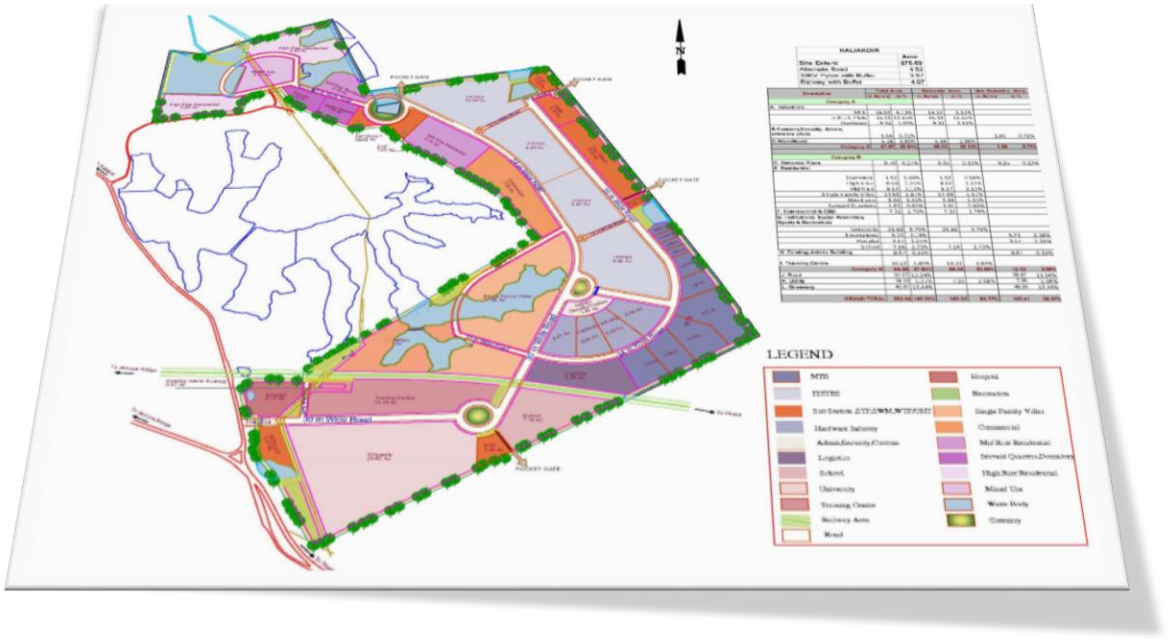
ESIA STUDY OF THE BANGABANDHU HI-TECH CITY PROJECT OF BANGLADESH TECHNOSITY LIMITED (BTL)



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FINAL REPORT: VOLUME-II

Bangladesh Technosity Limited

Prepared by: BETS Consulting Services Ltd.
An ISO Certified Consulting Firm

ESIA Study of the Bangabandhu Hi-tech City Project of Bangladesh Technosity Limited (BTL)

Final Report

Volume-II

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ANNEX-I: ENVIRONMENTAL AND SOCIAL BASELINE

1.1 INTRODUCTION

1.1.1 Study Overview

This section discusses the existing conditions within the project study area, covering both the natural and social environments. The analysis was completed through the use of a combination of secondary data sources in addition to extensive on-ground reconnaissance and baseline studies. The assessment is divided into three broad categories:

- Physical Environment;
- Biological Environment; and
- Socio-economic Environment

1.1.2 Site Overview

The Bangabandhu Hi-tech City is located at Uttar Baktarpur village of Kaliakoir Union. The 10 km study area map is shown in Figure 1.1-1. The study area is situated at Kaliakair and Gazipur Sadar upazila of Gazipur district, and Dhamrai and Savar upazila of Dhaka districts.

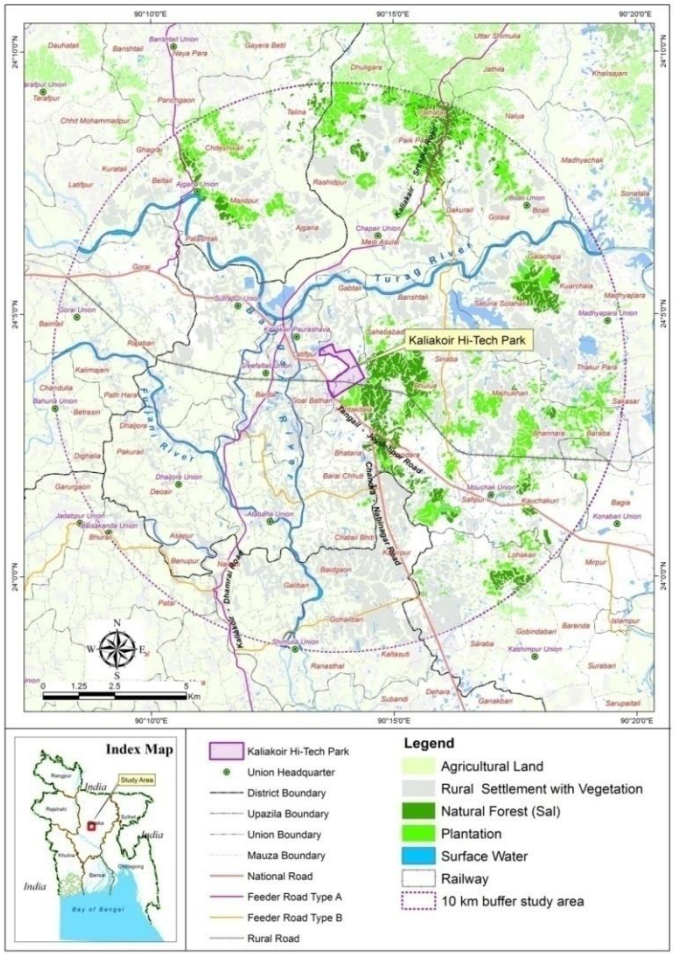


Figure 1.1-1 Project Study Area

1.1.3 Objectives and Methodology

The primary objective of the environmental and social baseline condition study is to provide an environmental and social baseline against which potential impacts from the operation of HTC can be compared.

The methodology adopted for collecting the baseline data was as follows:

- Study area of 10 km radial zone from the centre of the HTC location was selected for the baseline studies.
- The environmental and social field monitoring and survey was carried out during the period of June 2016 to July 2016.
- Primary data collection was through environmental monitoring and field survey for water, air and noise.
- Social baseline of the study area was captured through social surveys involving field consultations, interviews, meeting with stakeholders, discussions with government departments and secondary data review etc.
- Secondary data was collected from government reports, academic institutes, websites, published literature, interactions with government department and stakeholders etc.

1.2 TOPOGRAPHY

The study area mostly lies in flat topography. Presently, the area is dominated by agricultural practices followed by settlements, forest, fishing during wet season. The ground elevation gently lowers from east to west. The Project site is situated at the elevation ranges between 2-12 m PWD (Figure 1.2-1). The concerned study area is prone to occasional riverine flood but the project area has been developed considering 100 years flood level analysis. Topographic information of the study area was collected from the BWDB contour maps and SoB Topographic maps. The map has been updated incorporating other features such as alignment of the khals, river, road, beels etc. and a Digital Elevation Model (DEM) has been developed using the spatial analysis tool in ArcGIS. The Digital Elevation Model and contour maps is presented in Figure 1.2-1.

1.3 LAND USE AND LAND COVER OF THE STUDY AREA

An overview of the land use and land cover pattern has been prepared based on the satellite images and presented using Geographical Information System (GIS). The total land of the study area is 31,415 hectares. The land cover of the study area is derived from multi-spectral color Rapid Eye satellite images. The major classes extracted from the images are as follows: agricultural land, char land/sandbars, forest, industrial area and other land uses (i.e., road, rural settlement with homestead vegetation, built-up area and water bodies). **Figure 1.3-1** shows the detailed general land use map of the study area.

The area is mostly surrounded by agriculture land (14,335.2 ha, which is 45.63% of the total area) followed by rural settlement with homestead vegetation of 23.2%, water bodies 6.18%, built-up area amounting to 3.26%, forest land cover of 17.23%, industrial area (including Bangabandhu Hi-tech City) of 1.39%, road 0.63%, other land uses of 2.19% and char land/sandbar occupying a

very insignificant area of 0.22%. The natural forest (sal) of the study area is not an ecologically critical area. The detail area coverage of each class and sub class is given in the **Table-1.3-1.**

Table 1.3-1: Land Covers Classification

Major Class	Sub-Class	Area (ha)	(%)
Agricultural Land	Aman-Fallow-Fallow	3025.7	9.63
	Aman-Boro-Fallow	6964.7	22.17
	Other Crops	4344.7	13.83
Built-up Area	Built-up Area	1023.3	3.26
Char Land/Sand	Char Land/Sand	70.5	0.22
Forest	Natural Forest (Sal)	927.1	2.95
	Plantation	1571.1	5.00
	Vegetation	2926.1	9.31
Industrial Area	Industrial Area	436.8	1.39
Other Land Uses	Important Places	515.5	1.64
	Brick-field	172.2	0.55
	Chatal	0.3	0.00
Roads	National Road	39.9	0.13
	Railway	20.3	0.06
	Regional Road	50.0	0.16
	Rural Road	80.8	0.26
	Zila Road	7.4	0.02
Rural Settlement with Homestead Vegetation	Rural Settlement with Homestead Vegetation	7297.3	23.23
Water Bodies	Beel	437.2	1.39
	Canal	107.6	0.34
	Ditch	116.7	0.37
	Pond	813.9	2.59
	River	384.2	1.22
	Lake	8.5	0.03
	Seasonal Water body	74.0	0.24
Total		31415.9	100.0

Source: Satellite image analysis

1.4 GEOLOGY

Physiographically, the area falls partly in the Old Brahmaputra floodplain and Madhupur tract which are marked respectively as code 4 and 16b on the physiographic map of Bangladesh (Figure:1.4-1). The area is located in the central part of the Bengal basin an extensive alluvial plain of the quaternary sediments laid down by the Ganges-Brahmaputra-Meghna river system.

The surface of the area is covered by paludal deposit. The thickness of this section ranges from 7 to 9 meters. It is composed of Holocene river alluvium, meander, inter-stream, swamp deposit, marsh clay and peat. Immediate below this section underlies 16,000 m thick sequence of quaternary sediments. Lithology shows that the area comprises of alternation of sand/silt and clay sequences.

As per tectonic classification, the area falls under Madhupur Tripura threshold of eastern platform flank of the Bengal basin. Tectonically this area is inactive and no apparent major structure like fault or fold exists in the region that might be geologically significant (Figure: 1.4-2).

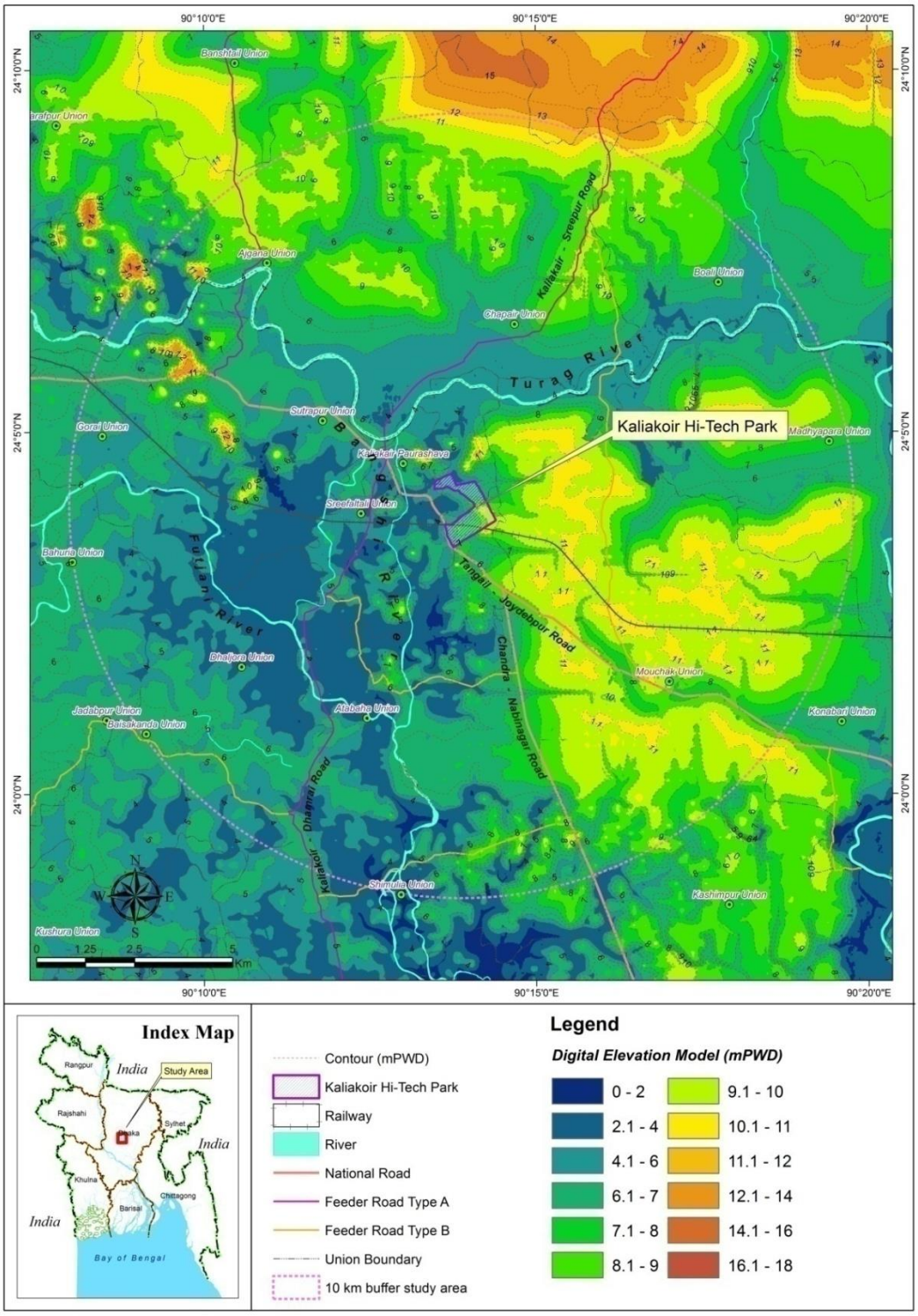


Figure 1.2-1: Digital Elevation Map of the Study Area

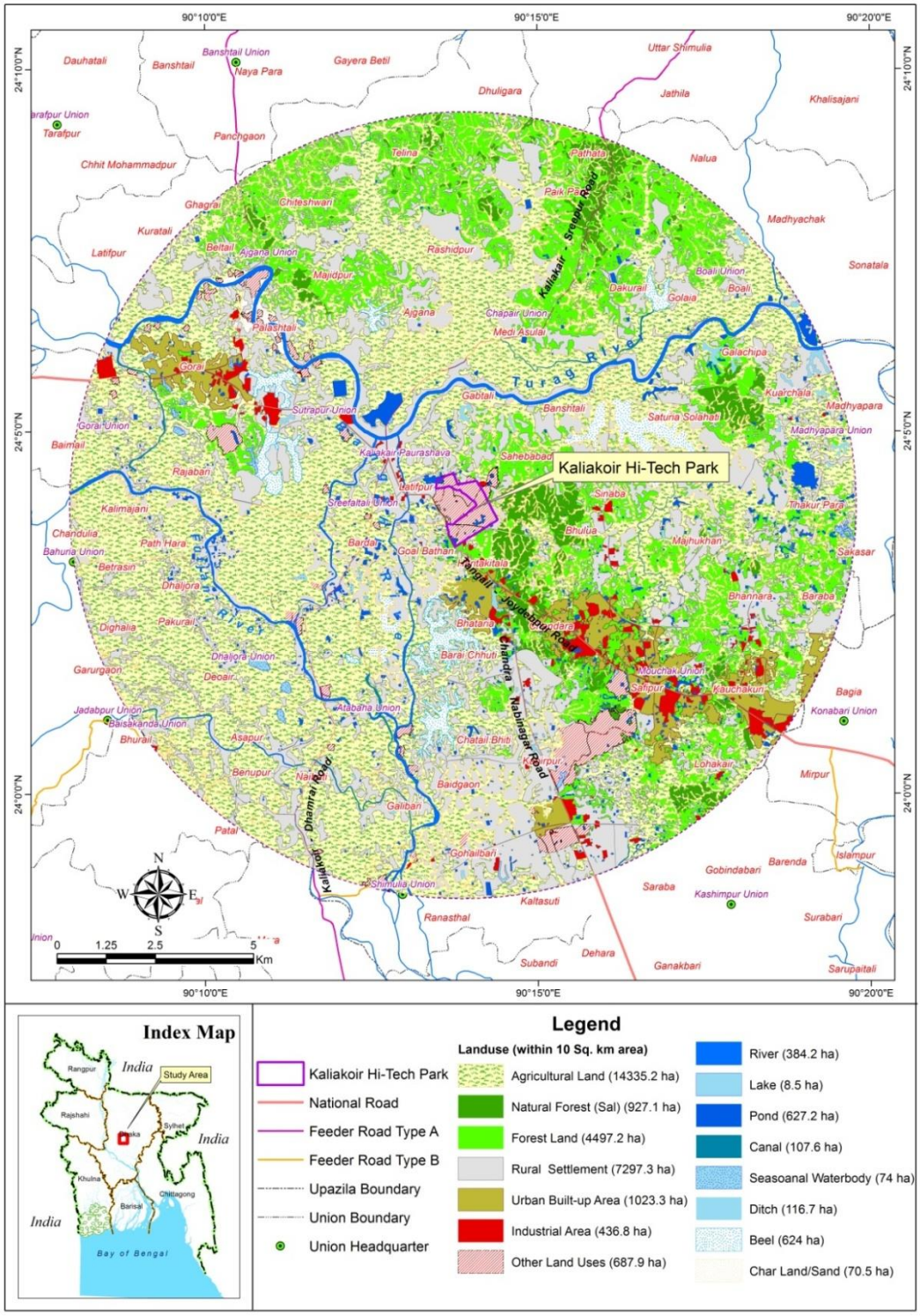


Figure1.3-1: General Land Use Map

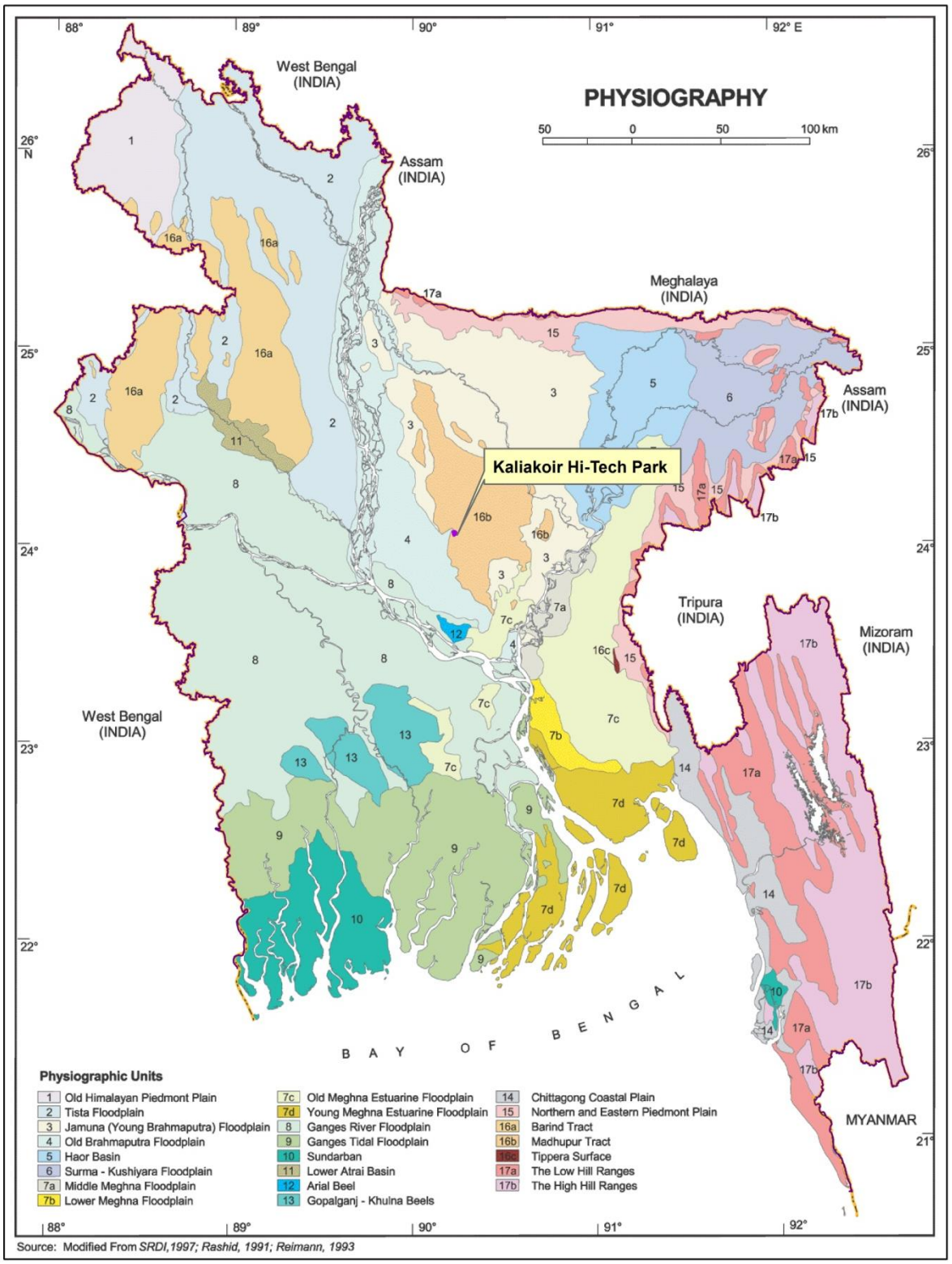


Figure1.4-1: Physiographic Map of Bangladesh

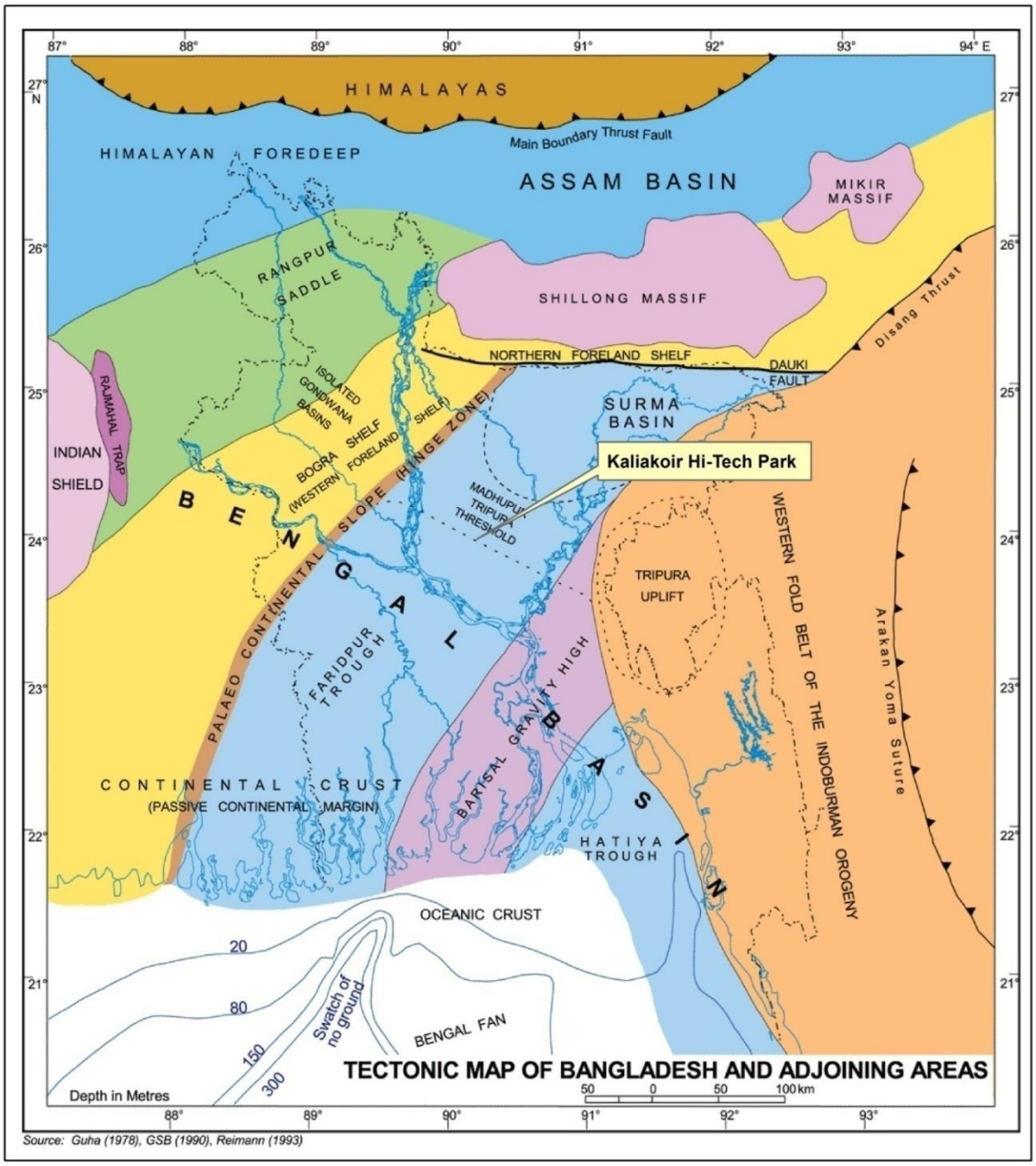


Figure1.4-2: Project Site on the Generalized Tectonic Map

1.5 WATER RESOURCES

Bangladesh and the western portion of the Indian State of Bengal are located within the 'Bengal Basin'. According to Rahman et al (2003), this basin includes the world's largest river delta, which is 140,000 square kilometers (the Ganges-Padma, Jumna-Brahmaputra- Tista and Meghna rivers and numerous tributary complexes) and the world's largest submarine fan complex (the Bengal Fan). These river systems carry a combined annual sediment load of 1.5 to 2.4 billion metric tons.

