/PGCB
Fauna (Wildlife)	Checking whether wildlife is disturbing/killing by the workers	DOE/FD	Inspection	Weekly	ROW of Route	Contractor/FD	DSC/PGCB
Drainage Congestion/Flooding	<ul style="list-style-type: none"> Checking drainage congestion & top of substation site above HFL 	Hydrological/Drainage study	Inspection	Regular during earthworks	Substation site	Contractor	DSC/PGCB
Noise Pollution	Ambient noise level	DOE Noise Pollution Control Rules, 2006	Measurement	As & when required	At construction sites & camps	Contractor	DSC/PGCB
Dust Pollution	<ul style="list-style-type: none"> Dust should be controlled by water spraying regularly specially during dry period. 	DOE guidelines	Inspection	Regular	SS sites	Contractor	DSC/PGCB
Surface Water Quality	pH, BOD ₅ , COD, NH ₃ -N, PO ₄	DOE Standards	Sampling and Laboratory Analysis	Quarterly	Nearby 3 Water bodies	Contractor	DSC/PGCB
Ground Water/Drinking Water Quality	pH, Mn, Fe, As, TC, FC	DOE Standards	Sampling and Laboratory Analysis	Quarterly	At 3 construction camps (in Chittagong, Comilla & Noakhali)	Contractor	DSC/PGCB
Dredge Materials	Pb, Cd, Cr, Cu, Zn, Mn, As, Se, Hg	US EPA, 2000	Sampling and laboratory Analysis	Once before dredging and once after dredging	Dredging sites (such as Meghna – Gumti River, Bay of Bengal etc.)	Contractor	DSC/PGCB
Pollution due to Wastes	<ul style="list-style-type: none"> Checking collection, storage, transportation, and disposal of hazardous waste; Waste from construction site to be 	DOE guidelines	Inspection	Regular	Construction camps	Contractor	DSC/PGCB

Environmental Issues/Parameters	Monitoring Parameters	Standards/Guidelines	Means of Monitoring	Frequency	Location	Implementation Agency	Supervision Agency
	collected and disposed safely to the designated sites; and ▪ Wastes from labour camp to be disposed properly at the designated sites.						
Traffic Congestion/ Road Accident	▪ Checking meeting point of existing road & access road	BRTA	Inspection	Regular	Meeting point of existing road & access road	Contractor	DSC/PGCB
Occupational health and safety	Checking health, use of PPE & 1 st aid facilities, DWQ, sanitation and accommodation	DOE/IFC guidelines	Inspection & testing of DWQ	Regular & twice	At construction sites and camps	Contractor	DSC/PGCB
Community health and safety	Awareness of local people and staying safely from the project activities	DOE/IFC guidelines	Inspection	Regular	At construction site and camps	Contractor	DSC/PGCB
Operation Stage							
Tree replantation	Replanting of saplings and checking replacement of dead saplings & nursing (watering & fertilizer) of saplings for 2 years	FD	Inspection	As & when required	Access road side slopes	FD	PGCB
Drainage congestion	Checking drainage congestion in the substation sites during monsoon	Hydrological/Drainage study	Inspection	As & when required during monsoon	Substation sites	PGCB	PGCB
Community health and safety	Community H&S nearby the substation site	DOE/IFC guidelines	Inspection	Regular	Substation sites	PGCB	PGCB
Safety & Security of Substation & workers	Checking use of PPE & duty of security force	DOE/IFC guidelines	Inspection	Regular	Substation sites	PGCB	PGCB

Table 8.6: Environmental Monitoring Plan for TL/Lilo lines Subprojects

Environmental Issues/Parameters	Monitoring Parameters	Standards/Guidelines	Means of Monitoring	Frequency	Location	Implementation Agency	Supervision Agency
Preconstruction/Construction Stage							
Requirement of	▪ Ensure that PAPs get compensation as	As per RAP	Inspection	As per RAP	ROW of the	DC	DSC/PGCB

Environmental Issues/Parameters	Monitoring Parameters	Standards/ Guidelines	Means of Monitoring	Frequency	Location	Implementation Agency	Supervision Agency
land (Temporary requisition for 3 years)	per RAP which needs to be prepared.				TL/LILOlines		
Trimming of trees within ROW and clearing vegetation from the tower bases of the TL/LILO lines.	<ul style="list-style-type: none"> Checking whether proper compensation as mentioned in RAP is received by PAPs. 	DOE/FD	Inspection	Regular during tree felling and site clearing operations	Trimming of trees within ROW and clearing vegetation from the tower bases of the TL/LILO lines.	FD	DSC/PGCB
Noise Pollution	Ambient noise level	DOE standards	Measurement	As & when required	At adjacent subproject cultural sites & construction camps	Contractor	DSC/PGCB
Pollution due to Wastes	<ul style="list-style-type: none"> Checking storage, transportation, handling, and disposal of wastes; Wastes from construction sites and camps to be disposed properly at the designated waste dumping sites. 	DOE guidelines	Inspection	Regular	Construction sites and camps	Contractor	DSC/PGCB
Surface Water Quality	pH, BOD ₅ , COD, NH ₃ , PO ₄	DOE Standards	Sampling and Laboratory Analysis	Quarterly	River Crossing Site of Meghna-Gumti & Feni River by TL	Contractor	DSC/PGCB
Ground /Drinking Water Quality	pH, Mn, Fe, As, TC, FC	DOE Standards	Sampling and Laboratory Analysis	Quarterly	3 Construction camps (in Chittagong, Commilla & Noakhali)	Contractor	DSC/PGCB
Traffic congestion/Road Accident	Checking road crossing points, road adjacent to towers etc.	BRTA	Inspection	Regular	At road/Rly. crossing points & road adjacent to towers	Contractor	DSC/PGCB

Environmental Issues/Parameters	Monitoring Parameters	Standards/ Guidelines	Means of Monitoring	Frequency	Location	Implementation Agency	Supervision Agency
Cutural sites in SPIA (such as a mosque at R/S at about 20m distance at ch 48+300 and a graveyard at L/S at about 25m distance from Korerhat-Choumohini TL.	Checking whether these two cultural sites are affected by the project activities such as by noise, wastes etc.	DOE guidelines	Inspection	As & when required	A mosque at R/S at about 20m distance at ch 48+300 and a graveyard at L/S at about 25m distance from Korerhat-Choumohini TL.	Contractor	DSC/PGCB
Occupational health and safety	Use of PPE, general health, water supply and sanitation	DOE/IFC guidelines	Inspection	Regular	At construction sites and camps	Contractor	DSC/PGCB
Community health and safety	Awareness of local people	DOE/IFC guidelines	Inspection	Regular	At construction site and crossing of roads	Contractor	DSC/PGCB
Operation Stage							
Tall trees	Trimming of tall trees under the TL	ESMF	Inspection	Once every year and as directed by the relevant engineer of PGCB	Along the TL/LILO Lines	PGCB	PGCB
EMF	Checking of clearance of TL & top of houses (for housing structures) and for river crossing clearance from HFL to TL	Australian Standard for the safety of power lines (No BD standard & no device available in BD)	Inspection	As & when required	At populated /housing area where TL/Lilio lines passes over	PGCB	PGCB
Short circuit/ accident	Safety	DOE guidelines	Inspection	Regular	Along the TL/Lines	PGCB	PGCB
Occupational Health and Safety (OHS)	Use of PPE	As required	Inspection	Regular	Along the TL/LILO lines	PGCB	PGCB
Power Supply	Access to electricity in the rural area on priority basis.	DOE/PDB guidelines	Inspection	Whole project period	Along the TL/LILO lines	PGCB	PGCB

8.4 Environmental Code of Practice

The design, construction, installation and rehabilitation of electricity works shall take into consideration environmental issues and concerns. Factors to consider include, but are not limited to:

- the promotion of energy efficiency,
- the efficient use of non-renewable resources,
- the use of renewable resources,
- the social impact of new projects, and community concerns,
- the minimization of environmental damage, including visual impacts,
- tree management programs, and
- a reduction in and the correct disposal of waste products.

A Standard Environmental Code of Practice (ECOP) is prepared as a guideline for environment management of different components of the following subprojects:

- I. Construction of Sub-stations, and
- II. Construction of Transmission Lines/LILO Lines.

The main objective of an ECOP is to manage construction activities in harmony with the environment in an effort to contribute to the well-being of the community and the environment by: (a) Minimizing pollution, (b) Sustaining eco-systems, (c) Conserving cultural heritage, and (d) Enhancing amenity. The ECOP has designed to address all potential impacts during the construction of the substations, rehabilitation of the transmission/distribution cable, and construction of the new transmission/distribution lines by the PGCB and REB. The ECOP will provide guidelines for best operating practices and environmental management guidelines to be followed by the contractors for sustainable management of all environmental issues. This ECP could be annexed in the general conditions of all the contracts carried out for the subprojects of the project. The list of ECOP, prepared for the subprojects of project is given below and the ECOP are given in Appendix I.

- ECOP-1: Project Planning and Design,
- ECOP-2: Route Selection,
- ECOP-3: Tower/Pole Erection,
- ECOP-4: Overhead Power Cable Installation,
- ECOP-5: Installation of Transformer on H-Pole,
- ECOP-6: Substation Site Preparation,
- ECOP-7: Construction Camps,
- ECOP-8: Topsoil Salvage, Storage and Replacement,
- ECOP-9: Borrow Areas, (10) Land Reclamation,
- ECOP-10: Waste Management,
- ECOP-11: Water Bodies,
- ECOP-12: Water Quality,
- ECOP-13: Electromagnetic Field,
- ECOP-14: Public Health and Safety,
- ECOP-15: Material Storage, Transport & Handling,
- ECOP-16: Cutting/triming of Trees,
- ECOP-17: Vegetation,
- ECOP-18: Natural Habitats,

ECOP-19: Occupational Health and safety, and

ECOP-20: Community Health and safety.

It is recommended that all major contractors to be procured under the Project will be a compliant of ISO 14001. This will be done by the PGCB imposing the requirements of ISO certification during prequalification of contractors. These Contractors should prepare a 'Construction Environmental Management Plan' (CEMP) demonstrating the manner in which they will comply with the requirements of ECP and the mitigation measures proposed in the EMP. The CEMP will form the part of the contract documents and will be used as monitoring tool for compliance. Violation of the compliance requirements will be treated as non-compliance leading to the corrections or otherwise imposing penalty on the contractors.

8.5 Approximate EMP Budget

Cost estimates are prepared for all the mitigation and monitoring measures proposed in the EMP. The details of the cost estimates and the budget during construction stage and first year of the operation stage for the mitigation measures are given in Table 8.7.

The cost estimates also includes the budget for environmental monitoring, consultants for EMP implementation, institutional strengthening and capacity building of PIU and environmental enhancement/compensation measures. The total budget for EMP implementation is estimated to be BDT 7,124,000.

Table 8.7: Approximate EMP Budget for the Project during Preconstruction/Construction stage

Sl. No.	Environmental Components	Items	Unit	Quantity	Rate (BDT)	Amount (BDT)
A. Substation Subprojects						
1	Waste Management	Handling, storage and disposal in the designated area of the construction camp	Lump-sum			800,000
2	Noise Level	Purchase Noise Meter and do monitoring as prescribed in the monitoring plan	Lump-sum			50,000
3	Surface Water Quality	Sampling and testing of water quarterly/year for 3 years at nearby 3 waterbodies)	No.	36	10,000	360,000
4	Ground Water/Drinking Water Quality	Sampling and testing of water quarterly/year at 3 construction camp sites	No.	36	10,000	360,000
5	Dredged Materials (for filling of substation subproject areas & const.yards)	Measurement of heavy metals of bed materials of Meghna-Gumti River & Sea from where sand will be collected (once during pre-construction and during construction)	No.	4	26,000	104,000
6	Occupational and Health and Safety (H&S)	H&S measures for workers (such as PPE, First Aid Boxes etc.)	Lump-sum			1,000,000