Bangladesh has an average annual surface flow of approximately 1,073 million acre feet (MAF), of which about 870 MAF (93%) are received from India as inflow and the remaining 203 MAF (7%) as rainfall. This water is enough to cover the entire country to a depth of 9.14m. About 132 MAF (65% of rainfall and 12% of total) is lost to evaporation each year (114.30 cm), the remainder flows out to the Bay of Bengal.

Water sampling and analysis was undertaken to understand the overall baseline water quality characteristics of the surface and groundwater in the study area. Samples were taken from representative selected water body and groundwater sources representing different parts of the study area.

Two surface water sampling were conducted for this study. One sample was within the Hi-Tech parks lake and the other from the Bangshi River which is adjacent to the project area. Groundwater sampling locations were selected to obtain representative water samples within the park and outside the park. The samples were collected from existing ground water sources. A total of 4 samples, two (2) surface water and two (2) ground water samples were collected. Detail of the sampling location is provided in Table-1.6-1 and depicted in Figure-1.5-1.

Table 1.5-1: Details of Surface and Ground Water Sampling Locations (26th April 2019)

Sl.	Sampling Location	Sampling Code	Geographic Location
1	Hi-Tech Park Lake	SW-L-01	24° 3'47.10"N; 90°14'0.54"E
2	Bangshi River	SW-L-02	24° 4'19.26"N; 90°12'50.28"E
3	PTW of Hi-Tech Park	GW-L-01	24° 3'56.64"N; 90°14'6.06"E
4	HTW of the Baktarpur	GW-L-02	24° 3'55.38"N; 90°14'10.74"E

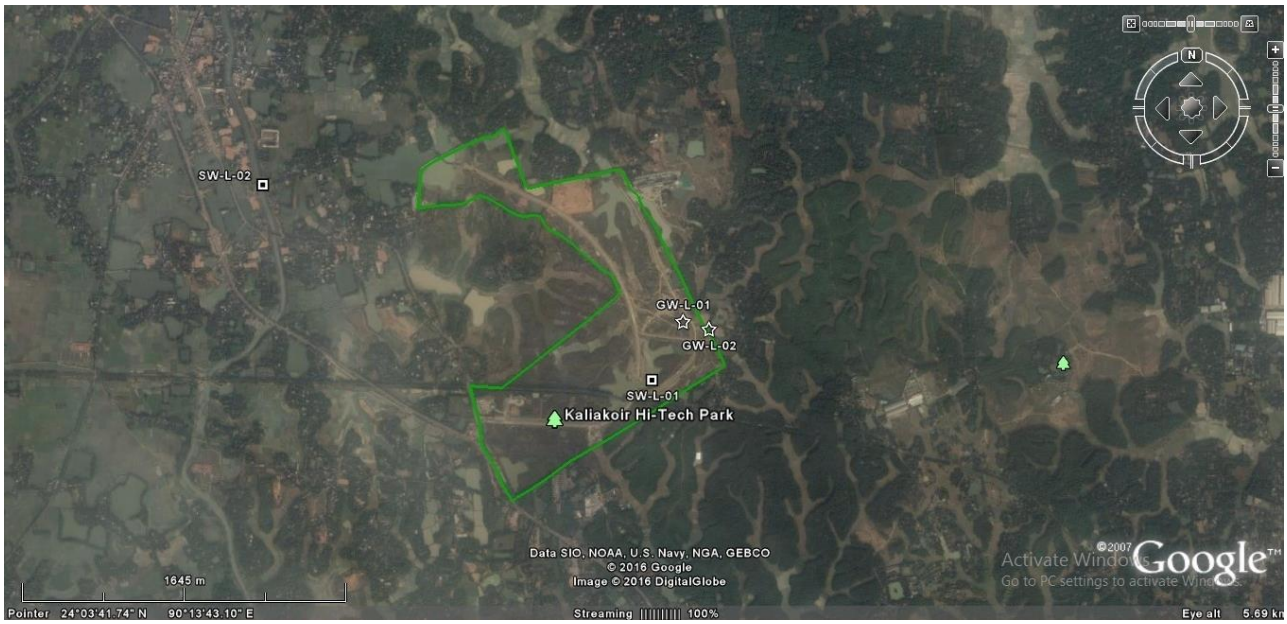


Figure1.5-1: Surface and Ground Water Sampling Locations

Sampling of HTC Lake Water (Surface Water)

Sampling of Surface Water of Bangshi River

Ground Water Sampling (within the HTC)

Ground Water Sampling of Baktarpur

Surface and Ground Water Monitoring of the Project Study Area in the year 2016

Ground Water Sampling (within the HTC)

Ground Water Sampling of Baktarpur

Sampling of Surface Water of Bangshi River

Sampling of HTC Lake Water (Surface Water)

Surface and Ground Water Monitoring of the Project Study Area in the April 2019

The samples were analyzed for parameters covering physico-chemical characteristics.

Water samples were collected in a 250 ml sterilized clean PET bottle for complete physio-chemical tests.

The samples were analyzed as per standard procedure/method given in Standard Method for Examination of Water and Wastewater Edition 20, published by APHA. Details of the analysis method and protocol are presented in Table-1.5-2.

Table 1.5-2: Methods for Water Analysis

Monitoring Parameter	Test Method (APHA)	Monitoring Parameter	Test Method (APHA)
As	AAS	Fe	AAS
BOD	5 days incubation	Pb	AAS
Ca	AAS	Mn	AAS
COD	CRM	Hg	Mercury Analyzer
Chloride	Titrimetric	Nitrate	UVS
Coliform (Total)	MFM	Ammonia	UVS
Colour	UVS	Oil & Grease	Oil Content Meter
Cr (Total)	AAS	pH	pH Meter
DO	Multimeter	Phosphate	UVS
EC	EC Meter	Salinity	Multimeter
TDS	Multimeter	Sulphate	UVS

AAS- Atomic Absorption Spectrophotometer, UVS – Ultraviolet Visible Spectrophotometer, MFM – Membrane Filtration Method, CRM – Closed Reflex Method, LOQ – Limit of Quantization

1.5.1 Surface Water Resources

The Turag River and the Bangshi River are the main water system that flows in close proximity of the proposed project site (Figure 1.5-2). The Bangshi River system provides the central spine drainage of the North Central Region. It originates from Banar Upper River at Sharifpur union of Jamalpur Sadar Upazila and flow through Tangail district and joins the Dhaleswari River at Kulla union in Dhamrai Upazila. It is fed partly by spill from the Jamuna through the Northern Dhaleswari intake via the Pungli River, partly by the accumulated runoff from the north-west of the region, (Jhenai River, Futikjani River), and partly from the direct runoff into the Bangshi from the western slopes of the Madhupur Tract. Over recent years, the rainfall/runoff contribution from the Madhupur Tract may have increased significantly due the extensive denudation of the Madhupur Forest (FAP).

The Turag River is the upper tributary of the Buriganga, a major river in Bangladesh. It originates from the Bangshi River, the latter an important tributary of the Dhaleshwari River, flows through Gazipur and joins the Buriganga at Mirpur in Dhaka District. It is navigable by boat all year round. The Turag suffers from acute water pollution. While attempts have been made to marginally widen the river the majority of industry has made little effort to follow environmental law and the water has become visibly discolored. Figure-1.5-2 shows the water resources system map of the study area.

1.5.2 Surface Water Quality

The surface water Quality was compared with the Bangladesh ECR standard for best practice based classification criteria. Table-1.5-3 shows the analysis results. Some of the water analysis parameters are discussed below in detail:

pH

pH of the Hi-Tech Lake water and Bangshi River is within the permissible limits of 6.5 to 8.5.

Dissolved Oxygen (DO)

The DO of the sample of Hi-Tech Lake water and Bangshi River is above 5 mg/l and thus meets the surface water classification for different usages.

Biological Oxygen Demand (BOD)

The BOD level of Hi-Tech Lake is 3.0 mg/l and thus is well below the permissible limits. This water could not usable as a source of drinking water for supply only after disinfecting.

The Bangshi River's BOD level is 4.0mg/l which indicates that this water could not be usable as a source of drinking water for supply only after disinfecting and for recreational activity also.

Comparison of the field tested data with the surface water quality standards of government of Bangladesh reveal the fact that water of the water bodies are fit for supply after conventional treatment, Water usable by fisheries, Industrial process and cooling industries and Water usable for irrigation.

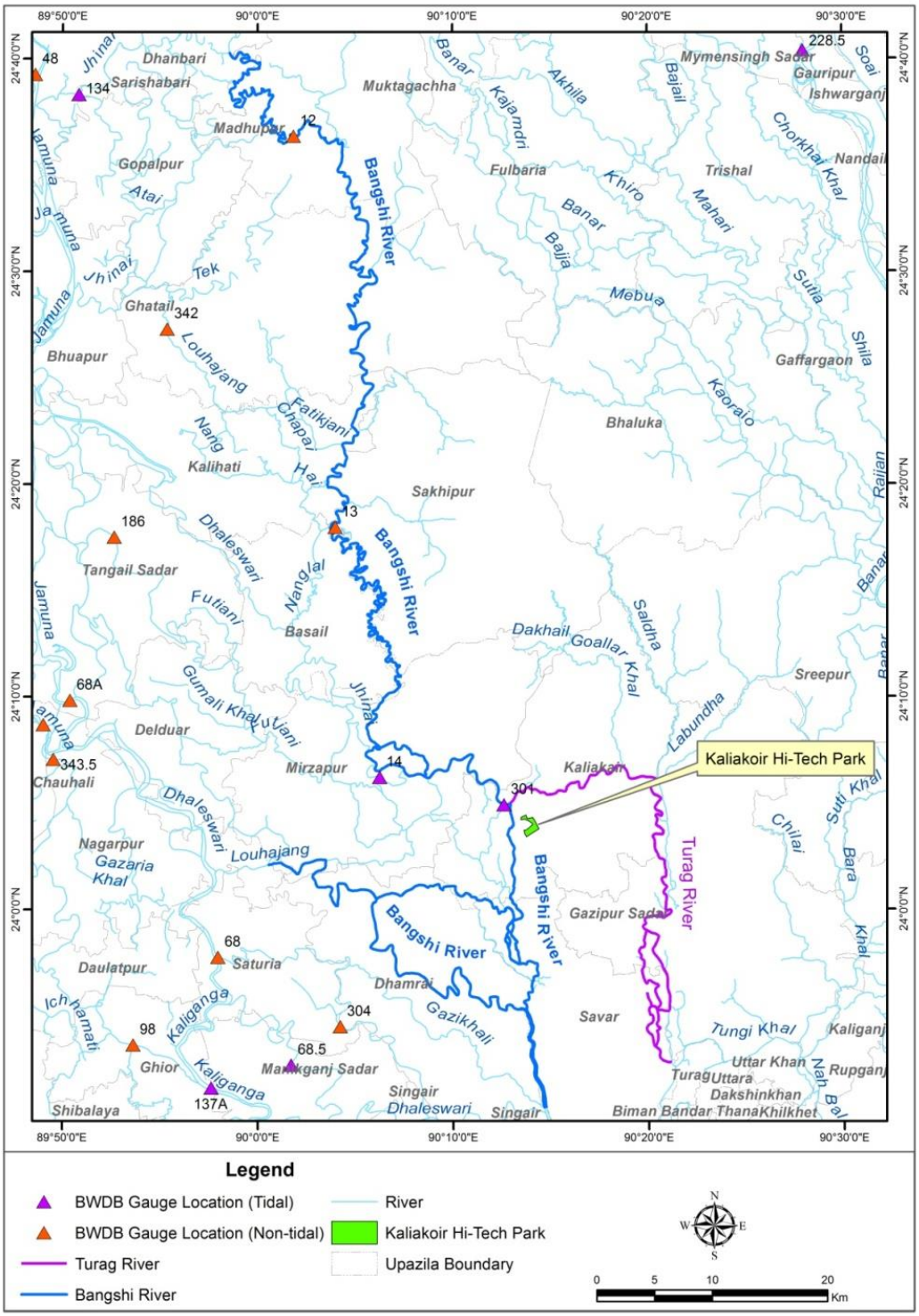


Figure 1.5-2: Water Resources System Map of the Study Area

Figure-1.5-3 Partial River Sytem Map showing Turag & Bansi River

Source: Survey of Bangladesh (SOB); Sheet No.: 78 L/4; Scale: 1:50,000

Notes: In google satellite Image the Turag River is wrongly identified as Bansi River

1.5.3 Ground Water

Groundwater aquifers in Bangladesh are constantly recharged by major river systems and by infiltration of rainwater. Groundwater is usually available within 5 m below ground surface (mbgs). This level fluctuates seasonally but approaches close to the surface in most parts of the country from July to September. At Gazipur, the groundwater level is about 6 mbgs surface during the dry season, with levels returning to their normal position before the end of the monsoon season. This fall in ground levels is an entirely natural process that arises because of the

hydrological link with the river. The groundwater present in the project area is at three distinct levels:

- An upper silty clay cover of less than 20 m thicknesses, along the borders of the NCR. The maximum thickness ranges from 50 to 100 m.
- A middle composite aquifer of fine to very fine sands, varying in thickness from 30 m to 60 m along the border of the NCR. In the centre of the region, the aquifer is less than 10m thick. Although it is a good aquifer, its irrigation development potential is poor, because its sands are too fine for slotted well screens and for providing high discharge rate. However, it is used as a source of supply for HTWs and MOSTIS.
- The lowest and main aquifer consists of medium, medium-to-fine or medium-to-coarse sand with layers of clay and silt extending to 30-60m. The coarser-grained structure of this aquifer is suitable for large-scale groundwater development with screened wells. Most tube wells within the main aquifer are less than 150 m deep.

1.5.4 Ground Water Quality

The groundwater quality of the project study area showed compliance with drinking water standards. The results of two groundwater samples are shown in Table-1.5-3 and Table-1.5-4.

Table 1.5-3: Surface Water Quality Analysis (26th April 2019)

Characteristics	Unit	Sampling Location		LOQ	Bangladesh Standard*					
		SW1	SW2		Source of drinking water for supply only after disinfecting	Water usable for recreational activity	Source of drinking water for supply after conventional treatment	Water usable by fisheries	Water usable by various process and cooling industries	Water usable for irrigation
As	mg/l				-	-	-	-	-	-
BOD	**mg/l**				2 or less	3 or less	6 or less	6 or less	10 or less	10 or less
Ca	mg/l	11.25	23.58		-	-	-	-	-	-
COD	**mg/l**				-	-	-	-	-	-
Chloride	mg/l	12	12		-	-	-	-	-	-
Coliform (Total)	CFU/100 ml				-	-	-	-	-	-
Colour	Hazen				-	-	-	-	-	-
Cr (Total)	**mg/l**				-	-	-	-	-	-
DO	mg/l				6 or above	5 of more	6 or more	5 or more	5 or more	5 or more
EC	µS/cm	256	242		-	-	-	-	-	-
Fe	mg/l	1.45	3.79		-	-	-	-	-	-
Pb	mg/l				-	-	-	-	-	-
Mn	mg/l	0.20	0.25		-	-	-	-	-	-
Hg	mg/l	<LOQ	<LOQ	0.00015	-	-	-	-	-	-
Nitrate	mg/l	0.8	4.0		-	-	-	-	-	-
Ammonia	mg/l			0.10	-	-	-	-	-	-
Oil & Grease	mg/l				-	-	-	-	-	-
pH		7.9	7.0		6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5
Phosphate	mg/l				-	-	-	-	-	-
Salinity	ppt	0.12	0.11		-	-	-	-	-	-
Sulphate	mg/l	1.0	35		-	-	-	-	-	-
TDS	mg/l	124	118		-	-	-	-	-	-

*(Source: Laboratory Analysis, Department of Public Health Engineering) * Bangladesh Environment Conservation Rules, 1997- Schedule 3 (Standards for inland surface water)*

Table 1.5-4: Ground Water Quality Analysis Result (26th April 2019)

Characteristics	Unit	Sampling Location		LOQ	Bangladesh Drinking Water Standard
		GW1	GW2		
As	mg/l				0.05
BOD	mg/l				0.2
Ca	mg/l	28.94	26.26		75
COD	mg/l				4.0
Chloride	mg/l	12	10		150-600
Coliform (Total)	CFU/100 ml				0 CFU/100
Colour	Hazen				15
Cr (Total)	mg/l				0.05
DO	mg/l				6.0
EC	µS/cm	264	110		-
Fe	mg/l	0.26	0.32		0.3-1
Pb	mg/l				0.05
Mn	mg/l	0.29	0.13		0.1
Hg	mg/l			0.00015	0.001
Nitrate	mg/l	4.6	3.3		10
Ammonia	mg/l			0.10	0.50
Oil & Grease	mg/l				0.01
pH		7.1	7.1		6.5-8.5
Phosphate	mg/l				6.0
Salinity	ppt	0.13	0.05		-
Sulphate	mg/l	1.0	<1		400
TDS	mg/l	130	53		1000

(Source: Laboratory Analysis, Department of Public Health Engineering, Sampling Date: 11/06/2015) Bangladesh Environment Conservation Rules, 1997)*

1.6 NATURAL HAZARDS

1.6.1 Introduction

Bangladesh is susceptible to several natural hazards, such as, flood, drought, river bank erosion, cyclone etc. This is due to its combination of geographic, physiographic, morphological and other natural features which have led to the direct loss of life and properties, and sometimes on a massive scale. Among these various natural hazards flood is the most recurring one, hence analyzed within the framework of this study.

1.6.2 Flood

Every year near about one-fifth of Bangladesh undergoes flood during the monsoon season. A flood season in Bangladesh may start as early as May and can continue until November.

Floods of Bangladesh can be divided into three categories: (i) monsoon flood - seasonal, increases slowly and decreases slowly, inundate vast areas and causes huge loss to the life and property; (ii) flash flood-from sudden torrential flows, following a brief intense rainstorm or the bursting

of a natural or manmade dam or levee; and (iii) tidal flood - short duration, height is generally 3-6m, prevents inland flood drainage.

Bangladesh is receptor of flows from three major rivers namely the Ganges, the Brahmaputra and the Meghna. The origin of these rivers is located outside its national boundary. It was observed that extreme flood events occurred due to excessive rainfall in the catchments mostly upper basins. When a water level in the major river systems rises simultaneously and crosses the danger levels, the flood usually occurs all over the country. This was observed during the three major floods of 1987, 1988, and 1998. Water levels crossing the danger levels start occurring from mid-July and continue till mid-September. Inundated area during 1987, 1988 and 1998 were 66%, 68% and 70%, respectively. Duration of the extreme flood events usually extends from 15 days to 45 days occurred during 1998. Sometimes, Individual River may also experiences extreme flood events due to excessive rainfall in the respective river catchments independently.

Flood Level Analysis:

Data collection: Water levels was collected from the BWDB water level gauge station at Kaliakoir (Stn. ID 301) which is about 3.0 km upstream from the proposed Project site. Yearly maximum water level data at this station has been analyzed from 1950 to 2010 shown in Figure 1.6-1.