Sl. No.	Environmental Components	Items	Unit	Quantity	Rate (BDT)	Amount (BDT)
7	Replantation of saplings	Replantation of trees with nursing and fence at the end of construction or starting of operation (preferably during monsoon period)	No.	7,000	200	1400,000
8	Training		Lump-sum			100,000
9	Contingency		Lump-sum			100,000
Total:						4,274,000
B. TL/Lilo Lines Subprojects						
1	Waste Management	Handling, storage and disposal in the designated area of the Construction Camp	Lump-sum			1,000,000
2	Noise Level	Purchase Noise Meter and do monitoring as prescribed in the monitoring plan	Lump-sum			50,000
3	Surface Water Quality	Sampling and testing of water quarterly/year for 3 years at Feni and Meghna-Gumti river crossing sites of the TL.	No.	24	10,000	240,000
4	Drinking/Ground Water Quality	Sampling and testing of water quarterly/year for 3 years at 3 const. camps	No.	36	10,000	360,000
5	Occupational Health and Safety (H&S)	H&S measures for workers (such as PPE, Fast Aid Boxes etc.)	Lump-sum			1,000,000
6	Training	LS				100000
7	Contingency	LS				100000
Total:						2,850,000
Grand Total (A+B):						7,124,000

9 INSTITUTIONAL ARRANGEMENT AND CAPACITY BUILDING

9.1 General

Institutional arrangement is essential to implement the suggested mitigation measures and to execute monitoring plan at different project phases illustrated in chapter 8 under EMP. The implementation of the EMP also requires capacity building of the EMP implementation agency through training needs and plan. The structured institutional settings facilitate proper implementation of the environment safeguard requirements for the project. The PGCB is the key authority to follow up all the relevant environmental safeguard requirements following institutional arrangement.

Environmental & Social Unit (ESU) under the Technical Services Wing of PGCB headed by Superintending Engineer and supported by Executive Engineer, Sub-division Engineer, Assistant Engineer and Sub Assistant Engineer is the responsible unit to monitor that environmental safeguard requirement is being properly followed for the project. Figure 9.1 represents the proposed organizational structure to implement the EMP for the project which is a part of institutional arrangement. The selected contractor(s) for the subprojects will be responsible to implement the suggested mitigation measures and monitoring plan during the construction and operation stages of the project and the Design and Construction Supervision Consultant (DSC), engaged for the subprojects will be responsible to monitor and supervise the contractor(s) environmental activities to ensure that relevant environmental safeguard requirement is being properly followed or not. The DSC will report to Project Implementing Unit (PIU) and then PIU will maintain reporting, information management and liaison with ESU of PGCB Head Quarter and Project Director (PD) in time and following structured procedures.

9.2 Institutional Arrangement and Responsibilities

9.2.1 Power Grid Company of Bangladesh (PGCB)

The PGCB is in the process of creating an Environment and Social Unit (ESU) in the regular organogram and the ESU is expected to be set-up before commencement of implementation stage of the project. The ESU of PGCB under the leadership of the Project Director (PD)/Superintending Engineer (SE) will be responsible for taking care of issues related to environmental and social management. In addition, PGCB will hire an individual consultant for safeguard management of the project. He will review the environment screening/assessment report and do the periodic supervision of EMP implementation. The organogram for the proposed ESU of the PGCB for the project, as shown below in Figure 9.1:

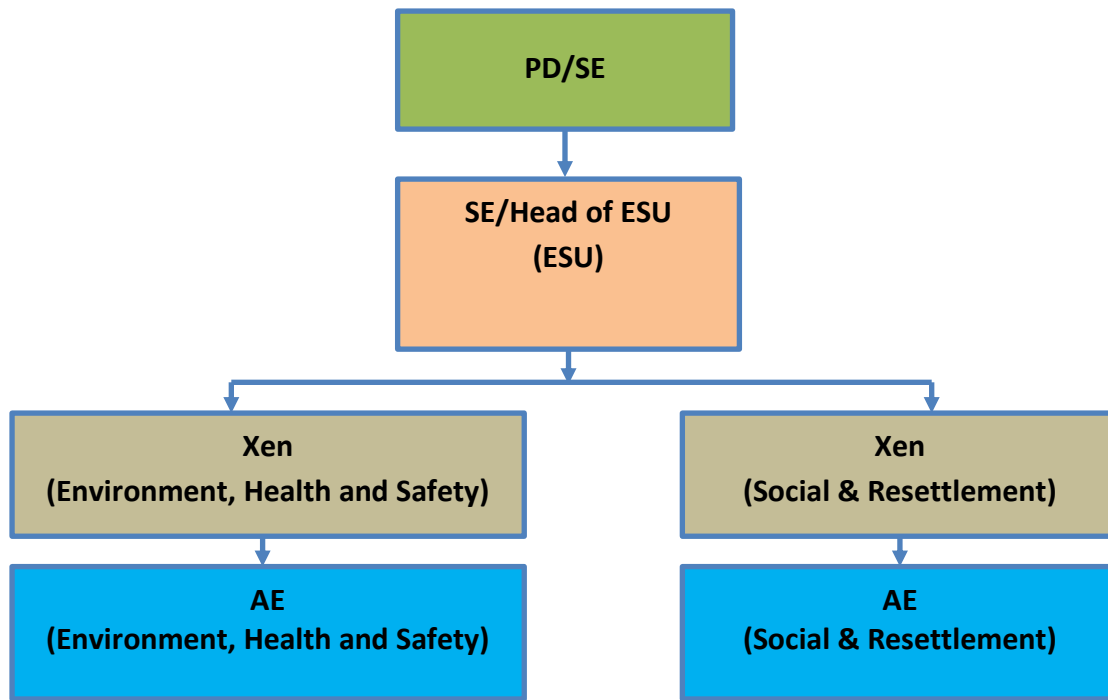


Figure 9.1: The organogram for the proposed Environment and Social Unit

The ESU will be responsible for overall environmental and social management of sub-projects to be implemented under the proposed project. The PGCB field level staff will carry out “Environmental and Social Screening” and “Analysis of Alternatives” of sub-projects with the support from individual consultant for first year and onward, following the guidelines contained in the ESMF.

Further environmental and social assessment (ESA) will be carried out by the unit or individual consultant to be hired by PGCB. The PGCB ESU will review the documents and be responsible for implementation of EMP (as well as RAP, TPP) and preparation of quarterly reports. The PGCB will hire an NGO with requisite experience in implementing resettlement programs and working in tribal areas and issues for the field level implementation of the RAP and TPP under the direct supervision of the ESU and in close coordination with the contractors. Figure 9.2 shows activities and institutional responsibilities for overall implementation of the proposed project by the PGCB.