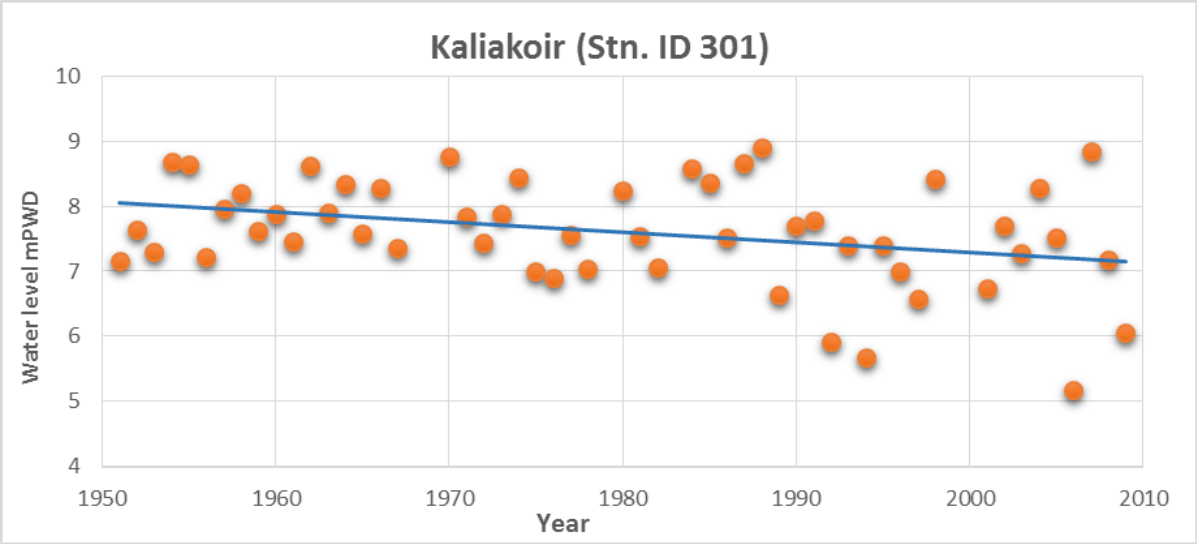


Figure 1.6-1: Yearly maximum water level at Kaliakoir (1950-2010)

At the Kaliakoir station, the annual maximum water level varied between 5.91 and 8.91mPWD. The historical highest water level was found at the project site is about 8.91 mPWD in 1988 shown in Figure 1. Besides, water level data in 1998 and 2004 was 8.43 mPWD and 8.28 mPWD respectively. Generally, the river reaches its highest water level in the months between July and September and the lowest in the months between January and March. Monthly maximum and average water level is shown in Figure 1.6-2.

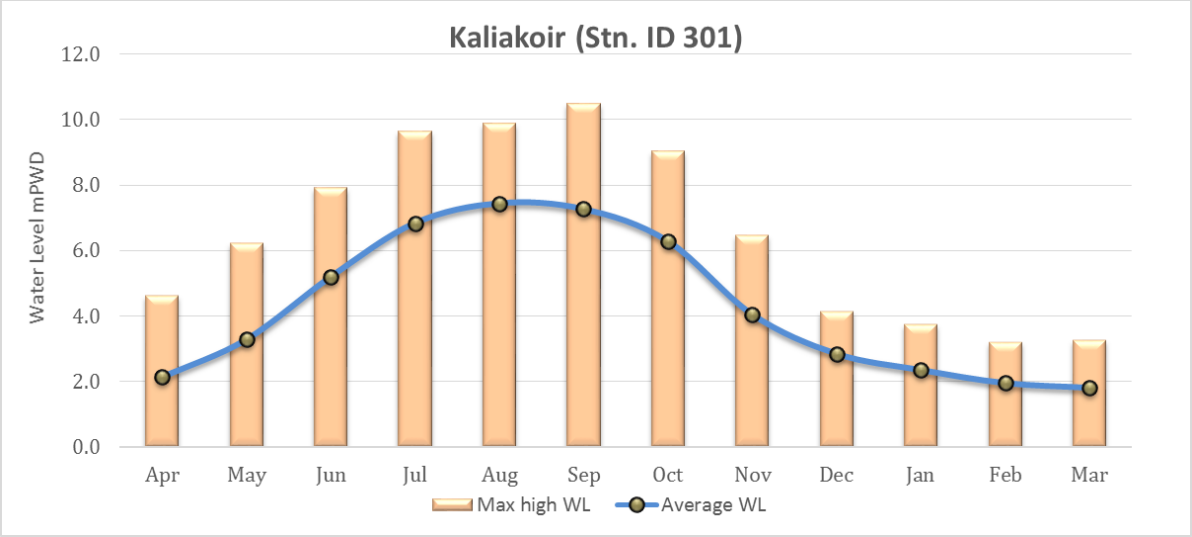


Figure 1.6-2: Monthly maximum and average water level

According to the Digital Elevation Model (Figure 1.6-4) and Area Elevation curve, land elevation of the proposed Project site ranges between 3.7-12.5 m PWD (Figure 3). Analyses of the historical water level data of Kaliakoir (Stn. ID 301) shows that the maximum water level reached at about 8.91m PWD. Since 1988 which was an extreme flood event in Bangladesh. Beside, monthly average maximum water level is 7.45 m PWD which indicates about 75% of the study area inundate during average flood period.

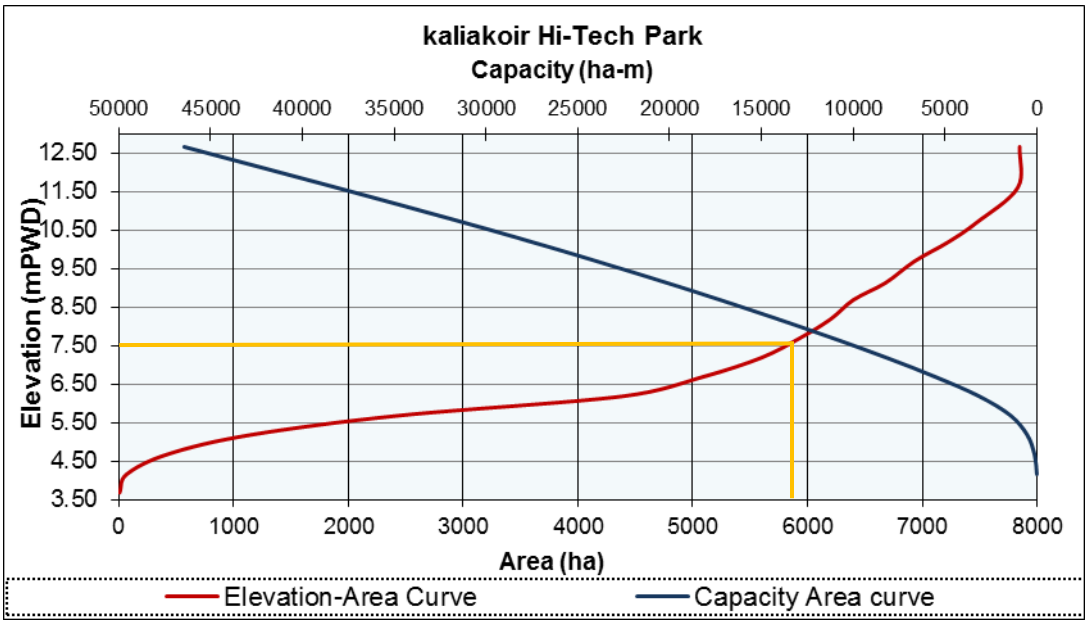


Figure 1.6-3: Area Elevation curve

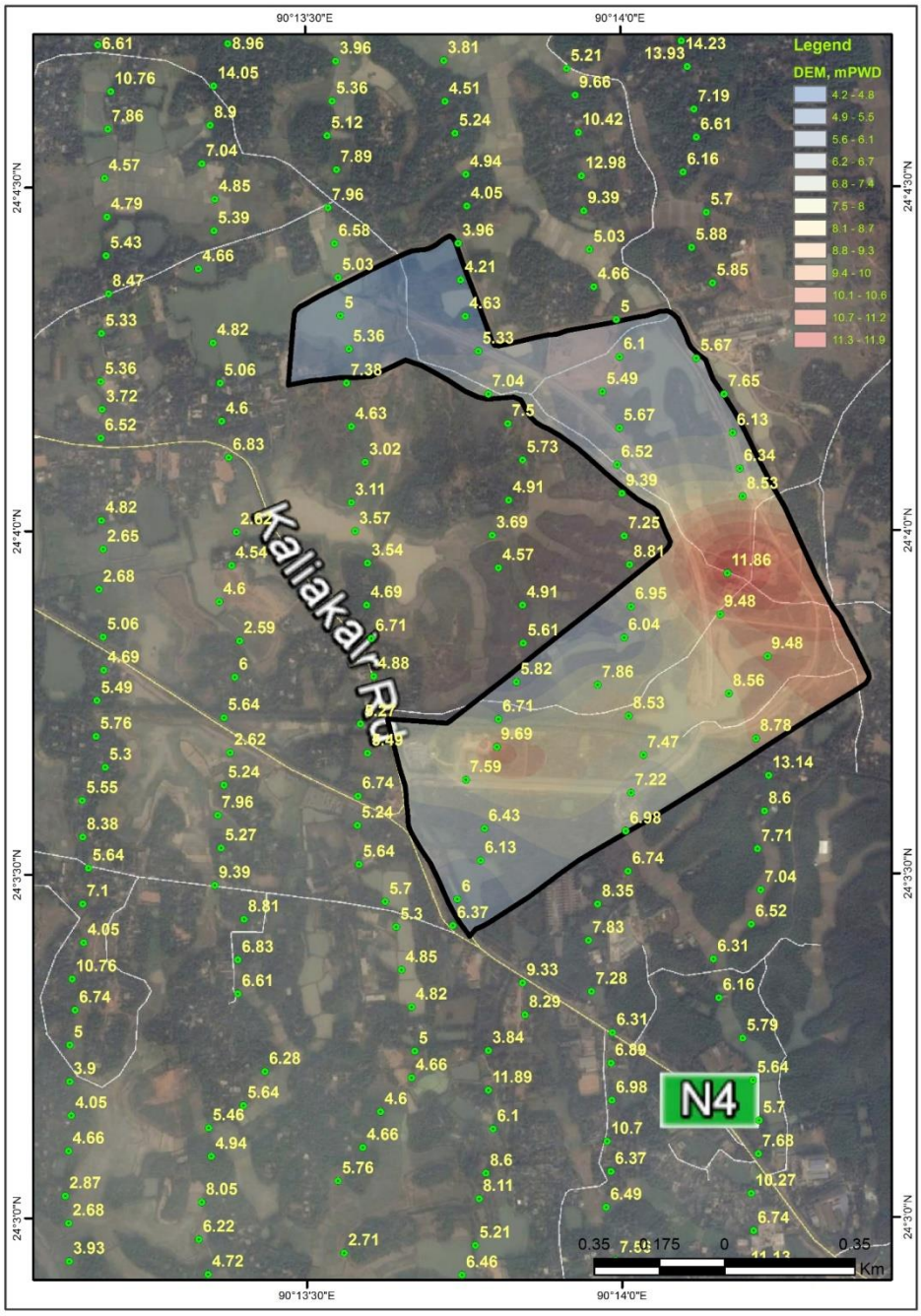


Figure 1.6-4: Spot level in mPWD from BWDB Irrigation Map

1.6.3 Cyclone

Devastating cyclones hit the coastal areas of Bangladesh almost every year usually accompanied by high-speed winds, sometimes reaching 250 km/hr or more causing extensive damage to life, property and livestock. Because of the funnel shaped coast, Bangladesh repeatedly becomes the

landing ground of cyclones formed in the Bay of Bengal. The proposed HTC site is far from the coastal belt, the likely impact of cyclones is relatively small.

1.6.4 Seismicity

An earthquake is the result of a sudden release of energy in the Earth's crust that creates seismic waves. Bangladesh lies between 20°30′ and 26°40′ north latitude and 88°03′ and 92°40′ east longitude which is within an active seismic zone and the probability of earthquake is high. Bangladesh is subdivided into three seismic zones namely zone-l, zone-ll and zone-lll with seismic coefficient of 0.08, 0.05 and 0.04 respectively where zone-III is the most and zone-1 is the least vulnerable to seismic risks. In accordance with the earthquake zones, the maximum magnitude of earthquake is within the range of 4≤M<5 on the Richter's scale in and around the Gazipur district.

The study area of KHT Project falls under Zone-II which comprising the central part of Bangladesh consists of the regions of recent uplifted Pleistocene blocks of the Barind and Madhupur and the western extension of the folded belt and the Bask coefficient for this zone is 0.05g. This zone has the mediocre vulnerability for earthquake in Bangladesh with a risk of possible earthquake of magnitude 6 (on Richter scale). Details of seismic intensity and the historical records of major earthquakes in and around Bangladesh that occurred during last 250 years are presented in Table 1.6-1.

Table 1.6-1: List of Major Earthquakes in Last 250 Years

Sl. No.	Year	Source Area	Magnitude (Rechter Scale)	Depth (Km)
1	1548	Sylhet	-	-
2	1664	Shillong-Plateau	-	-
3	1762	Chittagong-Arakan	-	-
4	1858	Sandway, Myanmar	6.5	-
5	1869	Cachar, India	7.5	48
6	1885	Sirajganj, Bangladesh	7	72
7	1897	Assam, India	8.1	60
8	1906	Calcutta, India	5.5	-
9	1912	Mandalay, Myanmar	7.9	25
10	1918	Srimangal, Bangladesh	7.6	14
11	1930	Dhubri, India	7.1	60
12	1934	Bihar, India-Nepal	8.3	33
13	1938	Mawlaik, Myanmar	7.2	60
14	1950	Assam, Himalaya	8.6	25
15	1954	Manipur, India	7.4	180
16	1975	Assam, India	6.7	112
17	1984	Cachar, India	5.7	4
18	1988	Bihar, India-Nepal	6.6	65
19	1997	Sylhet, Bangladesh	5.6	35
20	1997	Bangladesh-Myanmar	5.3	56
21	1999	Maheskhali, Bangladesh	4.2	10

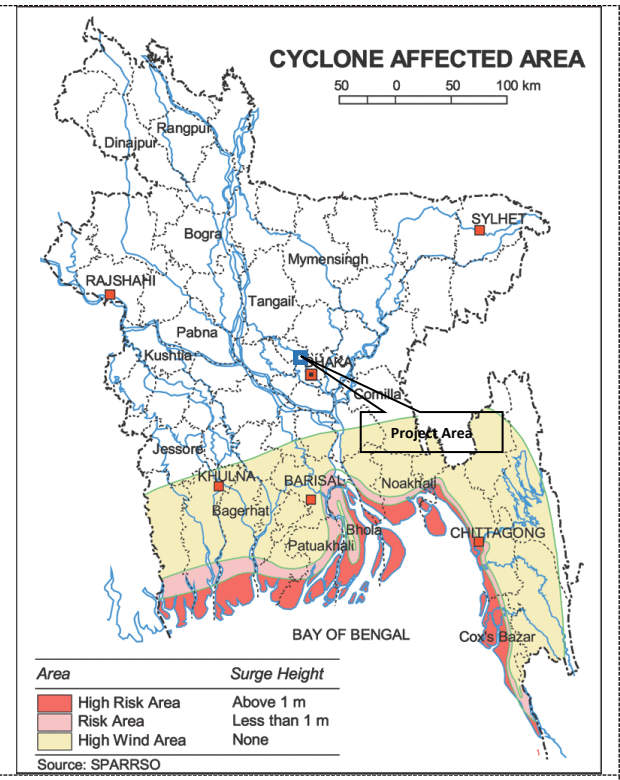


Figure 1.6-5: Cyclone affected area of Bangladesh

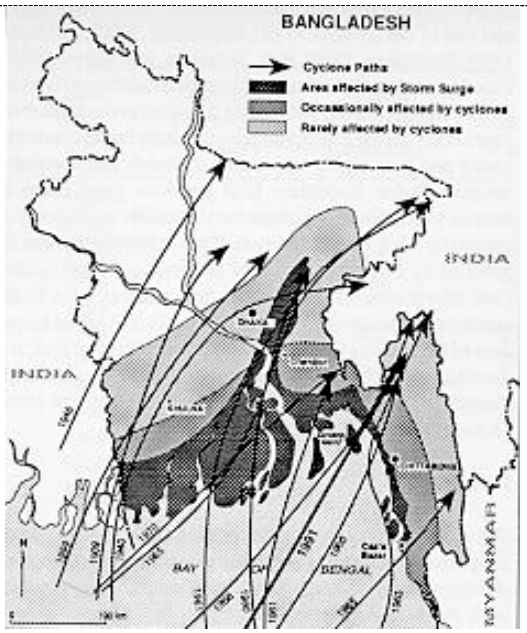


Figure 11.6-6: Project Area Affected by Storm Surge

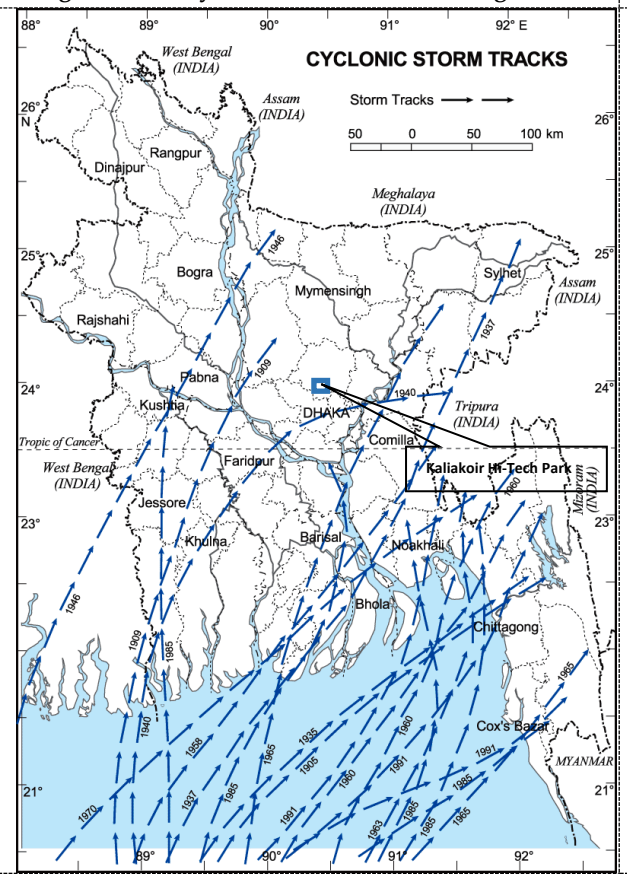


Figure 1.6-7: Cyclone Storm Tracks of the Project Area	Figure1.6-8: Seismic Zone Map of the Project Area

According to the records, collected and reviewed, the project site falls in an area from where the nearby known earthquake epicenter has been at least 50 Km distant and the nearest position of magnitude of about 6 has been encountered hundreds of Kilometers away. Therefore, the area is not depicted as lying on an earthquake prone area nor the area has any active tectonic movement to initiate thus catastrophic events.

1.7 PHYSICAL ENVIRONMENT

1.7.1 Climate and Meteorology

The project site is located in Dhaka Division. According to Köppen climate classification, it falls under Aw category which is characterized by tropical wet and dry climate. Hence, it experiences hot and humid summer and dry winter. According to the climatic characteristics, Bangladesh is divided into 7 different climatic sub-regions. The study area of the project falls under category "G", which is the south-central climatic zone of the country (Figure 1.7-1).

The summary of the analysis of the climatic and meteorological parameters are discussed in the following sections:

Temperature

Temperature data of Dhaka Station from Bangladesh Meteorological Department (BMD) for 34 years (from January 1980- December 2013) has been analyzed to see the monthly variation of the average maximum temperature which is between 39.6^{0}C to 30.1^{0}C. The monthly variation of the average minimum temperature is 22.5^{0}C to 6.5^{0}C. The maximum recorded temperature in Dhaka station was 39.6^{0}C, which occurred on March, 1999 and April, 2009. On January 1995, the minimum temperature was recorded as 6.5^{0}C in Dhaka and its surrounding areas. The warmest month of the year is April and the coldest month of the year is January. Figure 1.7-2 shows the maximum, minimum, average of maximum and average of minimum temperature of Dhaka station from 1980 to 2013.