Activity		Responsibility
Identification of sub-project/ project activities. Prepare/ complete: <ul style="list-style-type: none"> • Subproject Description (Form-1) • Environmental/social Screening (Form-2) • Analysis of Alternatives (Form-3) 		Individual Consultant of Power Cell with PGCB field level staff
↓		
Review of project documents, including Forms-1, 2 and 3 and Screening / assessment		Individual Consultant of project and ESU, PGCB
↓	Additional Environmental/ Social Assessment (ESA)	
	Carry out: (a) IEE and EMP or (b) full scale ESIA (including RAP, TPP, if needed); following the ESMF	Independent consultant
	↓	
	(1) Review of ESA by PGCB (2) Obtaining necessary environmental clearance from the DOE and WB	Individual Consultant of project and ESU, PGCB
↓		
Implementation of EMP/RAP/TPP/ ECOP during “construction phase” of project components.		The RAP and TPP will be implemented by an NGO hired by the client under the direct supervision of the ESU and in coordination with the Contractor. EMP Implemented by the Contractor and Supervised by PGCB’s field staff. Periodic monitoring by Individual Consultant and ESU, PGCB
↓		
Preparation of quarterly progress and monitoring reports		Social safeguard report by the contracted NGO. One Environment report prepared by the Contractor. Another report prepared by Individual Consultant and ESU, PGCB.
↓		
Implementation of EMP/ SMF during “operational phase” of project components, including monitoring and quarterly reporting		NGO and PGCB’s field staff with supports from ESU, PGCB

Figure 9.2: Institutional set up, including major activities and assignment of responsibility for their execution, for implementation of proposed project by the PGCB

9.2.2 Department of Environment (DOE)

The designated institution for overseeing environmental management in Bangladesh is the Department of Environment (DOE). The DoE is responsible for ensuring that EA/EIA is carried out following the requirements of the Environmental Conservation Act (1995) and Rules (1997). Unfortunately the DOE is a relatively new institution and has been poorly resourced in the past. It has an institutional presence only down to divisional level (six offices in Bogra, Sylhet, Chittagong, Rajshahi, Khulna, Comilla plus a combined headquarters in Dhaka). It thus falls to each of the

government line agencies to ensure that their work abides by the environmental laws, rules and procedures, with overall direction given by the DOE.

9.2.3 Forest Department (FD)

The Forest Department (FD) sometimes requires authorization for the cutting of trees, especially if they are in specially planted areas under their jurisdiction. To obtain the correct clearance documentation can be time consuming, although with the proposed project tree planting programs there will be far more tree cover as a result of the project. It is thus vital to ensure that adequate time is made available to obtain the required clearance. As for the FD, it is vital to ensure that adequate time is made available in the program for obtaining any such clearance that may be required. It is noted that due to running of 11.334 km long Korerhat-BSRM LILO line over the pocket hilly area (max. 6m ht) with forest trees (from ch 3+450-11+700), prior to start construction need clearance from the Forest Department (FD) of Bangladesh.

9.2.4 Design and Supervision Consultants (DSC)

The proposed framework for implementation of the project shall utilize consultancy services from both international and national companies for the overall design, management and supervision of construction works of the subprojects under the project.

9.2.5 Contractors

The tender for the construction of the subproject would be national/international competitive bidding contractors. There will be a need for environmental awareness rising, particularly as it relates to directly construction impacts and especially site health and safety issues. The need to develop self-regulation of the contractors will have to be emphasized, with the consultants supervising role being to check on conformity with the relevant clauses in construction contracts as well as national and WB legislation and regulations.

In this regards, the following clauses can be incorporated in the project contract document:

- The contractor shall take all reasonable steps to protect the environment and avoid damage and nuisance arising because of his construction activities/operations.
- The contractor shall comply with all statutes and regulations concerning the execution of works as mentioned in DOE and WB environmental guidelines.
- The contractor shall be responsible for familiarizing himself with all legislation relating to environmental protection that is relevant to his activities. Reference to national environmental quality guidelines should be made.
- The contractor shall be responsible for the costs of cleaning up any environmental pollution resulting from his activities if methods for doing so are available and effective.
- In case of surface water pollution from contractor activities, the contractor shall take adequate preventive measures for not doing so and in case of pollution if occurred the contractor shall be responsible to make the water to its original quality especially where the surface water has potential use. Cost including for the tests and the purification shall be to the contractors own costs.
- Where abstraction from a borehole by the contractor results in adverse effects on groundwater, which at the time of commencement of the contract was being used by the

local people, the contractor shall arrange supplies of equivalent quality and quantity to that previously.

- The contractor shall, at all times, maintain all sites under his control in a clean and tidy condition and shall provide appropriate and adequate facilities for the temporary storage of all wastes before disposal.
- The contractor shall be responsible for the safe transportation and disposal of all wastes generated because of his activities in such a manner as to not cause environmental pollution or hazards to health in any form. In the event of any third party being employed to dispose of wastes, the contractor shall be considered to have discharged his responsibilities under this clause from the time the wastes leave sites under his control, providing that he has exercised due diligence in ascertaining that the proposed transport and disposal arrangements such as to not cause pollution or health hazards.
- The contractor shall not allow waste oils or other petroleum derived wastes to be used as dust suppressants and that all reasonable precautions shall be taken to prevent accidental spillage of petroleum products, their contact with soil or discharge into water courses.
- The contractor shall be responsible for the provision of adequate sanitary facilities for the construction workforce (including those employed under subcontracts) at all construction and camp sites. The contractor shall not knowingly allow the discharge of any untreated sanitary wastes to groundwater or surface water. Before mobilization of the construction workforce, the contractor shall provide details of sanitary arrangements to the Engineer for approval. The detail should include maintenance and operation plants and generally be sufficient to allow the Engineer to assess whether the proposed facilities are adequate.
- All vehicles and plant operated by the Contractor (including subcontractors) shall be maintained according to the original manufacturers' specifications and manuals, with particular regard to the control of noise and/or smoke emissions. The Engineer shall have the right to require the contractor to replace or rectify any vehicle or plant that he thinks emits excessive noise and/or smoke, within 48 hours of notice in writing.
- The contractor shall make every reasonable effort to reduce noise nuisance caused by construction activities, including siting of crusher and ancillary plant in locations where the distance between them and residential areas such it results in attenuation of noise at existing residential areas is.
- In case of any traffic disruption by the construction activities of the contractor (or his appointed subcontractors), the contractor shall be responsible to provide alternative road access to the full operational use for the vehicles. The facilities in this regard shall be such that either party is not disturbed.
- In case of any existing infrastructure/properties, damaged by the contractor (or his appointed subcontractor), the contractor shall notify the Engineer of it and at his own cost shall repair the road to its original condition.
- Upon completion of the construction works, the contractor shall remove all equipment, surplus material, wastes and temporary works of every kind, and the site in clean condition to the satisfaction of the Engineer.