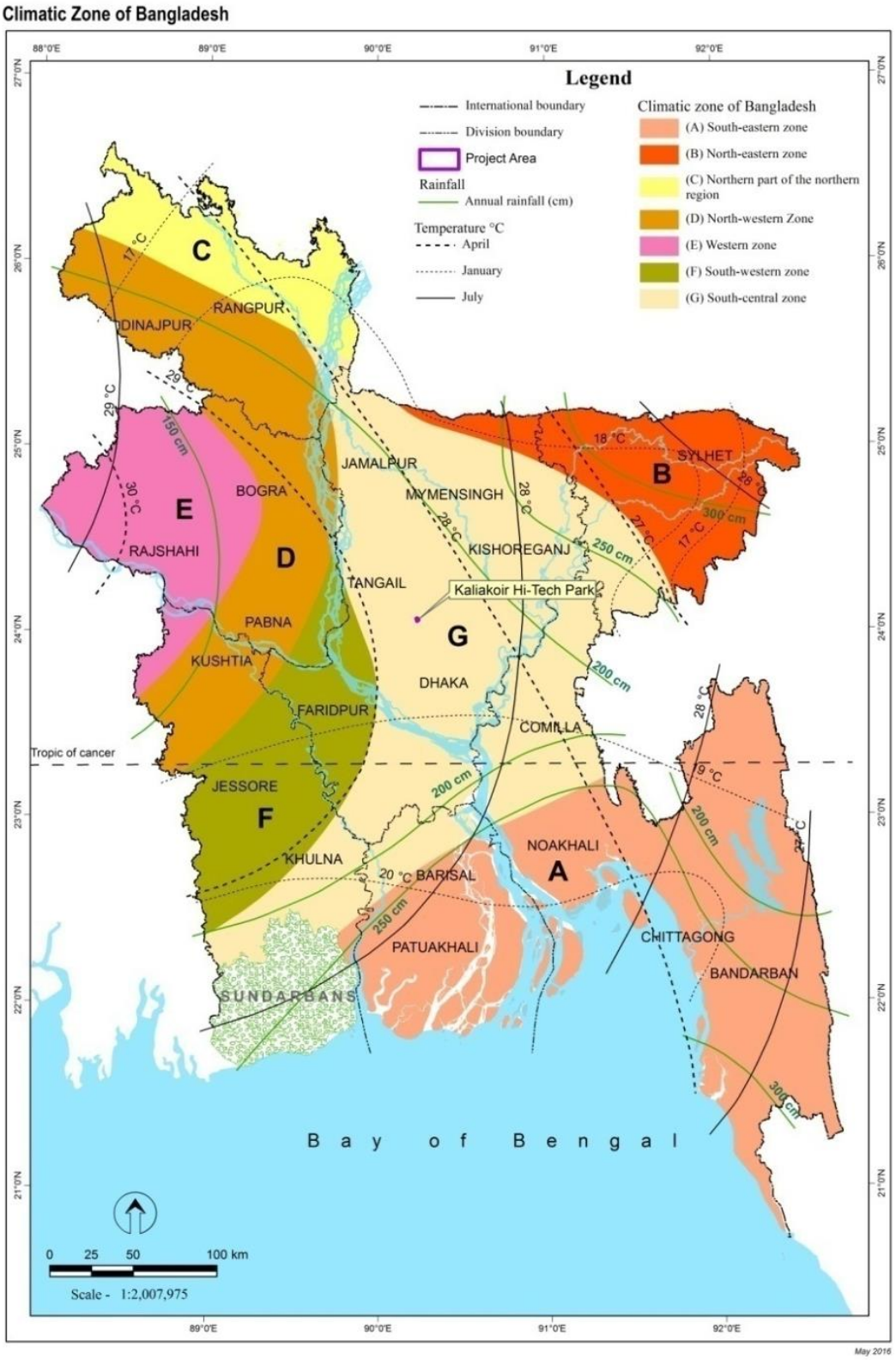
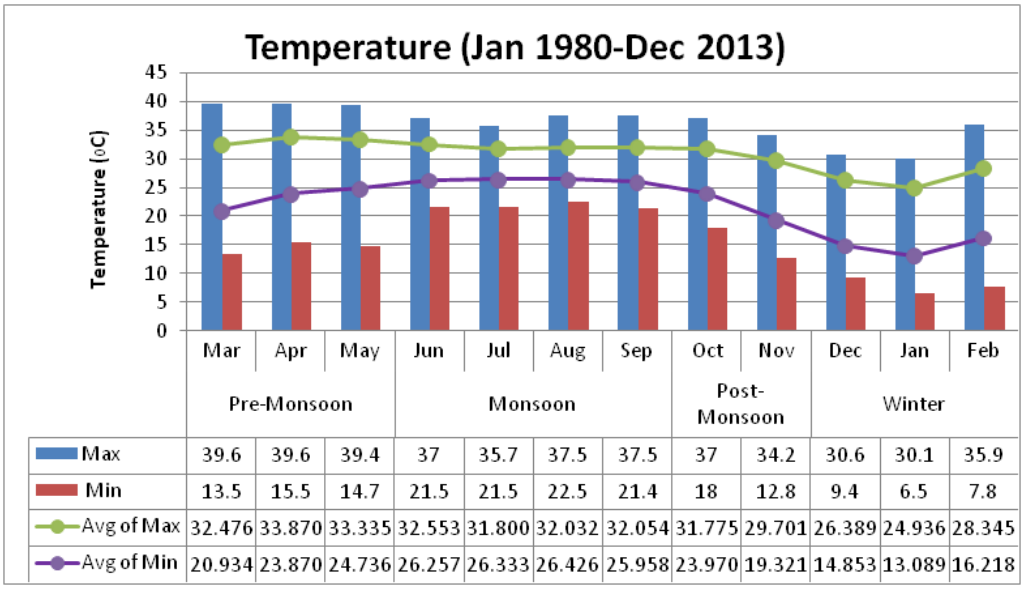


Figure 1.7-1: Climatic zone of the proposed Hi-Tech Park location

(Source: Bangladesh Meteorological Department)



	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Max	39.6	39.6	39.4	37	35.7	37.5	37.5	37	34.2	30.6	30.1	35.9
Min	13.5	15.5	14.7	21.5	21.5	22.5	21.4	18	12.8	9.4	6.5	7.8
Avg of Max	32.476	33.870	33.335	32.553	31.800	32.032	32.054	31.775	29.701	26.389	24.936	28.345
Avg of Min	20.934	23.870	24.736	26.257	26.333	26.426	25.958	23.970	19.321	14.853	13.089	16.218

Figure1.7-2: Monthly maximum, minimum and average temperature

Figure 1.7-2 shows the annual trend of temperature in the study area and reflects that the trend line of maximum of average temperature is almost a straight line and the trend line of minimum of average temperature is slightly increasing. The maximum of average temperature of the last 30 years is found to be in a steady state condition where variation is not observed. For the same years, the minimum of average temperature is slightly increasing with respect to time.

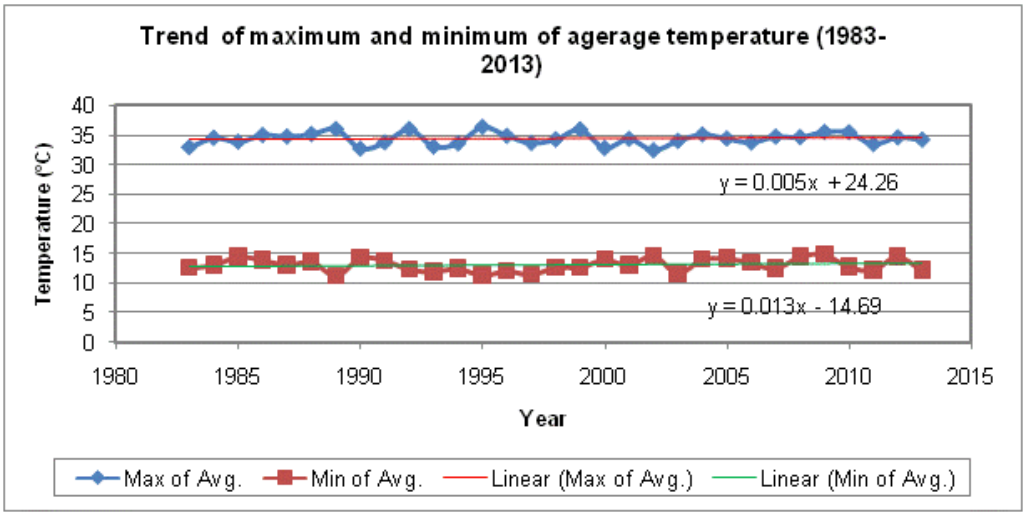
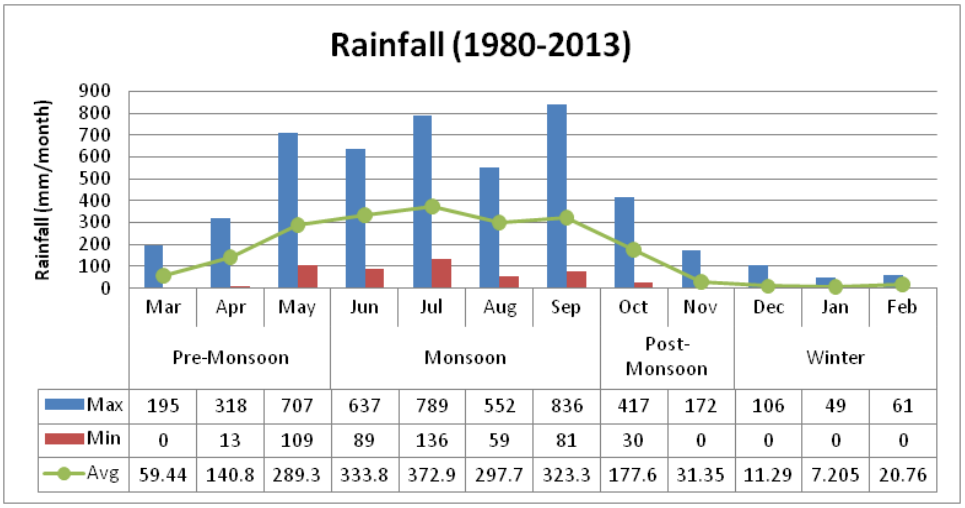


Figure 1.7-3: Temperature Trends of last 30 years

Rainfall

Monsoon is a prominent season in this area. The average monthly rainfall during monsoon (June-September) season from 1980-2013 is 332 mm/month. The variance in the maximum rainfall during monsoon season is 836 mm/month to 552 mm/month, whereas the variance in the minimum rainfall is 136 mm/month to 59 mm/month. The maximum 836 mm/month rainfall was recorded during September of the year 2004. Annual average rainfall is 2066 mm/year

(Figure 1.7-4) and the highest recorded yearly rainfall was 3028 mm in the year 1984. The driest period of the year is winter when the average monthly rainfall varies from 21 mm/month to 7.21 mm/month. Figure 1.7-4 shows the maximum, minimum and average rainfall from 1980-2013.



	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
	Pre-Monsoon			Monsoon				Post-Monsoon		Winter		
Max	195	318	707	637	789	552	836	417	172	106	49	61
Min	0	13	109	89	136	59	81	30	0	0	0	0
Avg	59.44	140.8	289.3	333.8	372.9	297.7	323.3	177.6	31.35	11.29	7.205	20.76

Figure1.7-4: Monthly Maximum, Minimum and Average Rainfall

The historical trend analysis of annual rainfall of last 30 years (1983-2013) shows a declining trend which indicates that the amount of yearly rainfall is decreasing with respect to time. Figure 1.8.5 reflects the rainfall trend of the study area and it is observed that decreasing of annual rainfall is 19.46 mm per year.

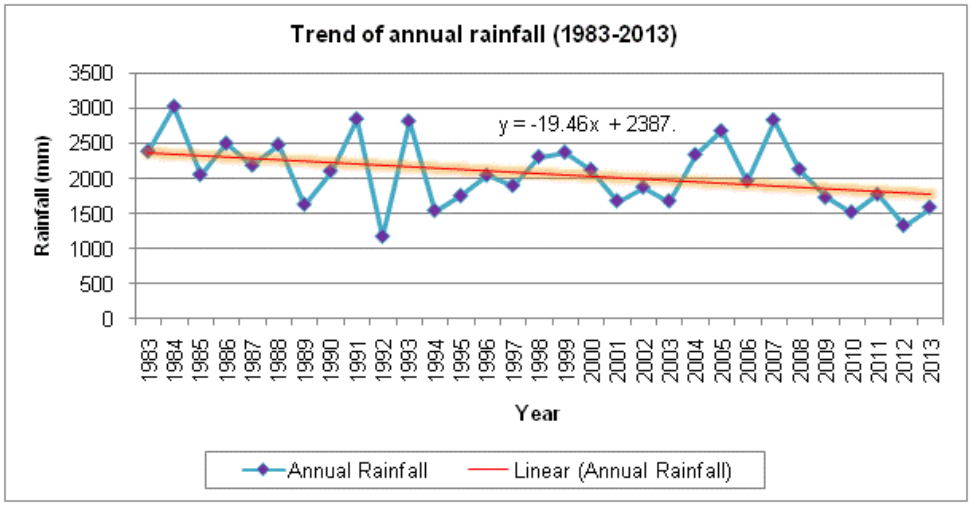


Figure 1.7-5: Annual rainfall trend

Humidity

The average relative humidity remains higher during the monsoon season. The variance in the average relative humidity throughout the year is 83.77% to 62.47%, whereas during monsoon the variance is 83.77% to 82.40%. Figure 6-16 shows the maximum, minimum and average relative humidity of Dhaka station from January 1980 to January 2013.

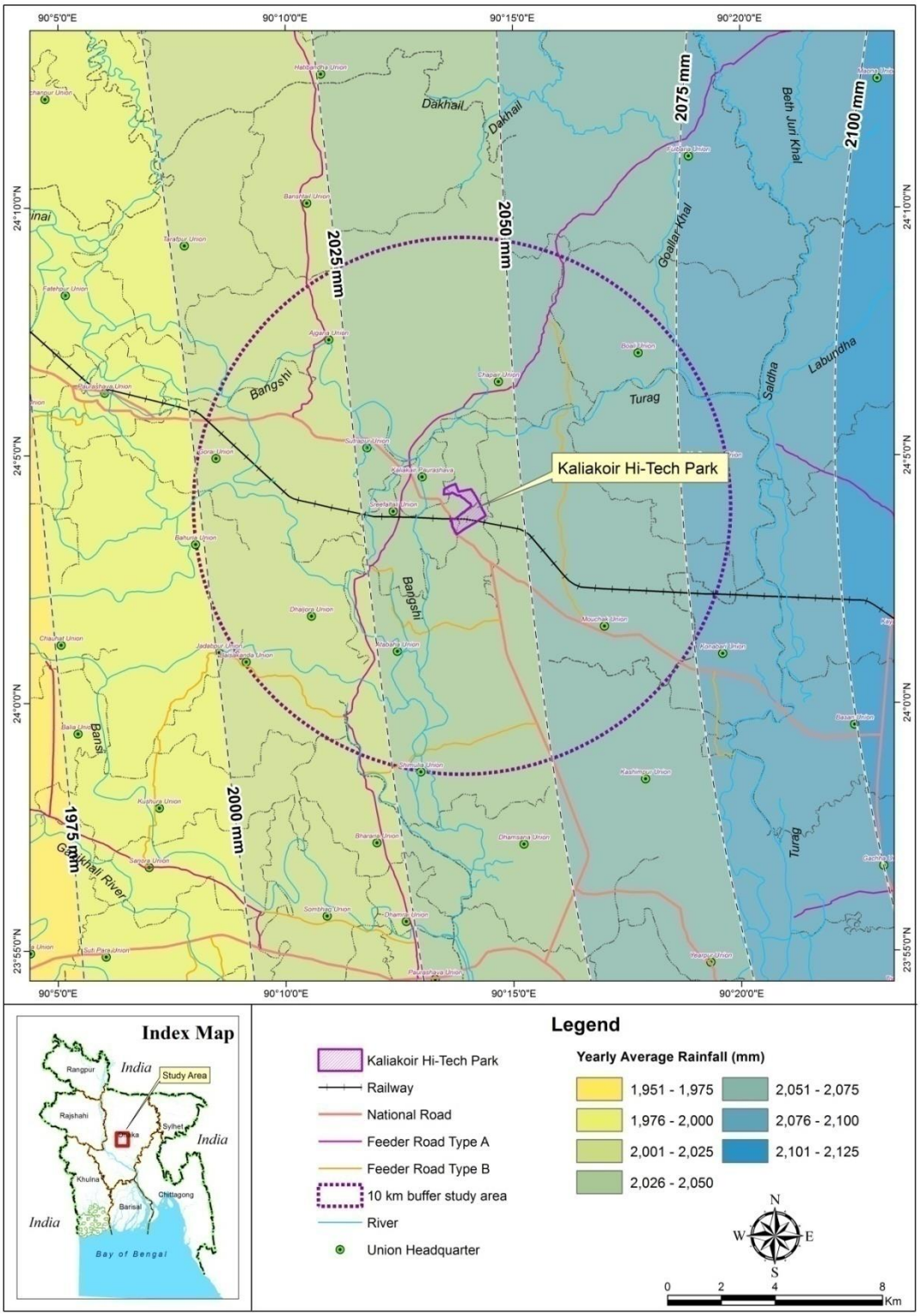
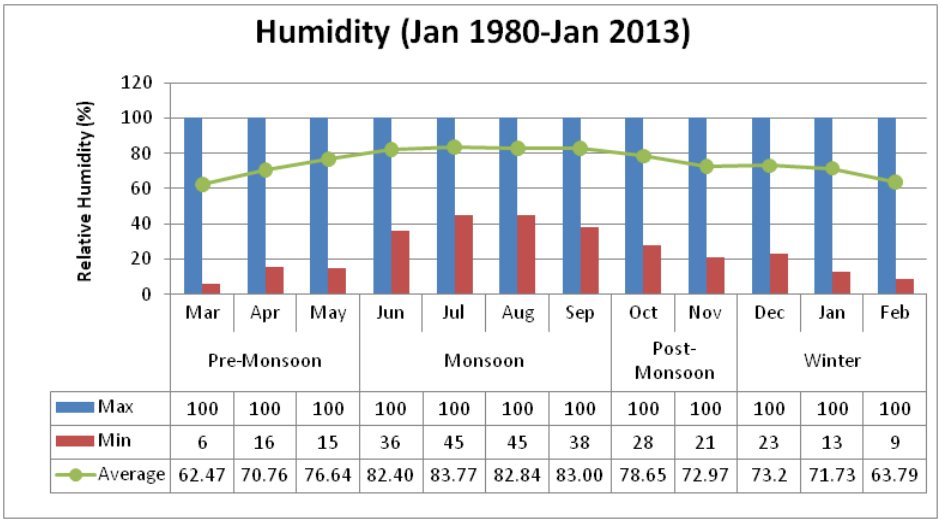


Figure 1.7-6: Yearly Average Rainfall of the study area



	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
	Pre-Monsoon			Monsoon				Post-Monsoon		Winter		
Max	100	100	100	100	100	100	100	100	100	100	100	100
Min	6	16	15	36	45	45	38	28	21	23	13	9
Average	62.47	70.76	76.64	82.40	83.77	82.84	83.00	78.65	72.97	73.2	71.73	63.79

Figure 1.7-7 Maximum, Minimum and Average Relative Humidity

Evaporation

The analysis shows variations in the monthly average evaporation and maximum of the monthly average evaporation at Dhaka for the period of 2001-2011. The maximum of monthly average evaporation rate is highest in May but the monthly average evaporation rate is highest in April. Maximum of monthly average evaporation rate ranges from 1.53 mm/day (December) to 3.6 mm/day (May). While, the monthly average evaporation ranges from 1.3 mm/day (January) to 2.8 mm/day (April). The monthly average evaporation rate is higher during February-August and gradually decreases to its lowest values during December-January.

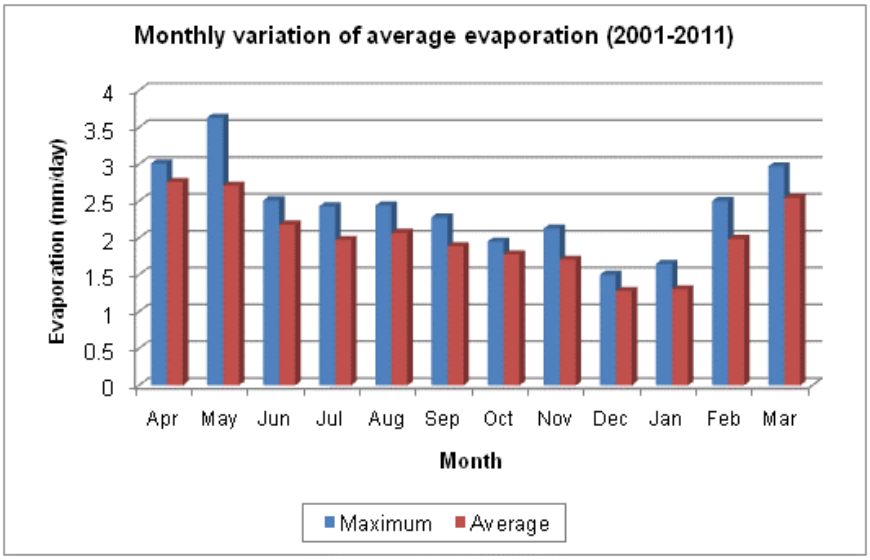


Figure 1.7-8: Maximum and Average evaporation

Sun-Shine Hour

The average sunshine hour data were collected from the Dhaka BMD station (1993-2013). Figure 1.7-9 shows an increasing trend from October to April. Maximum sunshine hour is found in April

(8hrs/day). However, a decreasing trend is observed from May to September. Sunshine hours were minimum in June (5 hrs/ day) and July (4 hrs/ day) due to the presence of monsoon cloud.

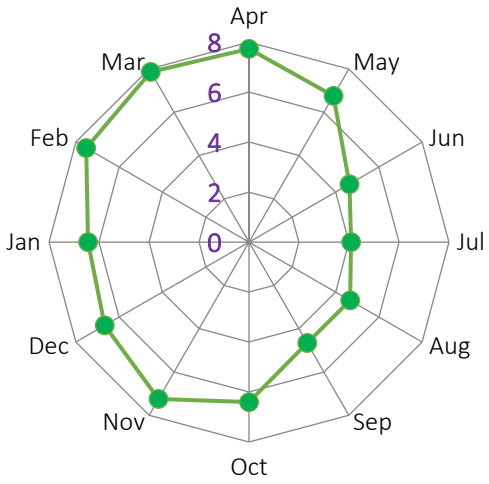
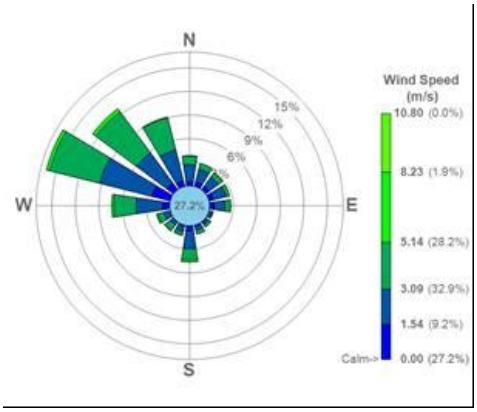


Figure 1.7-9: Monthly average sunshine hours

Wind Speed and Direction

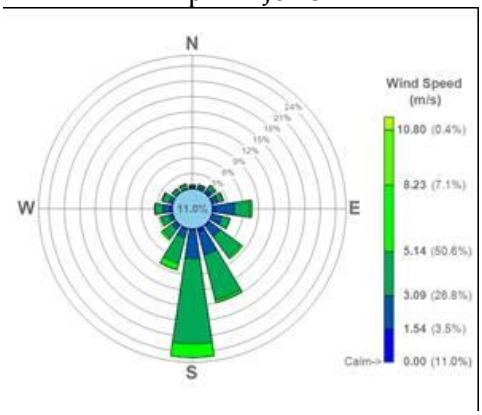
The direction of wind varies depending on the seasons. Therefore, whole year has been categorized into four clusters of months and these are: Cluster-1: December-March, Cluster 2: April-June, Cluster 3: July to September, and Cluster 4: October to December. Wind speed data and direction have been collected from the Dhaka BMD station at a height of 10 m from the ground level. During clusters 1 and 4 months wind direction is predominantly from northwest to southeast direction, inclined towards east and for clusters 2 and 3 it is predominantly from south and southeast to north and northwest. In cluster 1 calm wind prevails for 27.2% of total period, similarly it is 11.0% for cluster 2, 12.5% for cluster 3, and 56.9% for cluster 4, respectively. Figure 4.8-10 (a, b, c and d) present wind speed and direction graphically round the year.

December – March



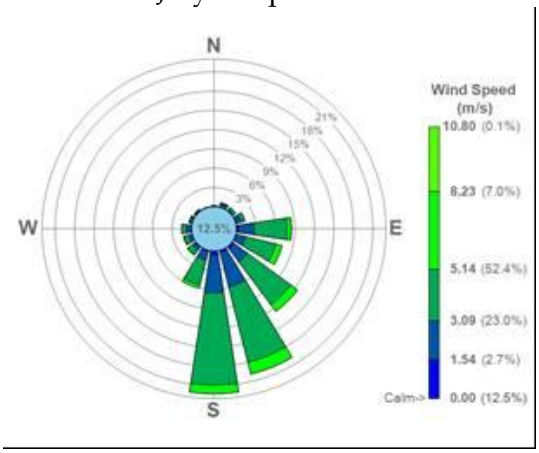
(a): Wind rose diagram for December-March

April – June



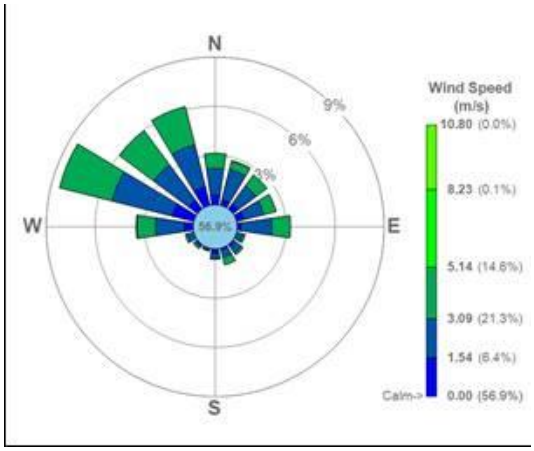
(b): Wind rose diagram for April-June

July – September



(c): Wind rose diagram for July-September

October – December



(d): Wind rose diagram for October-December

Figure 1.7-9: Wind Rose at Dhaka Station

1.8 AMBIENT AIR QUALITY

1.8.1 National Context

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 bio-fuel (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.

1.8.2 Extrapolation of Ambient Air Quality Yearly Data of Gazipur CAMS (2018)

The PM concentration at Gazipur is higher than Dhaka. In order to compensate for the local sources, the Gazipur CAMS data have been normalized using the site based measurement.

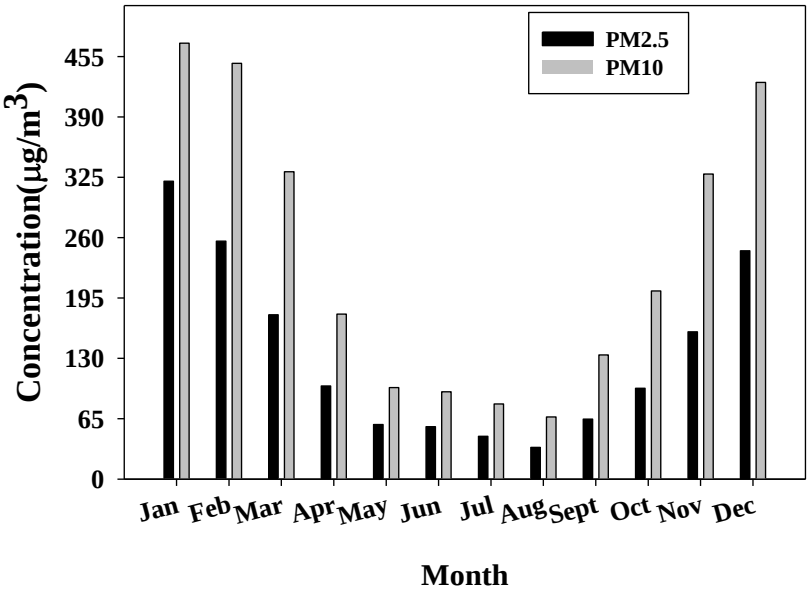


Figure-1.8-1 Yearly plot for ambient PM_{10}, $PM_{2.5}$ concentrations at the Project site using normalization procedure

Table 1.8-1: PM2.5 and PM10 concentration with standard deviation

Month	$PM_{2.5}$	PM_{10}
Jan	321±76.1	469±119
Feb	256±68.2	448±113
Mar	177±55.9	331±116
Apr	100±45.6	178±82.6
May	58.8±17.6	98.5±27.2
Jun	56.4±32.0	94.1±41.7
Jul	46.1±38.3	80.9±40.6
Aug	34.1±18.5	66.9±32.1
Sept	64.6±33.6	134±69.5
Oct	97.9±46.6	203±96.4
Nov	159±51.8	328±107
Dec	246±70.0	427±131

The Yearly average $PM_{2.5}$ **=135±96.0**
The Yearly average PM_{10}**=238±154**

Table: 1.8-2 PM10 and PM2.5 concentrations (µg/m3) during sampling period

Date	PM10	PM2.5
22/4/19	137	83.3
24/4/19	236	118
26/4/19	138	69.2
28/4/19	142	72.4
Average	163	85.7
1SD	48.4	22.4
2SD	96.8	44.7
3SD	145	67.1
%SD	29.7	26.1

Validation of PM Data:

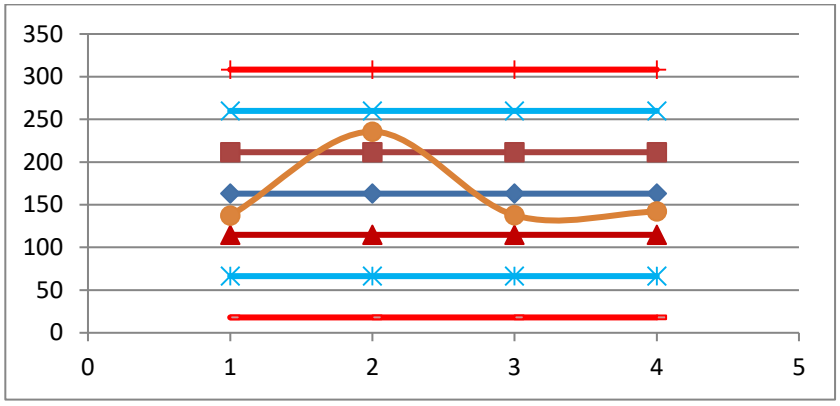


Figure 1.8-2: PM10 data

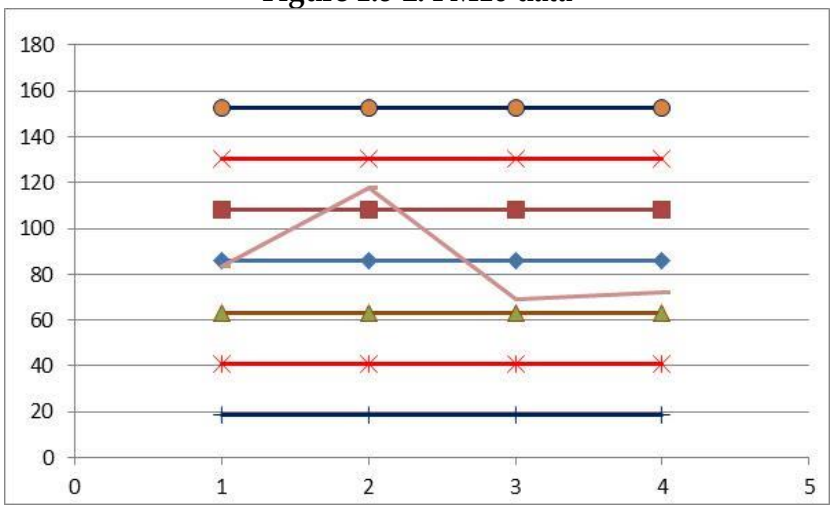


Figure 1.8-3: PM2.5 data

1.8.3 Methodology for Air Quality Monitoring

The existing ambient air quality of the study area was monitored in the project area (June-2016). The monitoring parameters included Particulate Matter (PM_{10} and $PM_{2.5}$), Sulfur oxides (SOx), Oxides of Nitrogen (NOx), and Carbon Monoxide (CO). All the parameters were monitored on 24-hourly basis except Carbon Monoxide (CO) during the duration of the study.

The particulate matters, PM_{10}, $PM_{2.5}$ concentrations were measured by collecting samples on Teflon filters using Airmetric portable samplers and subsequent gravimetric analysis using microbalance. The SO_2 and NO_2 samples were collected on impinger (For SO_2 the absorbing reagent is mercuric chloride and sodium chloride and for NO_2, the absorbing reagent is sodium hydroxide and sodium arsenite) using GENT sampler and CO concentrations were determined using Gas Badge Pro monitor.

The particulate and gaseous samples collected during the monitoring have been analyzed as per the procedures specified in Table-1.8-2. The geographical locations of the ambient air quality monitoring locations has been presented in Table 1.8-3 and depicted in Figure-1.8-2.

Table 1.8-2: Methodology for Analysis of Ambient Air Quality

Sl.	Parameter	Analysis procedure
•	PM10	Airmetric portable samplers
•	PM2.5	Airmetric portable samplers
•	SO_x	Impinger using GENT sampler
•	NOx	Impinger using GENT sampler
•	CO	Gas Badge Pro monitor

Table 1.8-3: Ambient Air Quality Sampling Location

Sl.	Sampling Station	Station Code	Geographic Location
1	Inside the HTC	AAQSL	24° 3'56.46"N; 90°14'4.86"E

Figure 1.8-2 Ambient Air Quality Monitoring Locations

1.8.4 Ambient Air Quality in the Study Area

The monitored ambient air quality is summarized in Table-1.8-4 and results are annexed in ANNEX III.

Table 1.8-4: Ambient Air Quality in the Study Area

Sampling Date		PM_{10}	$PM_{2.5}$	SO_X	NO_X	CO
		µgm/m³ (24h average)			mg/m³ (1h average)	
22/04/2019		137	83.3	21	0.066	<0.30
24/04/2019		236	118	25	0.076	<0.30
26/04/2019		138	69.2	23	0.072	<0.30
28/04/2019		142	72.4	23	0.068	<0.30
BNAAQS	24h average (µgm/m³)	150	65	365	-	40
	Annual (µgm/m³)	50	15	-	100	-
WHO	24h average (µgm/m³)	50	25	20	200 (1h average)	10,000
	Annual (µgm/m³)	20	10	-	40	-

*N.B.: It should be noted here that the AAQ data were sampled and tested by the Reputed Atomic Energy Center, Dhaka (AECD) laboratory. Dr. Bilkis Ara Begum, Chief Scientific Officer, Chemistry Division, Atomic Energy Centre, Dhaka has tested and analyzed the data with due diligence. The analysis of data were annexed in Annexure-I. **The Bangladesh National Ambient Air Quality Standards have been taken from the Environmental Conservation Rules, 1997 which was amended on 19th July 2005 vide S.R.O. No. 220-Law/2005. ***Who Ambient Air Quality Guideline Values (2005 and 2000), which are also being referred in the World Bank and IFC's General Guidelines (2007).*

Monitoring of Ambient Air Quality of the Project Area

1.8.5 Analysis and Discussion of Results

$PM_{2.5}$&PM_{10}

Table 1.8-4 represents the four days ambient PM_{10}, $PM_{2.5}$, concentrations as per NAAQS as determined.

The PM_{10} and $PM_{2.5}$ concentrations are higher than the yearly average Bangladesh National Ambient Air Quality Standards. As the project is now in the construction stage so the PM2.5 seems always higher in the sample analysis. PM10 looks much better for the 24 hour standards which is for the wet season sampling.

SO_2

The 24-hourly SO_2 concentration was recorded in the range of 8.02–27.45 µg/m³. Average concentration of SO_2 is reported much lower due to the agricultural setup. SO_2 concentration at project location was reported well below of 365µg/m³, which is a 24-hourly National Ambient Air Quality Standard (NAAQS) for SO_2 in Bangladesh. The results were also compared with the WHO guideline values for SO_2 and it is noted that the average SO_2 concentrations at the park is a bit higher than the stipulated guideline value (20µg/m³).

NO_x

The 24-hourly NOx concentration was recorded in the range of 10.3 – 42.6 µg/m³. During the monitoring period, the maximum NOx concentration is reported at HTC site as 0.076 mg/m³.There are no stipulated standards for 24-hourly NOx concentration in Bangladesh and also there is no WHO guideline value for the same. The annual Bangladesh standard and WHO guideline value for NOx are 100 µg/m³ and 40 µg/m³ and present average concentration at the BHTC is well below these values.

CO

Average concentration of CO is reported low at the monitoring location while comparing with the Bangladesh Standards as well as WHO guideline (10 mg/m³).

In the project, 4MW generator shall be installed for the power supply of the BTL facilities. The power of the generator will be the natural gas. The estimated carbon emission for the 4MW power plant is calculated below:

CO2 Emission from 4MW Power Plant:

As per Table 4–Typical CO_2 emissions performance of new thermal power plants of IFC guideline of "Environmental, Health, and Safety Guidelines for Thermal Power Plants-May/June-2017", the CO2 emission of <3000MWe will be ranged 361-488gm/kWh for a CCGT technology gas driven power plant.

Therefore, for the 4MW power generation the carbon emission would be:

= 4000X0.488kg CO_2/hour

=1952kgCO_2/hr.

1.9 ACOUSTIC ENVIRONMENT

Excessive noise is a potential issue for both human and biological receivers and can cause a range of negative issues, from mild annoyance and moderately elevated levels of agitation to significant disturbance of behavioral patterns and, in severe cases, temporary or permanent hearing loss.

According to the World Health Organization 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. Table-1.9-1 shows the Schedule 4 of the ECR sets the acceptable noise level criteria for various land uses in Bangladesh and World Bank general EHS guideline standard for noise level.

Table 1.9-1Standards for Noise (EQS)

Sl.	Area Category	Bangladesh Guidelines (dBA)		World Bank general EHS Guidelines	
		Day[1]	Night[1]	Day[2]	Night[2]
1.	Silent Zone	50	40	-	-
2.	Residential Zone	55	45	55	45
3.	Mixed Area	60	50	-	-
4.	Commercial Area	70	60	70	70
5.	Industrial Area	75	70	70	70

Source: Sound Pollution (Control) Rules-2006, Bangladesh, EHS Guidelines for General Environmental Guidelines, April 2007, WBG

1. GoB ―day‖ is 06:00-21:00; GoB ―Night‖ is 21:00-06:00
2. WBG ―day‖ is 07:00- 22:00, WBG ―Night‖ is 22:00-07:00

1.9.1 Ambient Noise Level in the Project Study Area

Noise levels were recorded at four corners of the study area during the monitoring period. Noise levels were recorded in the form of sound pressure levels with the help of a digital sound level meter. The purpose of ambient noise level measurement was to determine sound intensity at the monitoring locations. The noise level is monitored using Sound Level Meter (Model No SL 4012) which is calibrated using Tenma 72-945 (NEDA-1604 IEC-6F22). The noise levels at project sites are presented in **Table 1.9-3**. The noise levels of parks sites are lower than the ECR 1997.

Table 1.9-2: Details of Ambient Noise Monitoring Locations

Sl.	Code	Location	Geographic Location	Location Setting
•	NW-NL	North West	24° 4'3.96"N; 90°13'52.80"E	Vacant Land
•	NE-NL	North East	24° 4'6.54"N; 90°14'1.26"E	Vacant Land
•	SE-NL	South East	24° 3'53.04"N; 90°14'11.28"E	Vacant Land
•	SW-NL	South West	24° 3'57.72"N; 90°13'50.22"E	Vacant Land

Observation of the noise level monitoring data listed in Table-4.9-3 and the results are annexed in Annex IV:

- Noise level monitoring data of the project study area is compliant with the National Noise Level Standards (ECR1997).

Figure 1.9-1: Locations of Noise Level Monitoring

Generation should be placed away from the residential area and should have proper arrangement like use of Canopy to abate the noise level of the surrounding. Auto door closer of the generator should have to control the escape of noise.

Table 1.9-3 Noise Level in the Project Area (Monitoring dates 10th & 11th June 2016)

Location	Monitoring Time		
	6am	2pm	10pm
	Monitored Noise Level (dB)		
North West	41.8±3.0	43.7±1.7	42.7±2.4
North East	49.5±4.2	45.1±2.5	48.9±1.8
South East	49.1±0.8	47.8±1.9	53.2±1.8
South West	43.8±1.5	48.3±0.3	47.4±3.1
ECR 1997 (Industrial area)	**75 Day time (6am – 9pm)**	**75 Day time (6am – 9pm)**	**70 Night time (9pm-6am)**

Monitoring of Noise level at four corners of the Project Area

Envisaged sound level at the Project Area:

Source of Noise: Generator in Block-3.

Residential Area: 1500m from the Generator in Block-1.

Assuming 4MW power will be generated by a generator of Block-3. The reference sound level at 1m distance from the generator would be 110dB. So, calculated sound level at the receptor of residential area would be 47dB which is within the WB and DOE guidelines and standards.

1.10 AGRO-ECOLOGICAL RESOURCES

1.10.1 Introduction

Land includes the combination of the geological materials in which particular kinds of soil have been formed and the landscape on which they occur. An agro-ecological zone (AEZ) is a zone or region which has unique combination of physiographic, soil, hydrological and agro-climatic characteristics. Thirty agro-ecological regions and 88 sub-regions have been identified by adding successive layers of information on the physical environment which are relevant for land use and assessing agricultural potential. These layers are (i) Physiographic (land forms and parent materials), (ii) Soils and their characteristics, (iii) Depth and duration of seasonal flooding, (iv) Length of the rain fed, kharif and Rabi growing periods, (v) Length of the pre-kharif period of unreliable rainfall, (vi) Length of the cool winter period and frequency of occurrence of extremely low winter temperature and (vii) Frequency of occurrence of extremely high (>400C) summer temperature(FAO/UNDP, 1988). Agro-ecological regions and sub-regions are very broad units. Fertility status of these regions varies considerably. For detailed information about physical and chemical properties of soils, respective Upazila Nirdeshika may be consulted. However, for fertility data of a specific area soil samples should be collected for detailed analysis (BARC, 2005).

Bangladesh has a wide range of environmental conditions. Environmental diversity occurs not only at national and regional levels, it also occurs at the Upazila and village levels. Under consideration of year to year variability in moisture, the temperature and flood regimes types, tidal activity, agricultural and ecological characteristics, cropping patterns and seasonal characteristics, the classification of 30 agro-ecological zones (AEZ) and 88 sub regions has been made. Figure-4.10-1 shows the agro-ecological regions of the study area.

The study area which is considered as 10 km radius centering the proposed project site comprises two Agro-ecological regions (AEZ). The agro-ecological regions are:

- Madhupur Tract;
- Young Brahmaputra and Jamuna Floodplain

The locations of agro-ecological zones are shown in Figure-4.10-1. The study area is situated at Kaliakair and Gazipur Sadar upazila of Gazipur district, and Dhamrai and Savar upazila of Dhaka districts. Brief descriptions of agro-ecological zones are described below.

1.10.2 Young Brahmaputra Jamuna Floodplain (AEZ 9)

This region occupies a large area of the young Brahmaputra sediments before the river shifted to its present Jamuna channel about 200 years ago. The region has broad ridges and basins. Relief is irregular, especially near the old and present river channels. Soils of the area are predominantly silt loams to silty clay loams on the ridges and clay in the basins. Organic matter content is low on the ridges and moderate in the basins, tops oils moderately acidic but sub soils neutral in reaction. General fertility level is low. Some physico-chemical properties of soils of the Old Brahmaputra Floodplain (AEZ 9) are presented in Table 1-10-1.

Table 1.10-1: Physico-chemical properties of soils of Young Brahmaputra Jamuna Floodplain

Major land type	Soil pH	Extent	Soil OM	Nutrients status								
				N	P	K	S	Ca	Mg	Zn	B	Mo
High land	4.5-7.4	28%	L	VL-L	L-M	L	L-M	Opt	Opt	L-M	L-M	Opt
Medium highland	4.7-7.2	35%	L	VL-L	L-M	L	L-M	Opt	Opt	L-M	L-M	Opt
Medium lowland	4.5-7.2	20%	L	VL-L	L-M	L	L-M	Opt	Opt	L-M	L-M	Opt

OM=Organic matter; VL=Very low; L-Low; M=Medium; Opt=Optimum; H=High; VH=Very high; Source: BARC, 2005
Source: Fertilizer Recommendation Guide-2005, BARC

1.10.3 Madhupur Tract (AEZ 28)

This is a region of complex relief and soils developed over the Madhupur Clay. The landscape comprises level upland, closely or broadly dissected terraces associated with either shallow or broad, deep valleys. Eleven general soil types exist in the area of which deep red brown terrace, shallow red brown terrace soils and acid basin clays are the major ones. Soils in the valleys are dark grey heavy clays. They are strongly acidic in reaction with low status of organic matter, low moisture holding capacity and low fertility level. Some physico-chemical properties of soils of Madhupur Tract are presented in Table 1-10-2.

Table 1.10-2: Some Physic-chemical properties of soils of Madhupur Tract

Major land type	Soil pH	Extent	Soil OM	Nutrients status								
				N	P	K	S	Ca	Mg	Zn	B	Mo
Highland	4.1-6.2	56%	L	VL-L	L	L	L	L-M	L-M	L-M	L-M	L-M
Medium highland	4.4-6.5	18%	L	VL-L	L	L	L	L-M	L-M	L-M	L-M	L-M

OM=Organic matter; VL=Very low; L-Low; M=Medium; Opt=Optimum; H=High; VH=Very high; Source: BARC, 2005. *Source: Fertilizer Recommendation Guide-2005, BARC.*

1.10.4 Current Practice on Acquired land

The proposed site is a fallow land mostly covered with climbers, herbs and shrubs. There are some trees also seen in the site. No commercial farming activity is taken place in the area.

1.10.5 Land Type

Land type classification is based on depth of inundation during monsoon season due to normal flooding on agriculture land. In terms of depth of flooding, five classes of land type are recognized (SRDI, 1988).

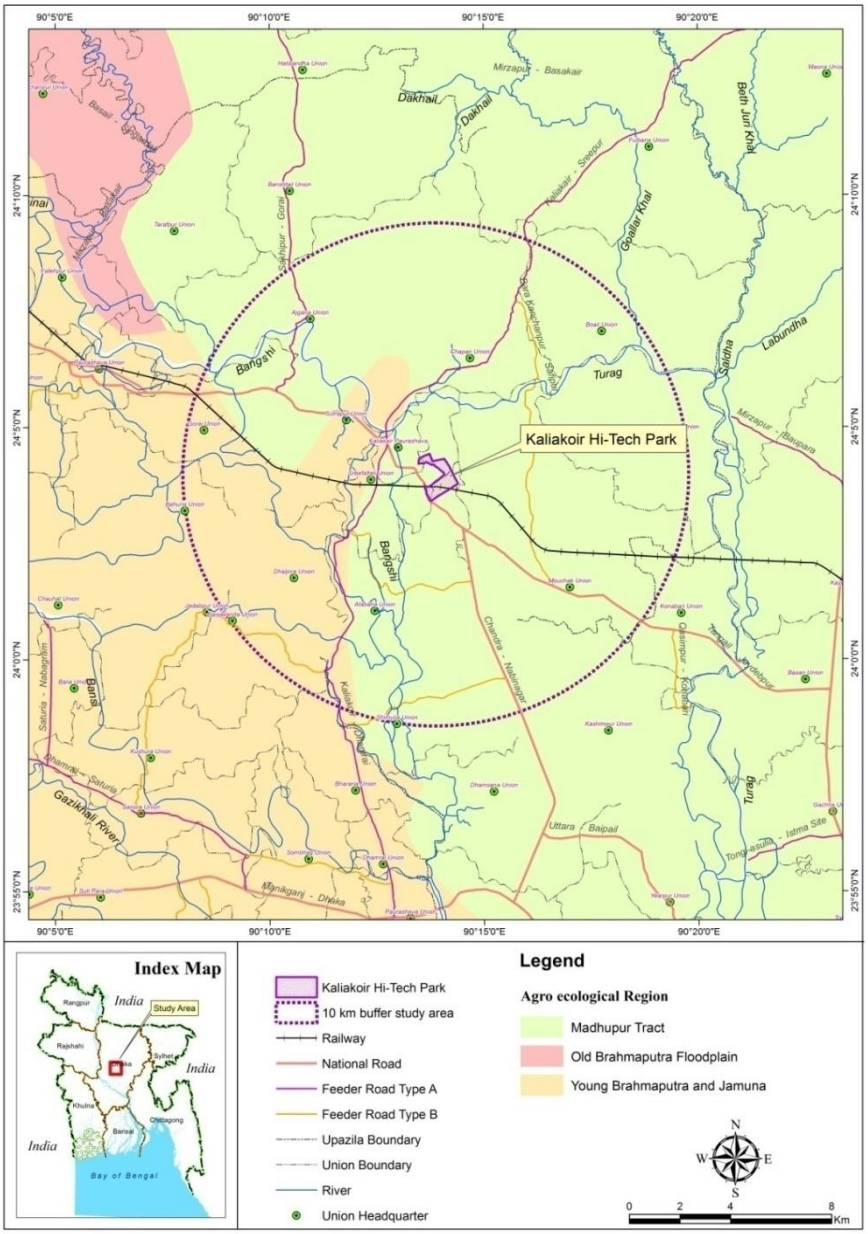


Figure 1.10-1: Agro-ecological Zones of the study area

The study area is dominated by highland (40%) followed by medium high land, medium low land and low land as shown in following Table 1-10-3. Figure 1.10-2 shows the land types of the study area.