In addition of Contractor's general arrangement to continue the construction and rehabilitation work under the project, contractor must hire at least one environment, health and safety supervisor/engineer for each subproject before the commencement of work. The Contractor/Subcontractor shall abide by the rules of regulation of the Occupational health and safety as stipulated in the Labour Act-2006 and BNBC codes of Bangladesh. The contractor shall also

abide by the clauses of health and safety in the clauses at General Condition and subsequent Particular Condition of the bid document.

Role of Environment, Health and Safety Supervisor/Engineer: Primary role is to monitor the movement of people, workers and equipment, give timely warnings of any risk or non-compliance with safe work procedures and, where necessary, stop work if a risk situation escalates or cannot be minimized as well as look the potential environmental issues (air pollution, noise level, water quality, waste management etc.).

The tasks of environment and safety supervisor/manager include the following:

- Ensure first aid facilities and PPE as mentioned in Table 6.1 and 6.2 for workers at the sites.
- Provide orientation to workers before start of the subproject activities.
- Warn the workers of any imminent or deteriorating risk situation that could result in an accident, and instruct when it is safe to proceed
- Ensure restrain from undertaking any other tasks that may distract the workers focus on the work, mainly, work on or near live overhead conductors, work on transmission and communication towers .
- Stop the work, if necessary safety would not be ensured.
- Pause the work while the safety observer changes position.
- Ensure special safety during elevated work platform work or crane operations on or near live conductors.
- Ensure proper collection and disposal of solid wastes within the construction site.
- Ensure proper infrastructure facilities, water supply and sanitation facilities for all workers.

The contractor will prepare a monitoring report on environment and safety for each subproject at every month during the construction/rehabilitation of transmission line and substation.

The proposed overall organizational structure of the implementation arrangement of the EMP of the project is shown in the Figure 9.3.

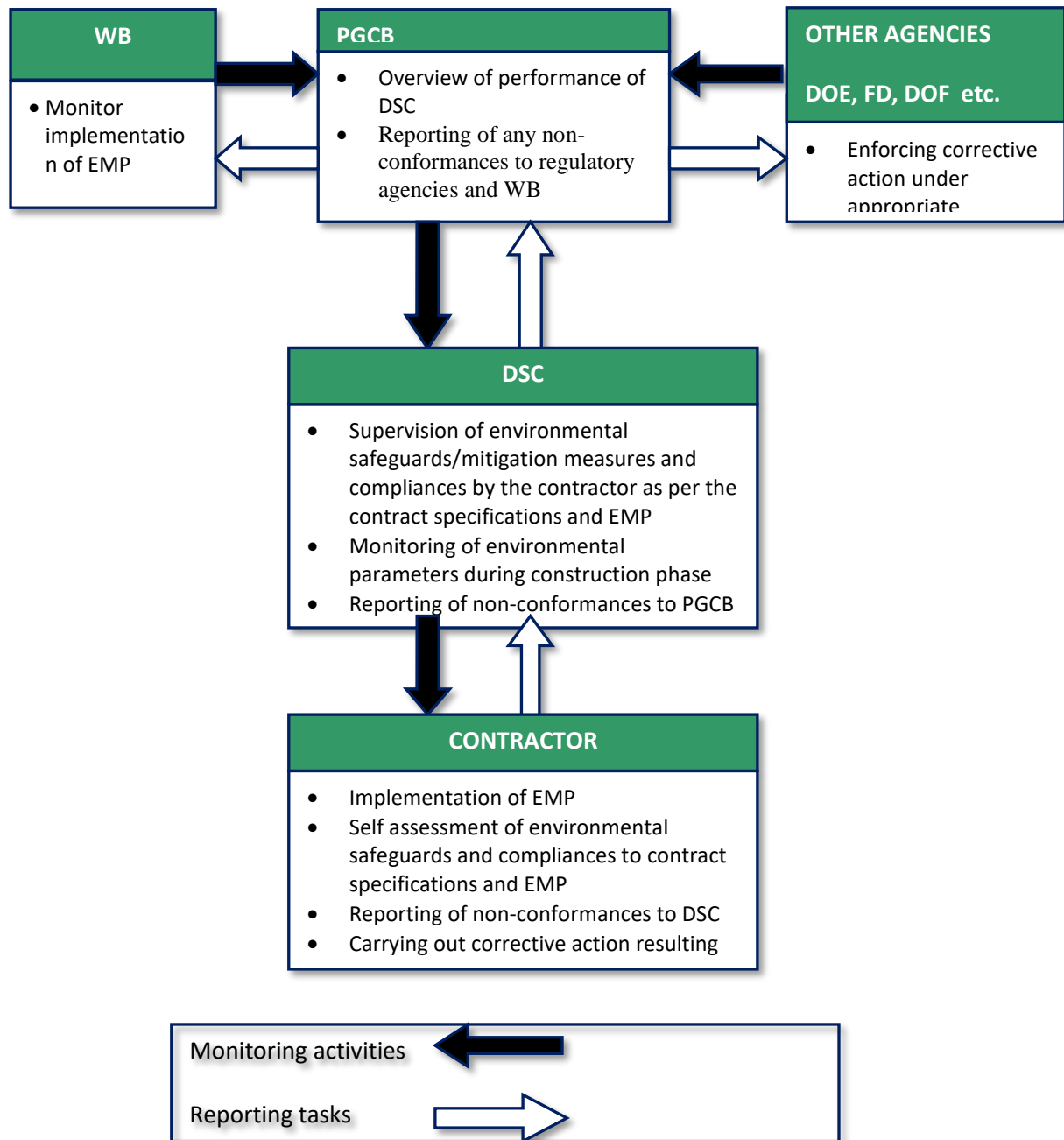


Figure 9.3: Organogram for the EMP Implementation of the Project

9.3 Capacity Building and Training Requirements

As a part of the “overall environmental and social assessment”, existing environmental practices in recently completed and ongoing projects and capacities of PGCB have been evaluated through analysis of organizational set up and interviewing officials/ engineers. Details of the evaluation are

presented under “Overall Environmental Assessment”. It appears that the engineers at the PGCB have limited exposure to environmental/social assessment and management. As discussed above, the PGCB will be responsible for carrying out “environmental/social screening” and “analysis of alternatives”, and guidelines have been provided in the ESMF for carrying out these activities. However, basic training on regulatory requirements, environmental impacts, and environmental assessment and management would greatly improve the capability of relevant PGCB engineers/officials in carrying out their responsibilities under the proposed project.