Table 1.10-3: Detailed distribution of land type in the study area

Land Type	Area (ha)	Percentage	Land Type	Area (ha)	Percentage
High land	12451.0	39.6	F2 (90 - 180 cm)	889.7	2.8
F0 (0 - 30 cm)	401.7	1.3	F3 > 180 cm	13592.8	43.2
F1 (30 - 90 cm)	2343.8	7.5	Permanent Water bodies	1751.5	5.6
Total Area: 31430.45 ha and Total Percentage: 100.0					

Source: Digital Elevation Model analysis

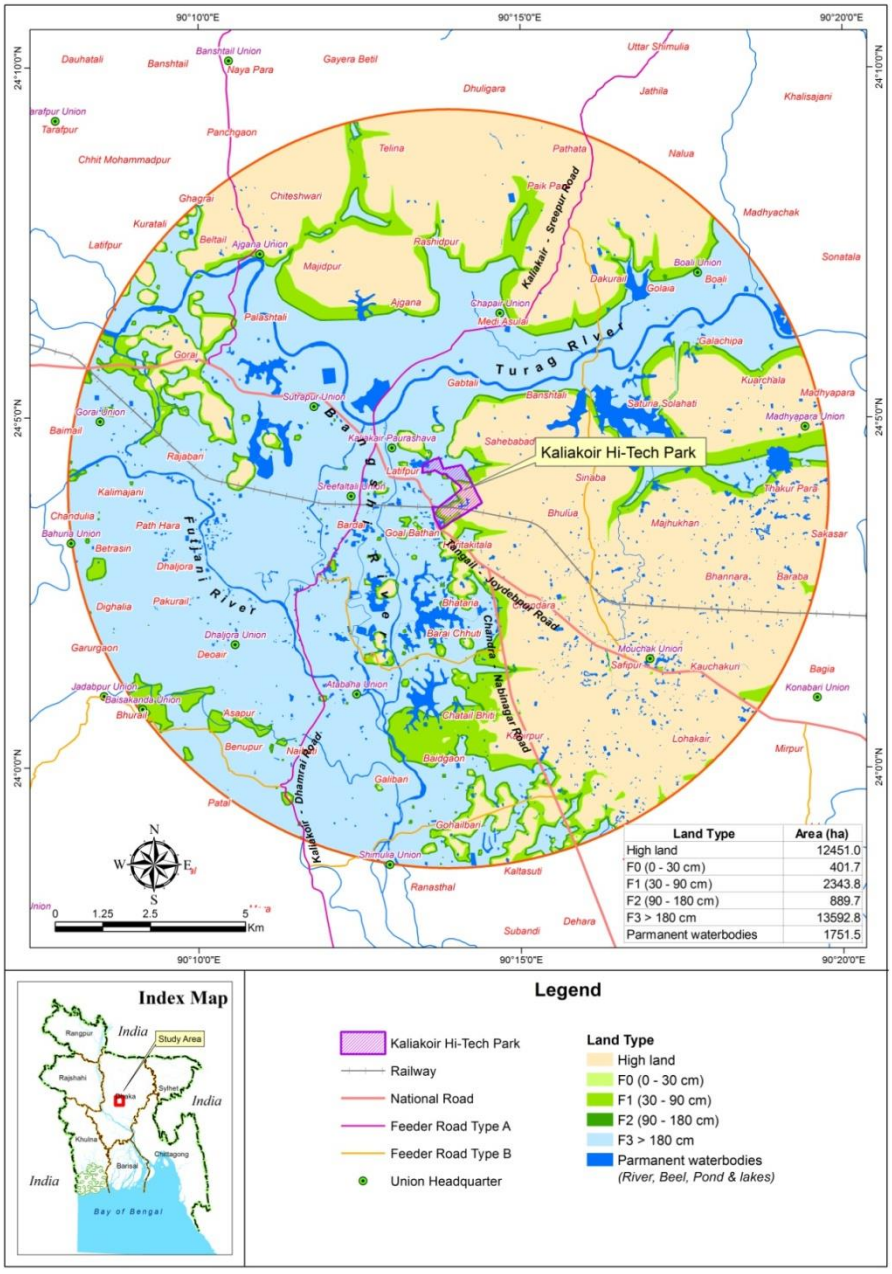


Figure 1.10-2: Land type of the study area

1.10.6 Soil Quality of the Project Area

Two representative soil samples have been collected from two location of the project study. One sample was taken **within** the HTC and another was collected from outside the HTC. The locations of the soil sample collections are listed in the Table-1.10-4 and shown in Figure 1.10-3.

Table 1.10-4 Details of Soils Sample Locations

Sl.	Code	Location	Geographic Location	Location Setting

1	SS-L-01	Within the HTC	24° 3'54.84"N; 90°13'56.22"E	Vacant Land
2	SS-L-02	Outside the HTC	24° 3'55.02"N; 90°14'10.92"E	Vacant Land

Within the HTC Outside the HTC

Monitoring of Soil Quality of the Porject Study Area

Figure 1.10-3 Soil Sampling Locations of the Project Study Area

More or less the soil quality of the project study area complies with the BARC studied (2005) Physico-chemical properties of soils of Young Brahmaputra Jamuna Floodplain and Madhupur Tract. The soil quality data is tabulated in Table 1.10-5. Test result of SRDI is annexed in Annex-V.

Table 1.10-5 Soil Quality of the Project Study Area (Sampling date: 11/06/2016)

Soil Sample	pH	Organic Matter	Total Nitrogen	Potassium	Calcium	Magnesium	Phosphorous	Zinc
		%		meq/100gm soil			µgm/gm (ppm)	
SSL-01	6.1	0.54	0.027	0.20	13.57	3.74	2.44	0.57
	Slightly Acidic	Very Low	Very Low	Medium	Very High	Very High	Very Low	Low
SSL-02	6.3	2.96	0.148	0.60	14.00	2.63	13.29	7.63
	Slightly Acidic	Medium	Low	Very High	Very High	Very High	Medium	Very High

1.10.7 Farming Practices

Farming practices largely depend on the cropping seasons. In the study area, there are three cropping seasons in a year. They are the Kharif-I, the Kharif-II and Rabi seasons. The Kharif-I start from March and ends in June. This season is characterized by the uncertainty of weather of alternating dry and wet spells. A little amount of vegetables, Lt. Aus are being produced due to uncertainty of weather in this season. Jute, Vegetables and Aus are grown in this season. The Kharif-II starts from July and ends in October. The Kharif -II season comprises wet and cloudy environment and is not favorable for high yields because of uneven distribution of rainfall, flooding depth, low solar radiation, high temperature and humidity. Rice is the predominant crop grown during this season due to the submergence of soil. Aman is grown in the Kharif -II season. T. Aman and Lt. Aman crops are grown mainly under rain fed condition. Farmers also provide supplementary irrigation to Aman crops under water stressed situation. The Rabi season starts from November and ends in February. During this season, crops are favored with high solar radiation, low humidity and temperature, but lack of adequate soil moisture depresses the crop yield. Wide range of crop is grown in this season. HYV Boro is cultivated in almost all over the study area under irrigated condition. Winter vegetables like Brinjal (Eggplant), Tomato; Spinach, Country bean etc. are grown in some places in Rabi season.

1.10.8 Constraints for Crop Production

The main constraint of crop production is the scarcity of irrigation water during dry season. Transplanted Aman crops are grown under rain fed condition. Delay onset of monsoon rainfall and drought in late monsoon season affect normal yield of T. Aman.

1.10.9 Cropping Pattern and Intensity

The most prominent cropping pattern of the study area is Fallow - Lt. Aman - HYV Boro which is covered about 16% of net cultivable area (NCA). Detailed cropping pattern of the study area is presented in Table 5.10-6. The single, double and triple cropped area is about 6%, 78% and 16% of the NCA respectively.

Table 1.10-6: Cropping pattern of the study area

Study Location	Kharif-I (Mar-Jun)	Kharif-II (Jul-Oct)	Rabi (Nov-Feb)	Area (ha)	% of NCA
Study Area	Fallow	HYV Aman	Fallow	836	6
	Summer vegetables	LT Aman	HYV Boro	2,297	16
	Summer vegetables	Fallow	Winter vegetables	2,191	15
	Lt. Aus	Fallow	HYV Boro	1,292	9
	Summer vegetables	Fallow	HYV Boro	2,191	15
	Jute	Fallow	Winter vegetables	2,153	15
	Jute	Fallow	HYV Boro	3,375	24
	Total			14,335	100

Source: Field information, 2016

1.10.10 Agriculture Input

❖ **Seeds**

The role of seeds is very important for growing crops. Selection of seeds should be considered on the basis of more than 85% germination rate, free from disease infestation, good shape and size and high yield potential need to be considered. The seed rate used (Kg/ha) in the study area is presented in Table 1.10-7.

Table 1.10-7: Seed and Labor used in the study area

Crop Name	Seed Used (Kg/ha)	Labor (Number/ha)	Crop Name	Seed Used (Kg/ha)	Labor (Number/ha)
HYV Boro	50	190	Jute	8	130
HYV Aman	48	155	Winter Vegetables	4	190
Lt. Aman	50	135	Summer Vegetables	7	185
Lt. Aus	60	100			

Source: Field information; 2016

❖ **Labor**

In the study area, almost 80% of the cultural practices for crop production are being done manually. So, agricultural labor is considered as one of the essential inputs for crop production. The labor requirement is not uniform throughout the year. The number of labor requirement varies from crop to crop. The average number of labor used per hectare in the study area is presented in Table 1-10-7.

❖ **Fertilizer and Pesticides Application**

The rate of use of fertilizer per hectare varies considerably from farmer to farmer depending on soil fertility, cropping pattern and financial ability. The major fertilizers used in this area are Urea, TSP and MP. Most of the cases, 85% farmers use fertilizers in unbalanced way. Organic manures are hardly used which has led to depletion of organic matter content in the soil. The use of pesticides depends on the degree of pest infestation. The major insects are Stem borer, Grass hopper, Green leaf hopper, Ear cutting cater pillar, Brown plant hopper, Rice hispa and Jute hairy caterpillar etc. Different types of pesticides such as Karate, Furadan, Darsban, Cumulus, Fighter, Diazinon, Dimacron, Sumithion, Fighter, Sunfuran, Ripcord, Basudin, Rifit, Rison, Tilt, Subicron and Bhutafuran etc. are being used to prevent pest infestation in rice cropland. It is clear that

pesticide use is not anticipated in the HTC except for disease vector control only. Detailed information on fertilizer and pesticide used in the study area is presented in Table-1.10-8.

Table 1.10-8: Fertilizer and Pesticides used in the study area

Crop Name	Fertilizer (Kg/ha)					Pesticides		
	Urea	TSP	MP	Zn	Cow dung/ Compost Ton/ha	No. of Appli.	Liq. (ml/ha)	Gran. (Kg/ha)
HYV Boro	180	80	60	10	25	2-3	700	8
HYV Aman	140	50	30	7	15	2-3	700	-
Lt Aman	80	40	25	-	10	-	-	-
Lt. Aus	120	40	20	3	15	-	-	8
Jute	80	20	-	-	15	1		
Winter Vegetables	100	60	30		10	1-2	700	-
Summer vegetables	100	25	15	-	5	1	700	-

Source: Field information; 2016

1.11 LIVESTOCK AND POULTRY

1.11.1 Introduction

Most of the households raise poultry and livestock, a practice that significantly reduce poverty through generating income and employment. About 70% of household are rearing cows/bullock, 2% of household are rearing Buffalo; 50% of household are rearing goat; about 9% households are rearing sheep, 60% of household are rearing duck and 80% of household are rearing chicken at the study area. In the project area, there are no households. The status of livestock and poultry in the study area is presented in Table 1.11-1.

Table 1.11-1: Number of livestock and poultry in the study area

Name of Livestock/Poultry	Study Area	
	Percentage of HH having Livestock/Poultry	Numbers of Livestock and poultry
Cow/Bullock	70	55,180
Buffalo	2	519
Goat	50	35,156
Sheep	9	2,636
Duck	60	74,814
Chicken	80	2,16,310

Source: Field information

1.11.2 Feed and Fodder Shortage

The owners of the livestock population are facing problems in shrinking and degrading pastures coupled with limitations of fodder during the months of December to April due to dried up grazing land and in Kharif-II season, almost all over land remain under crop cultivation. Shortage of grazing area throughout the year aggravates the feed problem to the animal population. Poultry population at family level survives by scavenging and generally no feed supplements are provided. However, at times kitchen waste becomes feed to the poultry.

1.11.3 Livestock/poultry Health

Productions of livestock and poultry are mainly constrained due to diseases and death of the population. The economic impact of diseases and the cost of control measures are high and becoming higher. In the study area, every year livestock population is affected by different diseases like feet and mouth disease (FMD), Anthrax, Diarrhea, PPR, etc. The got/cyst in head is common disease of goat. Major poultry diseases are Ranikhet, Duck Plague, Paralysis, New Castle, Fowl pox, and Dysentery etc. The most vulnerable period is between July to October (rainy season) months for spreading diseases to livestock and poultry populations. The duck plague generally occurs in summer. However, some diseases are found round the year. During monsoon season, the soggy condition of the animal shelter promotes various kinds of diseases to the bullocks and cows. Moreover, the unhygienic condition of the courtyards during this season may increase the diseases to the poultry birds.

1.12 TRANSPORTATION SYSTEM

The proposed BHTC is having all the infrastructure facilities like electricity, gas, telephone, national highway, river transport and railway etc. The project location has got a good communication network with other parts of the country. The Bangshi River passes through adjacent to the site. The Bangshi river is connecting with the Turag River. The river has good navigation facility in the rainy season but limited navigation facility the dry season.

The site is located north of Dhaka off the Dhaka Tangail highway, further widening of which may be required when the BHTC is fully operational. The commute time to Dhaka is about one and a half hours by road.

The site of the BHTC is directly connective by a railway line to Dhaka. It has been earlier suggested that this be used to establish a high speed link to Dhaka and the Airport to enable an easy commute employees residing in the city. However, this would be a separate project and may involve substantial capital outlays.

Bangabandhu Hi-tech City site is located about 25 km from Dhaka's international airport, which is the country's largest airport with good connectivity to destinations within Bangladesh as well as international destinations in South Asia, South East Asia, the Middle East and Western Europe.

Although a port is not critical given the nature of activities envisaged in the BHTC, it is located 350 km from Chittagong port, the country's largest port, which is approximately 5 hours by road.

1.13 FISHERIES RESOURCES

5.13.1 Habitat Characteristics

The seasonal and perennial Beels (depressions) along with floodplains of the study area become connected to the Turag River and Bangshi River during pre-monsoon through a number of drainage canals (Khals). Connectivity is usually restored on the onset of monsoon and Beels become inundated earlier followed by the vast floodplains. These seasonal and perennial water bodies function as fresh water fish habitats. Open water fish habitats that are found in the study

area are; (i) river, (ii) Khal, (iii) Beel and (iv) floodplain. The estimated overall fish habitats of the study area accounts for 1,771 ha. Capture fishery constitutes about 1,220 ha and the rest is shared by the culture fishery.

1.13.2 Fish Production

The yearly production of the capture fishery resources in the study area is derived from river and Khal, Beel and floodplain. The yearly production of culture fishery resources is derived mainly from the cultured pond and culturable pond. The estimated total fish production of the study area is about 1,864 tons, where culture fishery contributes the most amounting to 88% and the rest is shared by the capture fishery. The yearly production of different fish habitats is presented in Table 1.13-1 for 2016.

Table 1.13-1: Fish habitat and production assessment

Sl. No.	Fishery Types	Habitat Types	Study Area		
			Habitat Area (Ha)	Yield/ Production (MT)	% of Production
1	Capture	River & khal	491.8	37	2
2		Beel	437.2	142	8
3		Floodplain	191	33	2
		Sub-Total=	*1,120*	*212*	
4	Culture	Fish pond	488	1,416	76
5		Culturable pond	163	236	13
		Sub-Total=	*651*	*1,652*	
		Grand Total=	1,771	1,864	100

Source: Analysis using FRSS, 2013-14 published data and on-field calculation

1.13.3 Fisheries Diversity-Species composition and biodiversity

Local fishermen reported that fish biodiversity has been declining over the years. Major factors responsible for the downturn of the species diversity are: (i) abstraction of river water for different industrial use; (ii) reduction of fish habitats; (iii) deteriorating water as well as habitat quality; (iv) increasing fishing pressure; (iv) obstruction in fish migration routes; (vi) aggradations of riverine habitats due to geo-morphological processes; (viii) alteration of fish breeding grounds; (ix) transformation of beel habitat into paddy fields, and (x) expansion of culture fishery. The capture habitats of the study area are dominated by small indigenous species (SIS) of fish. It is reported that the Turag river's major carp and SIS fishes which were once in abundance is now rather meager. Indicative fish species of the study area is given as follows:

The riverine major fish species are: Kalibaus *(Labeo calbasu*), Chital (*Notopterus chitala*), Juary/Joya (*Aspidoparia jaya*), Tit punti (*P. ticto*), Boro baim (*Mastacembelus armatus*), Batasi (*Pseudeutropius atherinodes*), Golsha (*Mystus cavasius*), Narkali chela (*Salmostoma bacaila*), Kaski (*Corica soborna*), Tengra (*Mystus tengara*), Ayer (*Sperata aor*), Kajoli (*Ailia punctata*), Ghero (*Clupisoma garua*), Kaikya

(*Xenontedon cancila*), Chanda (*Chanda nama*), Bele (*Glossogobius giuris*), Golda chingri (*Macrobrachium rosenbergii*), Gura chingri (*Leander styliferus*), Taki (*Channa punctatus*).

The floodplain and beel fish species include: Meni (*Nandus nandus*), Shol (*Channa striatus*), Taki (*C. punctatus*), Punti (*Puntius spp.*), Shingi (*Heteropneustes fossilis*), Magur (*Clarias batrachus*), Bujuri tengra (*Mystus vitatus*), Foli (*Notopterus notopterus*), Guchi baim (*Mastacembelus pancalus*), Kolisha/chopra (*Colisa fasciatus*), Boicha (*C. lalia*), Boal (*Wallago attu*), Koi (*Anabas testudineus*), Rui (*L. rohita*), Katol (*Catla catla*), Gura chingri (*Leander styliferus*), etc.

Culture fish species include: Rui (*Labeo rohita*), Katol (*Catla catla*), Kalibaus (*Labeo calbasu*), Mrigel (*Cirrhina mrigala*), Silver carp (*Hypophthalmichthyes molitrix*), Grass carp (*Ctenopharyngodon idela*), Mirror carp (*C. carpio.*), Common carp (*Cyprinus carpio*), Thai pangus (*Pangasius sutchi*), Tilapia (*Tilapia mossambicus*), Nilotica (*Tilapia nilotica*), Sharpunti (*Puntius sarana*), etc.

1.13.4 Fish Habitat Degradation

River water quality has been degrading due to discharge of untreated or improperly treated effluents of Garments, dying factory, cement factory, paper and pulp industry etc. At the same time, it entertains some fish species those prefer velocity. The industrial discharge of effluents and municipal sewages into the neighboring rivers, dust and other particles from various industries contaminate river water. Cumulative effects of all contaminants along with the untreated effluents of the industries cause fatality to fish species along with other aquatic eco-elements. But this HTC has no contribution of discharge waste to the nearby water body.

1.13.5 Fishermen Status and Effort

Pollutants come from various point and nonpoint sources are responsible for the decline of fish growth and fish production. The water quality of Turag and Bangshi River is too poor for fish to survive during dry season and this has been the case for an extended period of time. Decline of capture fishery is a country wide challenge and not specifically relevant to the proposed Bangabandhu Hi-tech City.

1.14 ECOLOGICAL RESOURCES

Ecological resources considered eco-elements in the range of vegetation to wildlife of the aquatic and terrestrial ecosystems. The study area contains general types of eco-elements with low to medium biodiversity and does not possess any kinds of specialized habitat or hot spot. The identified major ecosystems include homestead/settlements, crop-field, roadside, woodland, Sal forest, riverine, seasonal wetlands, etc.

1.14.1 Ecologically Critical Areas

The areas are defined as Ecologically Critical Area (ECA) where the ecosystems are affected adversely for the changes brought through human activities. The Bangladesh Environment Conservation Act (ECA), 1995 has provision for declaration of an area as ECA by the Director General of the Department of Environment in certain cases where ecosystem is considered to be threatened and attained a critical state. In September 2009, the four rivers around the capital city

Dhaka namely the Buriganga River, the Shitalakhya River, the Turag River and the Balu River have been declared as ecologically critical area by the Department of Environment. However, the Turag River has fallen outside the study area. This river deemed for environmental conservation to save wide variety of ecosystems. Although the Turag is in the ECA but there will be no direct/indirect influence of the BHTC project to the Turag River.

1.14.2 Ecological and Conservation Designations

The designation of tracts of land for ecology and landscape conservation is an important consideration of many national policies. Conservation agenda is also being embedded in land use strategies to response to changing social needs and environmental conditions. Field investigation revealed that there is no ecological hot-spot within the study area.

1.14.3 Ecosystems

The entire study area possesses both terrestrial and aquatic ecosystem having moderate to low floral and faunal diversity.