The PGCB will employ individual/supervision/DSM consultant, who would support PGCB in overall environmental/social management. However, since the overall responsibility of environmental management lies with the PGCB, they need to ensure that the consultants are carrying out their responsibilities properly. For this purpose, it is important that the PGCB engineers/officials receive advanced training on environmental management and monitoring. Such training will assist them in properly overseeing the activities of the consultant engaged in environmental management of the proposed project, following the ESMF.

During the implementation of the project, the PGCB will develop their own organizational environment and occupational health & safety strategy and guidelines for their regular development work.

The training requirements of the PGCB staff are summarized in Table 9.1. It is also advised to provide the basic training for key personnel on regulatory requirements, environmental impacts, and environmental assessment and management in home or abroad. It may be mentioned that cost of training and capacity building is included in the project resources.

Table 9.1: Training Plan for the Proposed Project

Target Group	Subject(s)	Method	Time Frame
Project relevant engineers/officers of PGCB, contractors	General environmental awareness, regulatory requirements, environmental impacts and mitigation, analysis of alternatives, environmental management (EMP and ECOP) and H&S	Workshop/Seminar	Prior to start the construction activities of the subproject
Project relevant engineers/officers of PGCB, contractors	Environmental assessment, environmental management (EMP, ECOP), monitoring activities, H&S.	Workshop /Seminar	Just after starting the construction of subproject

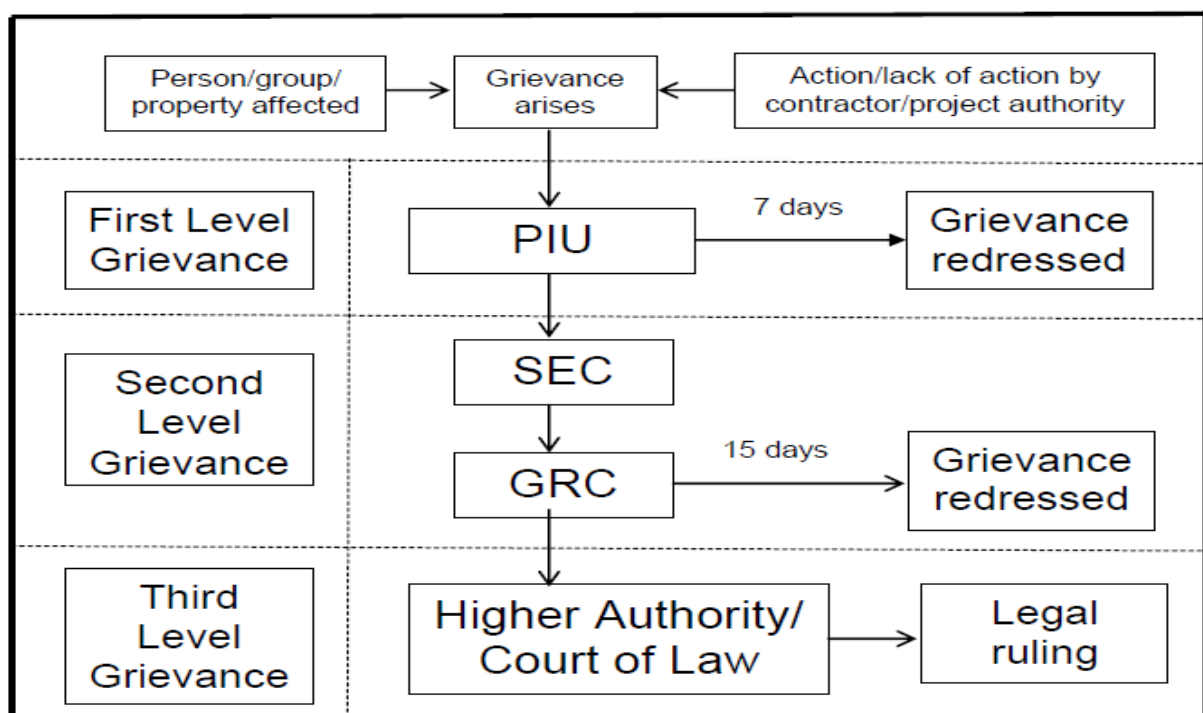
It would be essential to understand the legislative framework and enhance capacity of ESU of PGCB and Field Officer (Environment) for analysing the applicability of various environmental legislations and clearances, approvals and compliance monitoring requirements. An environmental legislation applicability matrix framework has already been given in Chapter 2 of this report for ready reference.

9.4 Grievance Redress Mechanism

The concern/grievances from local/affected people may come up related to inappropriate implementation of various components of EMP or the overall components/activities of the subproject itself. These issues will be addressed through acknowledgement, evaluation and corrective action and response approach. A Grievance Redress Mechanism (GRM) will be established

to receive, evaluate, and facilitate the resolution of affected people's concerns, complaints, and grievances about the social and environmental performance of the project. The GRM aims to provide a trusted way to voice and resolve concerns linked to the project, and to be an effective way to address affected people's concerns.

The Environmental and Social Unit (ESU) of the PGCB shall make the public aware of the GRM through public awareness campaigns. The contact phone number of the respective ESU will serve as a hotline for complaints, and shall be publicized through the media and placed on notice boards outside their offices and at construction sites. The project information brochure will include information on the GRM and shall be widely disseminated through the project area by the Environmental Specialist/Engineer in the ESU, with support from the NGOs and communication firm. Grievances can be filed in writing or by phone with any member of the ESU. Figure 9.4 represents how GRM will be implemented for the project.



GRC=Grievance Redress Mechanism, PIU= Project Implementation Unit, SEC= Soci Environmental Circle

Noted that Instead of SEC, it will be ESU.

Figure 9.4: Proposed GRM for the Project

First Tier of GRM: The Superintending Engineer (SE), ESU of PGCB (member of CC of PGCB, HQC) shall be the designated person as the key specialist for grievance redress (1st tier). Resolution of complaints will be done within 7 working days. Investigation of grievances will involve site visits and consultations with relevant parties (e.g., affected persons, contractors, traffic police, etc.) Grievances will be documented and personal details (name, address, date of complaint, etc.) will be included, unless anonymity is requested. A tracking number shall be assigned for each grievance, including the following elements:

- Initial grievance sheet (including the description of the grievance), with an acknowledgement of receipt handed back to the complainant when the complaint is registered;
- Grievance monitoring sheet, mentioning actions taken (investigation, corrective measures); and
- Closure sheet, one copy of which will be handed to the complainant after he/she has agreed to the resolution and signed off.

The updated register of grievances and complaints will be available to the public at the SEC office, construction site, and other key public offices along the project area. Should the grievance remain unresolved, it will be elevated to the second tier.

Second Tier of GRM: Adl. CE of MSW of PGCB, will activate the second tier of GRM by referring the unresolved issue (with written documentation). The GRC shall be established by the ESU of PGCB before commencement of site works. The GRC will consist of the following persons: (i) project director; (ii) representative of city ward; (iii) representative of the affected persons; (iv) representative of the local deputy commissioner's office (land); and (v) representative of the Department of Environment (DOE) for environmental related grievances. A hearing will be called with the GRC, if necessary, where the affected person can present his or her concerns and issues. The process will facilitate resolution through mediation. The local GRC will meet as necessary when there are grievances to be addressed. The local GRC will suggest corrective measures at the field level and assign clear responsibilities for implementing its decision within 15 working days. The contractor will have observer status on the committee. If unsatisfied with the decision, the existence of the GRC shall not impede the complainant's access to the government's judicial or administrative remedies.

The functions of the local GRC are as follows: (i) resolve problems and provide support to affected persons arising from various environmental issues, including dust, noise, utilities, power and water supply, waste disposal, traffic interference, and public safety, as well as social issues such as land acquisition, asset acquisition, and eligibility for entitlements, compensation, and assistance; (ii) reconfirm grievances of displaced persons, categorize and prioritize them, and aim to provide solutions within a month; and (iii) report to the aggrieved parties about developments regarding their grievances and decisions of the GRC. The SE, ESU will be responsible for processing and placing all papers before the GRC, maintaining database of complaints, recording decisions, issuing minutes of the meetings, and monitoring to see that formal orders are issued and the decisions carried out.

Third Tier of GRM: In the event that a grievance cannot be resolved directly by the PIU (first tier) or GRC (second tier), the affected person can seek alternative redress through the city ward committees or in appropriate courts. The PIU or GRC will be kept informed by the city corporation authority. The grievance redress mechanism and procedure has depicted in Figure 9.4. The monitoring reports of the EMP and the resettlement plan implementation shall include the following aspects pertaining to progress on grievances: (i) number of cases registered with the GRC, level of jurisdiction (first, second, and third tiers), number of hearings held, decisions made, and the status of pending cases; and (ii) lists of cases in process and already decided upon, which may be prepared with details such as name, identification (I.D.) with unique serial number, date of notice, date of application, date of hearing, decisions, remarks, actions taken to resolve issues, and status of grievance (i.e., open, closed, or pending).

10 CONCLUSIONS AND RECOMMENDATIONS

10.1 Conclusions

The proposed Enhancement and Strengthening of Power Network in Eastern Region (ESPNER) project, funded by WB is expected to provide support for the construction of the substations and TLs/LILOlines of the PGCB of Bangladesh. Main components of the project include:

- Construction of new 230/132 kV two substations and new 132/33 kV 10 substations;
- Construction of eight new 283.642km long 132 kV, 230kV and 400kV TL; and
- Construction of new eight LILO lines ;

The present power network in Greater Comilla, Noakhali and Chittagong areas of Bangladesh is aged and suffering numerous problems as system demand is growing rapidly. The greater Comilla and Noakhali areas are the second largest demand areas after the capital city of Dhaka. The greater Chittagong area is on the verge of massive industrialization as the government is taking initiatives to set up multiple economic zones, upgrade port facility and transportation network. Hence, the project was conceptualized with a rationale to expand the 230 kV transmission systems and to strengthen the 132 kV transmission systems in the project area, in order to, eliminate the operational bottlenecks caused due to inadequacy of the existing system. The project will also provide an adequate infrastructure for the future power sector development of the area.

The TOR has prepared to carryout detailed EIA for the project in accordance with the relevant laws and regulations of the GOB and the WB. The specific environmental guideline for the power sector is not available in Bangladesh. However the DOE environmental guidelines for the industries/projects provide a general framework for conducting environmental study for the entire sector. Therefore the proposed EIA will be conducted following the DOE environmental guidelines. In addition, it is suggested to follow the ESMF of Rural Electricity Transmission and Distribution Project (RETDP) of PGCB and BREB as well as WB environmental guidelines for the power sector.

The scope of work of the EIA includes: (a) Review of relevant information/data/documents from secondary sources, and identify gaps to be filled, relevant to the environmental screening needs from primary surveys. (b) Provide a description of the environment (such as baseline data on physical, biological/ecological and socio-economic characteristics of the subproject sites along with SPIA). (c) Represent the primary surveys where include baseline (air, water, noise, and riverbed) environmental quality monitoring at representative and sensitive locations, and identification of all macro-level environmental issues within the SPIA. (d) Survey the environmentally sensitive locations on and along the sub-projects and within the SPIA. (e) Arrange stakeholder consultations/individual consultations within the local people from all professions to find out their opinions on the subprojects. (f) Analysis of alternatives to the proposed subproject. (g) Identify and assessment of potential environmental impacts due to implementation of the subproject. (h) Formulation of Environmental Management Plan (EMP)

Initially, 3 sites for each proposed substation and 3 routes for each proposed TL have been selected and environmental screening and assessment for these 3 substation sites and TL routes have been done for identifying the potential impacts based on the collected baseline information/data by the environmental specialist and survey team according to Appendix-B (Substation subprojects) and

Appendix-C (TL subprojects) . From these 3 sites/routes, environmentally suitable substation site and TL have been finally selected. The potential impacts for the selected substation sites and TL routes during preconstruction/construction and operation stages of the subprojects are:

(a) For Substation Subprojects:

General/Common Potential Impacts:

- (i) During Preconstruction/Construction: A total of 86.62 acres land acquisition, clearing of vegetation including 3,501 trees , hydrology/ drainage congestion, top soils, and dust pollution, noise pollution, waste pollution , soil pollution, traffic congestion, occupational H&S, community H&S, and employment generation; and
- (ii) During Operation: Drainage congestion, tree replantation (a total 7000 various trees), landscape, occupational H&S, community H&S, and improvement of social and economical life of the people.