➢Terrestrial Ecosystem

The major terrestrial ecosystems of the area are as follows: (i) Homestead/settlements; (ii) Crop-field; (iii) Roadside; (iv) Woodland; and (v) Sal forest.

The BHTC is out of the Sal forest. So, world bank OP related to forestry will not be triggered.

➢Homesteads/Settlement Ecosystem

This type of ecosystem is usually evolved by the interaction of vegetation planted by the owners for their interests and the dependent wild fauna.

➢Homestead Flora

The major plant species of this ecosystem are: Tal (Borassus flabelifer), Kanthal (Artocarpus heterophyllus), Narikel (Cocos nucifera), Pepey (Carica papaya), Aam (Mangifera indica), Jarul (Lagerstomia speciosa), Rendi Koroi (Albizia saman), Akashmoni (Acacia auriculiformis), Euc alyptus (Eucalyptus citriodora), Bansh (Bambusa Spp.) etc. Besides these, there ecologically important herbs and shrubs also exist in this ecosystem.

➢Homestead Fauna

The homestead vegetation plays an important role in sheltering a variety of wild animals. Among them, the major ones are: Common Toad (Duttaphrynus melanostictus), Cricket Frog (Fejervarya limnocharis), Common Tree Frog (Polypedates maculates) under amphibian group; House Gecko (Hemidactylus frenatus), Common Garden Lizard (Calotes versicolor), Bengal Monitor (Varanus bengalensis), Common Skink (Mabuya carinata) as reptiles; Common Myna (Acridotheres tristis), Asian Pied Starling (Sturnus contra), Red-vented Bulbul (Pycnonotus cafer), Oriental Magpie Robin (Copsychus saularis), Spotted Dove (Streptopelia chinensis), Blue Rock Pigeon (Columba livia), Coppersmith Barbet (Megalaima haemacephala) and Black-hooded Oriole (Oriolus xanthornus) under avifauna; Common Mongoose (Herpestes edwardsii), Small Indian Mongoose

(Herpestes auropunctatus), Asian Palm Civet (Paradoxurus hermaphroditus), Common House Rat (Rattus rattus), Irrawaddy Squirrel (Callosciurus pygerythrus), Greater Short-nosed Fruit Bat (Cynopterus sphinx) and Indian Pipistrelle (Pipistrellus coromandra) as mammals.

Functionally, this ecosystem provides various goods and services, such as bamboos are inevitable elements for engraving the corpse of the villagers and also contribute in earning of the villagers. In addition, the homestead vegetation supports in meeting food, fuel, medicine and other household requirements.

➢Crop-field Ecosystem

This ecosystem is developed by the cultivation of crops and by the interaction of vegetation grows in that field supported with favorable wildlife.

➢Crop-field Flora

This ecosystem supports vegetation in association with the crop varieties like rice, jute, vegetables etc. Detail information on cropping pattern is discussed in the agricultural section. The crop-field vegetation under ecology has considered the different species of weeds: Echinochloa colonum, Paspalum distichum, Heliotropium indicum, Drypopteris Sp, Nicotiana plumbaginifolia, Croton bonplandianum, Chynodon dactylon,Panicum repens, Cheratopteris Sp, Heliotropium indicum, Amaranthus spinosus, Centipeda orbicularis, Cyperus Sp. etc. This type of vegetation provides feeding habitats to wildlife.

➢Crop-field Fauna

The faunal diversity of this ecosystem is a mixture of terrestrial and aquatic wildlife as the crop fields possess both terrestrial and aquatic habitats. The major wild fauna of this ecosystem are: Indian Bullfrog (Hoplobatrachus tigerinus) as amphibian; Checkered Keelback (Xenochrophis piscator) and Buff-striped Keelback (Amphiesma stolata) under reptiles; of the avian fauna Black Drongo (Dicrurus macrocercus), Crested Serpent Eagle (Spilornis cheela), Brahminy Kite (Heliastur indus), White-breasted Kingfisher (Halcyon smyrnensis), Pied Kingfisher (Ceryle rudis) and Brown Fish Owl (Ketupa zeylonensis) available in this type of ecosystem. Among them Brown Fish Owl considered as vulnerable (VU) as well as Crested Serpent Eagle categorized as Critically Endangered (CR) species. Of the mammals, Little Indian Field Mouse (Mus booduga), Common Mongoose (Herpestes edwardsii) and Bengal Fox (Vulpes bengalensis) have seen during the major field investigation.

➢Roadside Ecosystem

The roadside vegetation is part of a web of life in which there are intimate and essential relationships between plants and the road, between plants and other plants, between plants and animals. This vegetation represents ecologically meaningful examples of human-created ecosystem. Interactions between plant and soil communities (hereafter plant-soil interactions) are of major importance in understanding the role of biotic control in ecosystem functioning.

➢Roadside Flora

The slopes and edges of top of the roads are functioned as roadside ecosystem and supports with moderate diversity of species. The forest department and villagers plant trees under social forestry concept with the aim of financial benefits as well as protection of roads from soil degradation. Strip plantation with the mixture of exotic and local species on both sides of the rail line is implemented by the Bangladesh Railway. The major species are Rendi Koroi (Albizia saman), Mahogany (Swietenia mahagoni), Eucalyptus (Eucalyptus citriodora), Goraneem (Melia azadirachta), Sil Koroi (Albizia procera), Bansh (Bambusa tulda), Akashmoni (Acacia auriculiformis) and Sisu (Dalbergia sissoo). The roadside vegetation supports a variety of wildlife.

➢Roadside Fauna

This ecosystem consists of following wildlife such as Common Tree Frog (Polypedates maculates) and Ornate Microhylid (Microhyla ornata) under amphibians; Common Garden Lizard (Calotes versicolor), Bengal Monitor (Varanus bengalensis), Common Skink (Mabuya carinata), Checkered Keelback (Xenochrophis piscator) and Buff-striped Keelback (Amphiesma stolata), etc. under reptiles; Common Myna (Acridotheres tristis), Asian Pied Starling (Sturnus contra), Red-vented Bulbul (Pycnonotus cafer), Oriental Magpie Robin (Copsychus saularis), Spotted Dove (Streptopelia chinensis), Blue Rock Pigeon (Columba livia), Coppersmith Barbet (Megalaima haemacephala) and Black-hooded Oriole (Oriolus xanthornus), etc. under avifauna; and Common Mongoose (Herpestes edwardsii), Oriental Civet (Viverra zibetha), Little Indian Field Mouse (Mus booduga), Irrawaddy Squirrel (Callosciurus pygerythrus), and Indian Pipistrelle (Pipistrellus coromandra), etc. as mammals.

➢Woodland Ecosystem

Woodland is a habitat where trees are the dominant plant form. The individual tree canopies generally overlap and interlink, often forming a more or less continuous canopy which shades the ground to varying degrees. Depending on the amount of light reaching the ground through the tree canopy, there will be a great variety of other plants. These will include mosses, ferns and lichens, as well as small flowering herbs, grasses and shrubs. The more different kinds of plants there are, the greater the animal diversity will be in the woodland.

➢Woodland Flora

Woodland ecosystem is generally observed in the premises of industrial units, offices within the study area. This ecosystem supports a limited variety of exotic and local plant species. These are: Mahogony (Swietenia mahagoni), Rendi Koroi (Albizia saman) and Akashmoni (Acacia auriculiformis). This ecosystem also possesses mosses, ferns and lichens of different species. This ecosystem supports the community with providing timber, fuel wood and safeguarding natural disaster like Tornado, cyclone, etc. Some woodland developed with a single species as practice of monoculture which resulted less diversification of this ecosystem.

➢Woodland Fauna

The major woodland fauna includes Common Garden Lizard (Calotes versicolor), Common Skink (Mabuya carinata), etc. under reptiles; Common Myna (Acridotheres tristis), Asian Pied Starling (Sturnus contra), Red-vented Bulbul (Pycnonotus cafer), Oriental Magpie Robin (Copsychus saularis), Spotted Dove (Streptopelia chinensis) under avifauna; and Irrawaddy Squirrel (Callosciurus pygerythrus) and Indian Pipistrelle (Pipistrellus coromandra) as mammalian species.

➢Sal Forest Ecosystem

Geo-morphologically, Madhupur Garh is a part of the Madhupur Tract and topographically it is raised a few metres above the level of the surrounding flood plains. This ecosystem is situated in Gazipur district falls under the study area and the prominent species of this forest is Sal (Shorea robusta). Until beginning of the 20th century Sal forests existed as a large continuous belt with rich biological resources, but increasing human pressure has triggered the decline of such ecosystem by around 70%.

➢Sal Forest Flora

It is a deciduous forest comprising of Sal or Gajari as a major species but due to poor coppicing capability and poor management practices there population is now very restricted. Majority of the area has been replanted by short rotation exotic species and some have been brought under social forestry or participatory agroforestry schemes. Biodiversity has declined rapidly and many animal species have become locally extinct. The abundant plant species of this ecosystem may include: Sal (Shorea robusta), Koroi (Albizzia spp.), Raintree (Albizzia saman), Sissoo (Dalbergia sissoo), Bohera (Terminalia belerica), Horitaki (Terminalia chebula), Kanchan (Bauhinia acuminata), Polash (Butea monosperma) etc.

➢ Sal Forest Fauna

This ecosystem supports a variety of wildlife, such as Monkey (Macaca mulatta), Barking deer (Muntiacus muntjac), Spotted deer (Axis axis), Langur, Fishing cat, Marbled cat, Jackel (Canis aureus), Common Mongoose (Herpestes edwardsii), Irrawaddy Squirrel (Callosciurus pygerythrus), and Indian Pipistrelle (Pipistrellus coromandra), and Bengal Fox (Vulpes bengalensis) etc. under mammals; Common Garden Lizard (Calotes versicolor), Bengal Monitor (Varanus bengalensis), under reptiles; Common Myna (Acridotheres tristis), Asian Pied Starling (Sturnus contra), Oriental Magpie Robin (Copsychus saularis), Spotted Dove (Streptopelia chinensis) and Black-hooded Oriole (Oriolus xanthornus), etc. under avian fauna;. Common Palm Civet habituated in forests, and plantations, farmed areas and human habitations, sal and mixed-evergreen forests in the study area. The Common Palm Civet and Common Mongoose considered as vulnerable (VU) species respectively to the country (IUCN-Bangladesh, 2000).


Homesteads vegetation


Woodland vegetation


Sal Forest

Terrestrial Vegetation of the Study area

The aquatic ecosystem consists of different wetlands like rivers, canals, ponds and ditches. The wetlands are divided into two types based on the duration of inundation namely- i) Seasonal wetland, and ii) Perennial wetland.

- *Aquatic Flora*

The inundated area supports numerous hydrophytes in this study area i.e Shapla (Nymphaea nouchaali), Helencha (Enhydra fluctuans), Padma (Nelumbo nucifera) etc. Shapla and Padma are the main aquatic plants of the seasonal wetlands during the monsoon. The dominant aquatic species are Kachuripana (Eicchornia crassipes), Helencha (Enhydra fluctuans), Dhol Kolmi (Ipomoea carnea), Keshordam (Ludwigia repens), Topapana (Pistia strateotes), Tetulpana (Salvinia natans) and Kutipana (Azolla pinnata).

- *Aquatic Fauna*

The life cycle of aquatic fauna depends on the natural fluctuations of water and connection with the Sitalakshya River and other closer wetlands during monsoon. The Skipper Frog (Euphlictys cyanophlytis), Indian Pond Heron (Ardeola grayii), Little Egret (Egretta garzetta), Cattle Egret (Bubulcus ibis), White-throated Kingfisher (Halcyon smyrnensis), Common Kingfisher (Alcedo atthis), Asian Openbill (Anastomus oscitans), Little Cormorant (Microcarbo niger) and River Dolphin (Platanista gangetica) were seen during the field investigation.

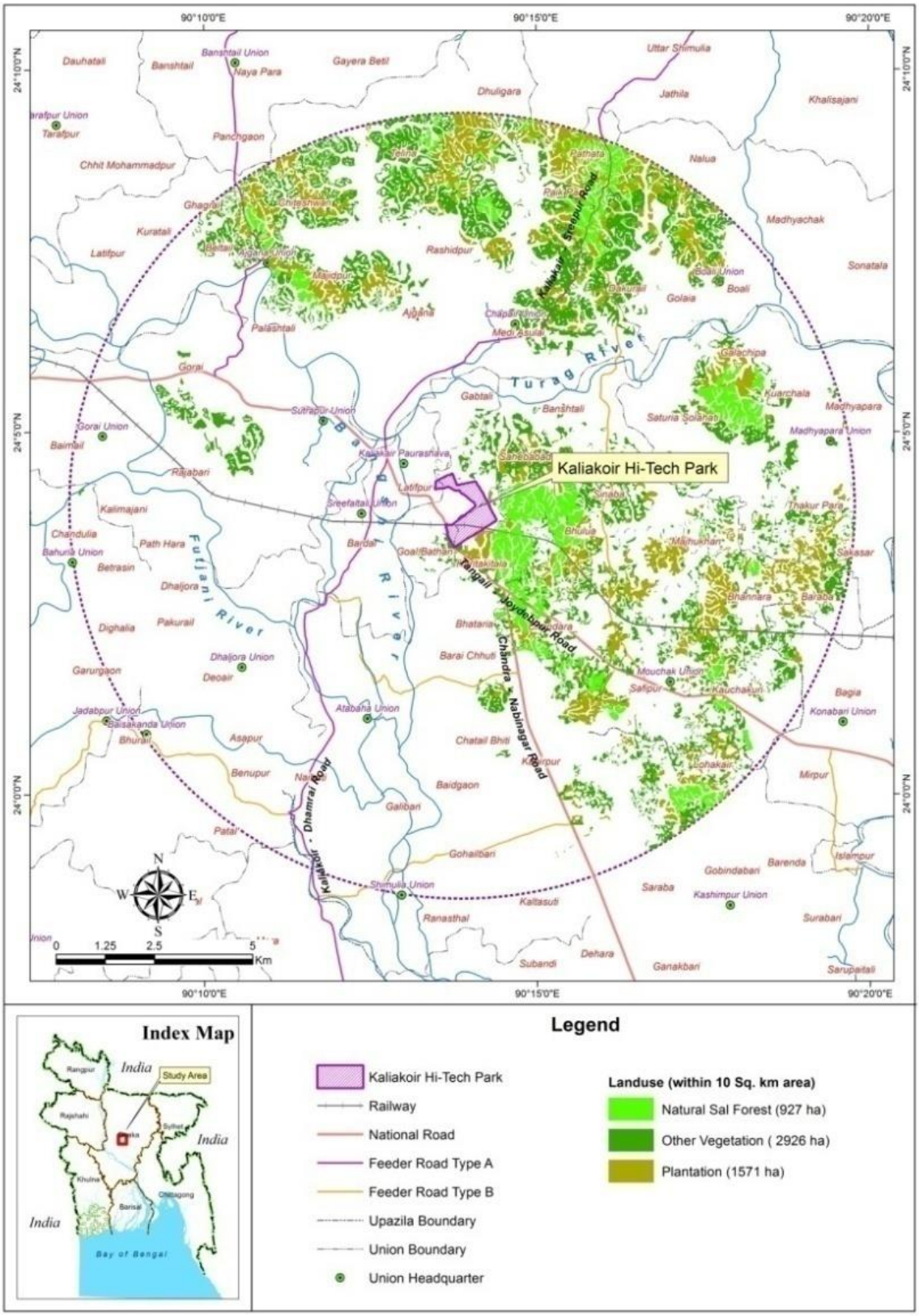


Figure 1.15-1 Ecological Use of Land

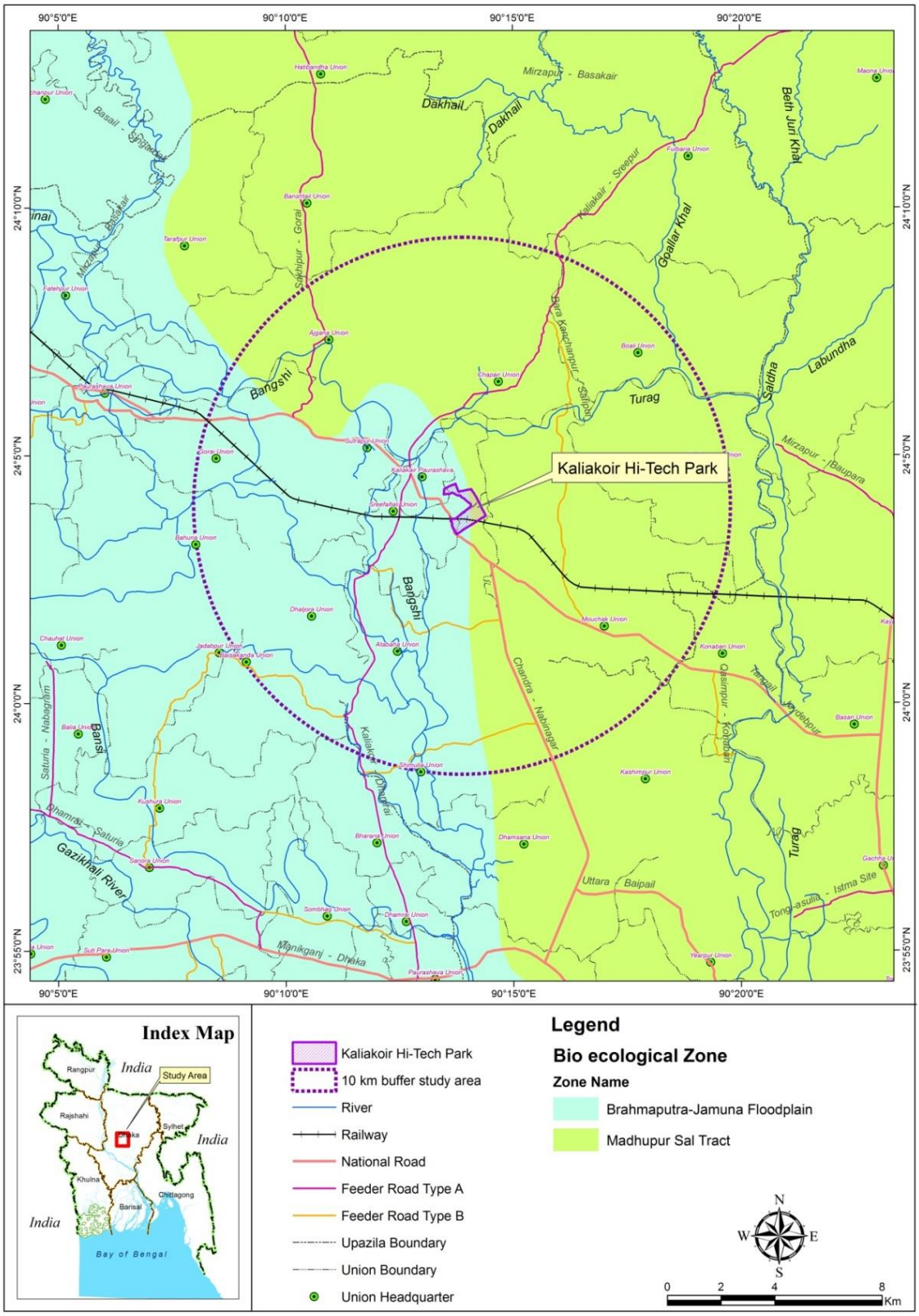


Figure 1.15-2: Bio-ecological zone of the study area

1.15 SOCIO-ECONOMIC RESOURCES

1.15.1 Introduction

Baseline scenario of the socio-economic environment is assessed based on primary and secondary data considering 19 unions of five (5) upazilas of Dhaka, Gazipur and Tangail district.

1.15.2 Population

Demography: The study area is the home of 330,307 people belonging to 77,267 households. Of the total population; 173,092 (52.4%) are male and 157,215 (47.6%) female. The average household size is 4.6, which is slightly higher than the national average of 4.50 [BBS, (HIES) 2010[1]]. The average population density is 2,511 per square kilometer which is more than double compared to national average of 1,055 (Table 4.15-1).

Table 1.15-1: Basic demographic profile of the study area

District	Thana	Union	Households	Population			Density
				Both	Male	Female	
Dhaka	Dhamrai	Baisakanda	1165	4969	2395	2574	889
		Bhararia	1520	6831	3421	3410	1444
		Jadabpur	1274	5408	2586	2822	919
	Savar	Shimulia	5973	27300	14377	12923	2574
Gazipur	Gazipur Sadar	Kashimpur	10032	41344	22228	19116	3188
		Konabari	13394	62229	35341	26888	11123
	Kaliakair	Atabaha	2391	10014	5142	4872	1823
		Boali	1814	7532	3714	3817	694
		Chapair	1888	8165	3968	4198	681
		Dhaljora	1512	6652	3238	3414	1182
		Fulbaria	2990	12047	5843	6203	529
		Madhyapara	2227	9593	4834	4759	891
		Mouchak	6938	31411	16350	15060	2379
		Sreefaltali	1405	6703	3352	3351	2177
		Sutrapur	1679	7677	3951	3726	1602
		Kaliakair Paurashava	12879	48088	25557	22531	11879
Tangail	Mirzapur	Ajgana	2284	10082	4919	5162	756
		Bahuria	1525	6549	3115	3434	1023
		Gorai	4378	17715	8761	8954	1960
		Total	**77,267**	**330,307**	**173,092**	**157,215**	2511

Source: Spatial analysis using GIS and Housing and Population Census, BBS, 2011

[1] HIES 2010 refers to Household Income and Expenditure Survey conducted by the Bangladesh Bureau of Statistics (BBS) in 2010.

In the study area, households with four members are the dominant. 24% households belong to this category (Figure 4.15-1). Although average household size is 4.6, 45% households have 5 or more than five members.

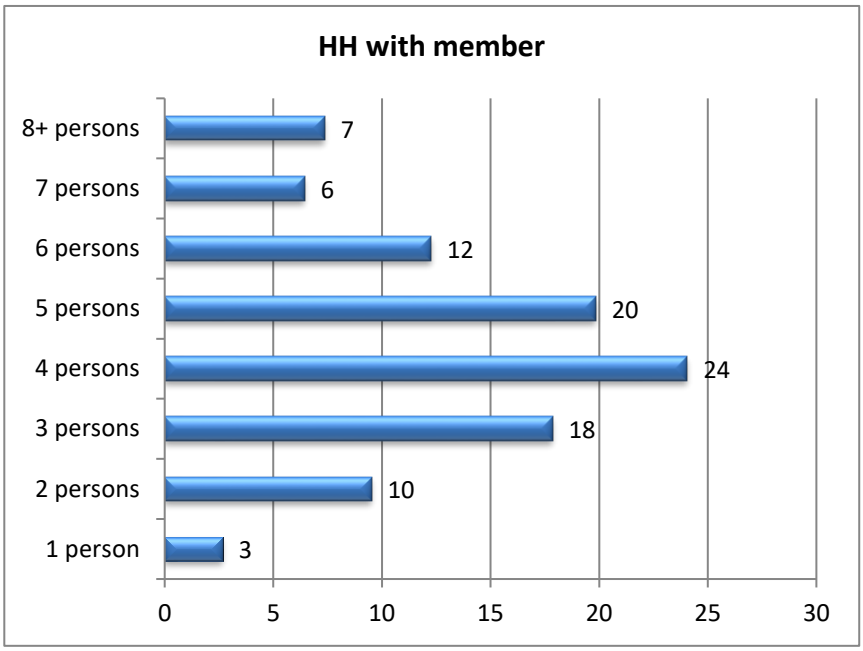


Figure 1.15-1: Distribution of Households Comprising Member in Each House

Source: Housing and Population Census, BBS, 2011

Age Structure: In the study area, the highest number of population (24%) belongs to age category of 30 to 49 years old. Only 3% people are in 60 to 64 years category. The young population (under age 15) would need more investment in schools, while size of older populations (ages 65 and over) would call for more invest in health sector.