Specific Impacts of Substations

- (i) During Preconstruction/Construction: 2945 trees, 136 trees & 420 trees need to be cut due to construction of Korerhat, Basurhat & Chandina substation respectfully. SW pollution of waterbodies will be occurred due to construction of Maijdee, Basurhat & Chandina substation respectfully.

(b) For Subproject: TL & LILO Lines

General/Common Impacts:

- (i) Pre-construction/Construction Phase: Trimming of 20252 trees, disturbance of fauna (wildlife), loss of top soil due to tower, noise pollution , air/dust pollution , soil pollution, pollution due to wastes, aquatic habitat , traffic congestion/road accident , siting of construction camps, occupational H&S, community H&S and employment generation/income
- (ii) Operation Stage: Landscape, community HS&, Occupational H&S, improvement of social & economic life, short circuit/accident, electro-magnetic fields (EMF).

Specific Impacts

- (i) Preconstruction/Construction Stage: Disrubtion of boat movement and water pollurion in the Meghna- Gumti River at ch 33+500 due to construction of the Kachua-Gazaria TL and disrubtion of boat movement and water pollution in the Feni River at ch 2+850 due to Korerhat-Chowmuhini TL; a mosque due at 20m far away at R/S of the TL at ch 48+300 and a graveyard at 25m faraway at L/S of the TL due to construction of the Korerhat- Choumohini TL. Pocket hilly areas with forest small to medium trees will be affected by trimming due construction of Korerhat-BSRM LILO line.

The potential impacts during construction stage are short-term that can be avoided or eliminate to ed or reduced by adopting the mitigation measures properly. Therefore, the anticipated negative construction related impacts could be mostly controlled/minimized or eliminated by taking suggested mitigation measures and manage the implementation of the mitigation measures through the EMP including effective monitoring plan during pre-construction/construction and operation phases of the project.

The potential impacts during operation are long term and PGCB should ensure to mitigate these impacts through implementation of the EMP including monitoring plan properly. Total approximate budget for EMP is about BDT 7,124,000.

10.2 Recommendations

Based on the findings of the EIA study, the following can be recommended:

- Based on the EMP of the EIA, Construction Environmental Management Plan (CEMP) should be prepared by the contractor prior to start construction of the project and act accordingly during construction;
- The EMP will be included in the bid document of the civil works along with adequate EMP budget and eventually become part of the civil works contract (s);
- The mitigation measures for the negative impacts and enhancement measures for the positive impacts of the project as mentioned in the EMP must be implemented by the contractor (s) properly in schedule time; and
- The main tool for the successful implementation of the EMP is the environmental monitoring during various stages of the project, which must be carried out properly in time by the client/DSC/other relevant organisations.

11. REFERENCES

1. Bangladesh Bureau of Statistics (BBS). 2011. *Population and Housing Census*. Dhaka, Bangladesh: Bangladesh Bureau of Statistics.
2. Bangladesh Centre for Advanced Studies (BCAS). 1999. Guide to the Environmental Conservation Act 1995 and Rules 1997. Dhaka: BCAS.
3. Bangladesh Meteorological Department (BMD), Ministry of Defense, Government of the People's Republic of Bangladesh, 2016. Climatic Database: Rainfall, Temperature, Relative Humidity and Wind Speed for Comilla, Feni and Sitakundo station, 2061-2015. Dhaka: BMD.
4. Graphosman, World Atlas, January 1996.
5. Brammer, H., 1996. The Geography of the Soils of Bangladesh. Dhaka: University Press Limited.
6. Department of Environment (DOE), Ministry of Environment and Forest, Government of the People's Republic of Bangladesh, 1997. EIA Guidelines for Industries. Dhaka: DOE.
7. Environmental Conservation Rules 1997. (Schedule 3), Dhaka: Ministry of Law and Justice, Government of the People's Republic of Bangladesh.
8. Farooque, M. & Hasan, S. R., 2004. Laws Regulating Environment in Bangladesh. Dhaka: Bangladesh Environmental Lawyers Association (BELA).
9. International Union for Conservation of Nature (IUCN), 2000a. Red Book of Threatened Animals of Bangladesh. Dhaka: IUCN-Bangladesh.
10. International Union for Conservation of Nature (IUCN), 2000b. Red Book of Threatened Birds of Bangladesh. Dhaka: IUCN-Bangladesh.
11. International Union for Conservation of Nature (IUCN), 2000c. Red Book of Threatened Amphibians and Reptiles of Bangladesh. Dhaka: IUCN-Bangladesh.
12. International Union for Conservation of Nature (IUCN), 2003. Threatened Animals of Bangladesh. Dhaka: IUCN-Bangladesh.
13. Rashid, H., 1977. Geography of Bangladesh. Dhaka: University Press Limited.
14. Soil Resource Development Institute (SRDI), 1997. Physiography of Bangladesh. Dhaka: SRDI, Ministry of Agriculture.
15. Soil Resource Development Institute (SRDI), 1998. Agro-ecological regions of Bangladesh. Dhaka: SRDI, Ministry of Agriculture.
16. Topographical Survey of the SS and TL/Lilo Lines Subproject Area, 2017
17. Socio-Economic Survey of the ESPNER Project, June-July, 2017.
18. TOR of the proposed ESPNER Project, 2017.
19. Monthly Environmental Progress Report of the KMG Project under RHD , funded by JICA, January 2016.

20. Monthly Environmental Progress Report of the CCORRP Project under CDA, Funded by JICA, May 2017.