According to the International Labor Organization (ILO) the population of 15 to 64 years is categorized as labor force whereas populations below 14 years and above 65 years are considered as dependent.

Therefore, the population data when analyzed to ascertain the size of (potentially) active working population then it appears that 61% percent population who are in the age bracket of 15-64 can be classified under this category. A small percentage (5%) is over 65 years old. The total dependency ratio[2] is 63 in which child dependency ratio is 56 and aged dependency ratio is 8. It

[2] Total dependency ratio=$\frac{number\ of\ people\ aged\ 0-14\ \&\ those\ 65\ and\ above}{number\ of\ people\ aged\ 15-64} \times 100$

Child dependency ratio= $\frac{number\ of\ people\ aged\ 0-14}{number\ of\ people\ aged\ 15-64} \times 100$

Aged dependency ratio= $\frac{number\ of\ people\ aged\ 65\ and\ above}{number\ of\ people\ aged\ 15-64} \times 100$

illustrates that total 63 persons are dependent on 100 labour forces in which 56 are children and 8 are elderly people.

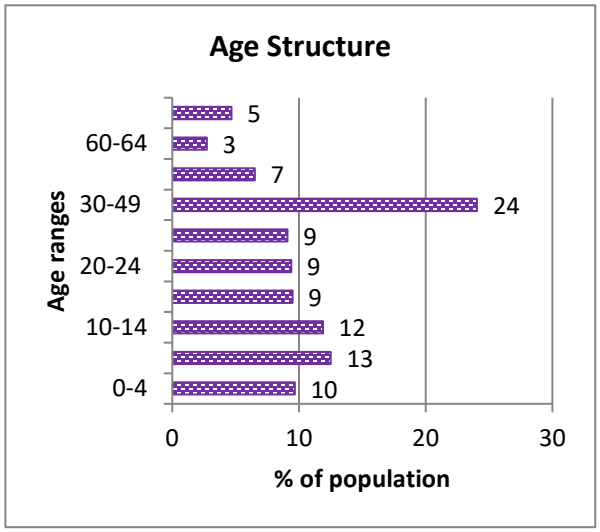


Figure 1.15-2 Age structure of the studied population

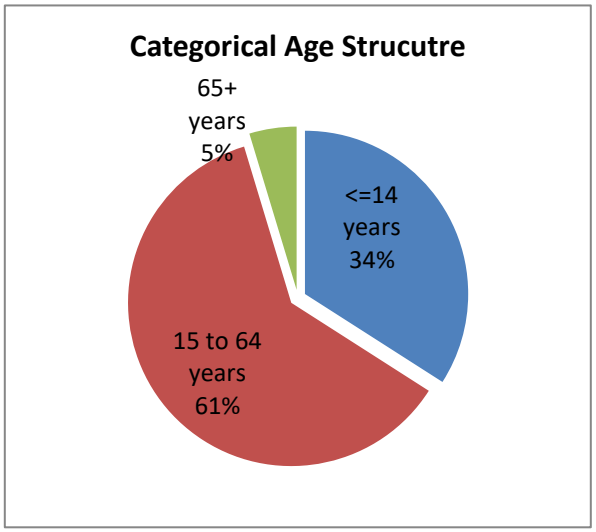


Figure 1.15-3: Categorical distribution of studied population

Source: Housing and Population Census, BBS, 2011

Sex Composition: Sex ratio when analyzed per Upazila appears to be almost similar. According to BBS (2011) data in the study area overall male-female sex ratio is 102, which means females are comparatively higher (102) than that of males (98). Male population is higher in Gazipur Sadar (124) and also in Kashimpur Upazila (116), when the lower ratio is in Fulbaria (95) upazilas. The data indicates that like national average (100.3), the discrepancy between male-female numbers is gradually decreasing. However, in unions there is higher ratio of female population over male population.

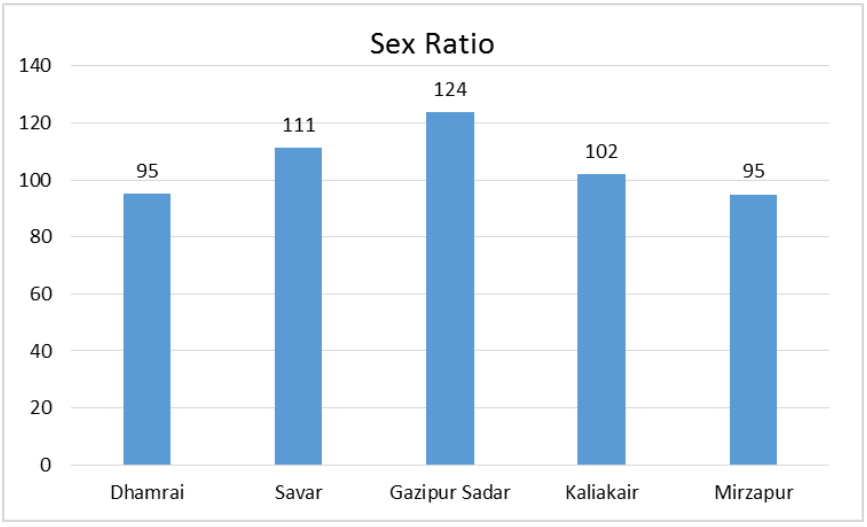


Figure 1.15-4: Sex ratio among the studied population

Source: Housing and Population Census, BBS, 2011

1.15.3 Public Health

Access to Health Services: Access to health services and facilities refer to availability and adequacy of supply, affordability, physical accessibility and socio-cultural acceptability. Field data shows that there are five (05) Upazila Health Complexes (UHC) at Upazila level and two district hospital in Gazipur Sadar. Besides, there are few community clinics at union level and several private health service providers also provide services to the local people. People stated that the existing services are almost inaccessible to rural poor therefore, a substantial number of population tends to receive services from the local chemists and/or "village doctors" either self-educated or locally trained who have some basic knowledge about health and medicines. They stated that most of the community clinics are located at preferable location of local political leaders therefore; remote villagers have limited access than that of these adjacent villagers.

Child and Mothers' Health: In the study area infant mortality rate (IMR) is 46. IMR is defined as the number of deaths of infants under one year old per 1,000 live births. On the other hand, the under-five mortality rate (U5MR) is 59.40; it also indicates the number of deaths of infants under five years old per 1,000 live births. This rate is comparatively lower than that of national average which is 49 for IMR and 64 for U5MR (source: Progoti Pathey, MICS, 2009). The child mortality is due to malnutrition, having scarcity of trained attendants at delivery, lack of timely initiation of breast feeding etc.

The following figure confirms that about 49% women aged 15-49 years with a birth in the 2 years preceding the survey can breastfeed their baby within one hour of birth and about 91% can breastfeed within one day of birth. Data also shows that the highest percentage (49%) of delivery was assisted by traditional birth attendant, about 17% by medical doctor and about 16% by nurse/midwife. It is noticeable that assistance to mother during child birth is still provided mostly by traditional untrained birth attendants and relatives.

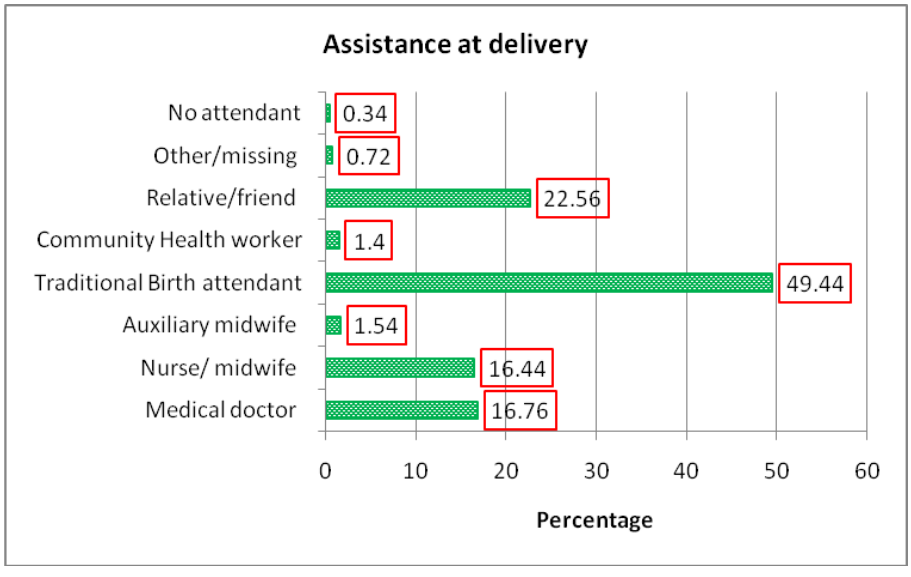


Figure 1.15-5: Women (%) aged 15-49 with a birth by assistance during delivery
Source: Progotir Pathey, MICS, 2009

Assistance at delivery by the untrained personnel also leads to higher mortality rate. The household size indicates household vulnerability leading to poor socioeconomic development which also leads to child and maternal mortality.

4.15.4 Ownership and utilization of land

The Census of Agriculture, 2008 conducted by BBS classified land holdings into two broad categories one is farm-holdings and another is non-farm holdings. A farm holding is defined as being an agricultural production unit having cultivated land equal to or more than 0.05 acre. Conversely, non-farm holding includes landless households and households having lands up to 0.04 acre. The study area shows that out of total holdings 51.5% is farm-holder and the rest 48.5% is non-farm holders.

According to BBS 2008 data on land holding distributions, in the study area 4.7% households are absolute landless i.e. they have no lands either homesteads or cultivated. 43.7% households belong to functional landless category, who have land up to 0.04 acres. Among them 41.7% households have only homestead lands and 2% have homestead plus farm land within the limit of 0.04 acre These households mainly own land adjacent to their homestead and being used as kitchen garden that are primarily used by the female members for household consumption.

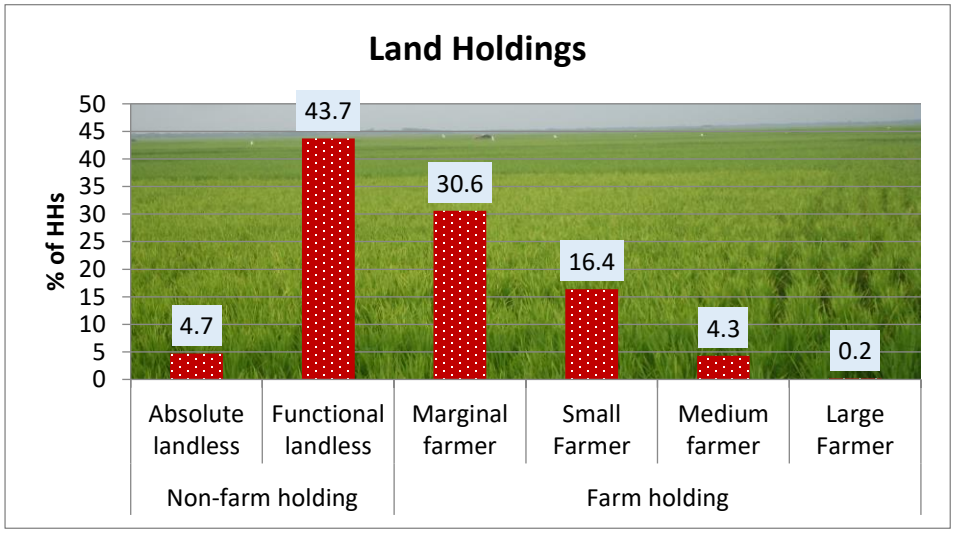


Figure 1.15-6: Households by land holdings
Source: The Census of Agriculture, 2008, BBS

On the other hand, farm holding distribution shows that 30.6% households belong to marginal farmer (0.05 to 0.99 acre), 16.4% belong to small farmer (1.00 to 2.49 acre), 4.3% belong to medium farmer (2.5 to 7.49 acre) and 0.2% belong to large farmer (7.5+ acre) categories. It is evident that land fragmentation decreases the holding size therefore; large and medium farmers are gradually being converted to marginal farmers.

In land tenure arrangement of farm holdings, it was found that 66.7% households belong to owner category, and they belong to various landownership categories such as marginal (61.5%), small (29.1%), medium (8.9%) and large (0.5%) land holders. It is evident that most of the owners

are marginal and small landowners therefore; their lands are usually operated by themselves. A few from medium and large owners tend to lease out their lands to the tenants.

Table 1.15-2: Land tenure arrangement in the study area

Tenancy type	Farmer by holding category (%)				Total
	Marginal	Small	Medium	Large	
Owner	61.5	29.1	8.9	0.5	66.7
Owner-cum-Tenant	54.7	37.7	7.4	0.2	32.3
Tenant	81.8	16.7	1.5	0.0	1.0

Source: The Census of Agriculture, 2008, BBS

The second dominant category is owner-cum-tenant which accounts 32.3% of the households. It comprises of 54.7% marginal, 37.7% small, 7.4% medium and 0.2% large land holders. As it is documented that small and marginal farmer is predominant (47% out of total farm holding), this owner-cum-tenant farm holder is to operate by leasing and or sharecropping to maintain their livelihoods. However, it is surprising that although the study area has a substantial percentage of landless households (48.5%) (both absolute and functional), only 1% is tenants those are belonging mostly to marginal category. Field data proved that this large numbers of landless populations usually adopt alternative livelihood options, for instances; farm and non-farm laboring, driving, working for industries and other manual works.

1.15.5 Occupations and livelihoods

Out of total 330,307 population, about 29.5% are economically active which include 41.4% employed, 0.4% are looking for work, and 38.4% engaged in household work.

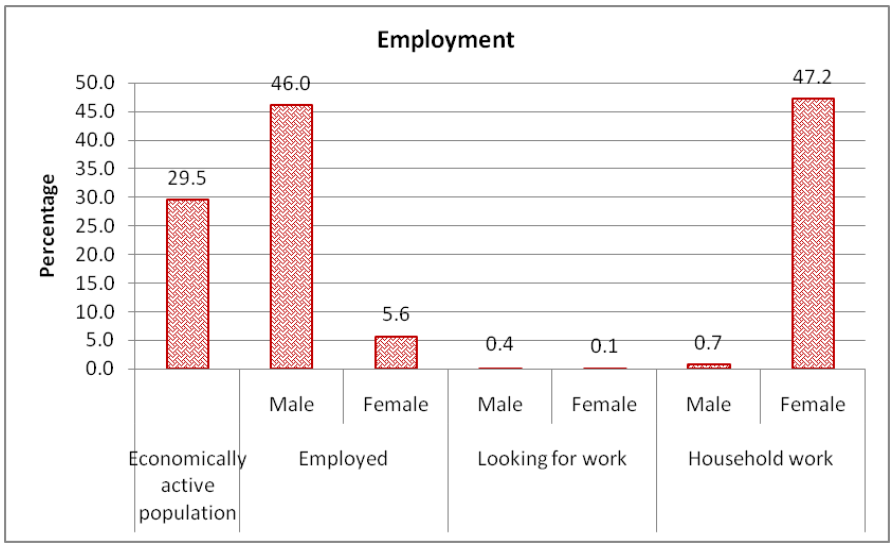


Figure 1.15-7: Employment Status
Source: Housing and Population Census, BBS, 2011

Distribution of employed population at reference period of the 2011 census shows that 16% are engaged in agricultural activities, 10% in industry and 15% in service.

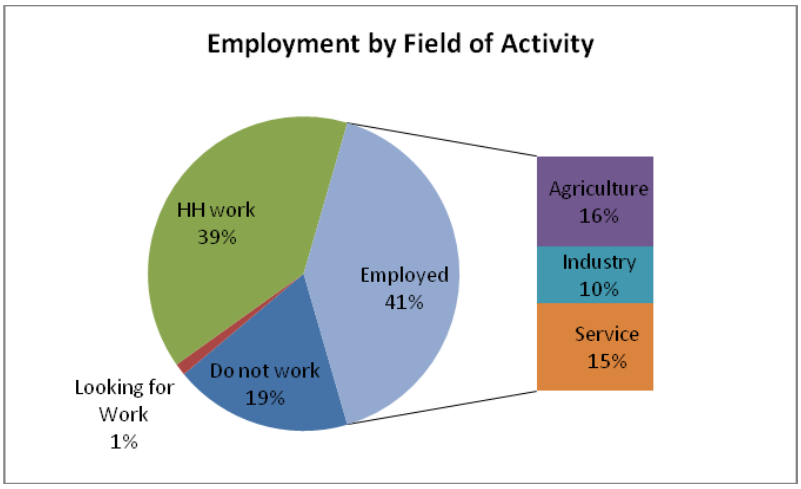


Figure 1.15-8: Employment status by field of activities

Source: Housing and Population Census, BBS, 2011

1.15.6 Labor Market

The employment[3] rate[4] in the study area is 51.6 whereas the unemployment rate[5] is 48.4. It is evident that about half of the total economically active population is still unemployed. Most of the unemployment populations are females who are solely involved in household work, and only 0.5% populations are looking for work.

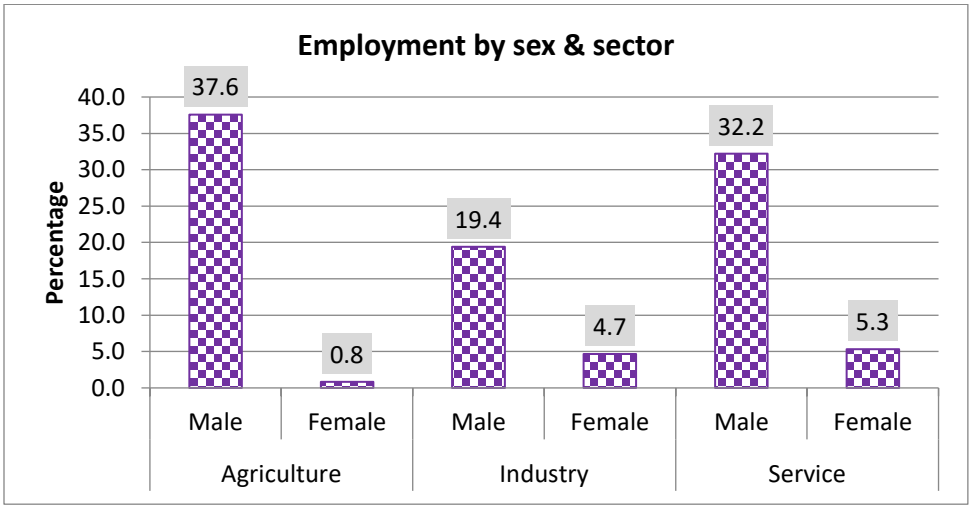


Figure 115-9: Distribution of population by sex and field of activity

Source: Housing and Population Census, BBS, 2011

[3] The ILO defines employed persons of those who, (1) do any work at all as paid employees, work in their own business or profession or on their own farm, or work 15 hours or more as unpaid workers in a family-operated enterprise; and (2) all those who do not work but had jobs or businesses from which they were temporarily absent due to illness, bad weather, vacation, childcare problems, labor dispute, maternity or paternity leave, or other family or personal obligations — whether or not they were paid by their employers for the time off and whether or not they were seeking other jobs.

[4] Employment Rate = $\frac{Employed\ Population}{Total\ labour\ force} X\ 100$

[5] Unemployment Rate= 100-Employment Rate

The above figure demonstrates that female participation in industry and service sectors is higher (10%) than that of agriculture (0.8%). According to our field research women involved in the industrial sector mostly work in textile industries.

Wage level varies regarding type of work. In agricultural sector laborers get daily wages in the range of Taka 300-400, whereas in industrial sector mostly textiles workers receive per day/per production basis. However, the trained group working for power plant received comparatively higher wages.

During field visit, people stated that there is no in-migration of laborers for agricultural sector. However, in the industrial sector a number of in-migrant laborers are working, but this trend is gradually increasing.

1.15.7 Standard of living

The study area shows the predominance of kutcha houses (66%) compared to other three types of houses such pucka, semi-pucka and jhupri. 23% houses are semi-pucka, 10% pucka and one percent is still jhupri. Most of the pucka houses are located in municipal areas, whereas semi-pucka are predominant at the peripheral areas of municipality. Kutcha houses are predominant in the rural area. Settlement pattern is shown in Figure-1.15-11 and distances of growth center and rural bazaars are shown in Figure 1.15-12.

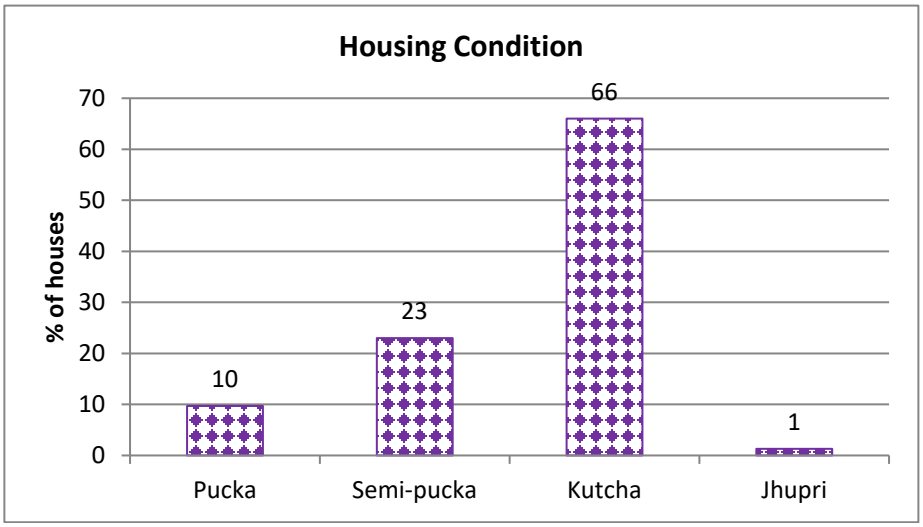


Figure1.15-10: Housing condition in the study area

Source: Housing and Population Census, BBS, 2011

Housing status of the study area

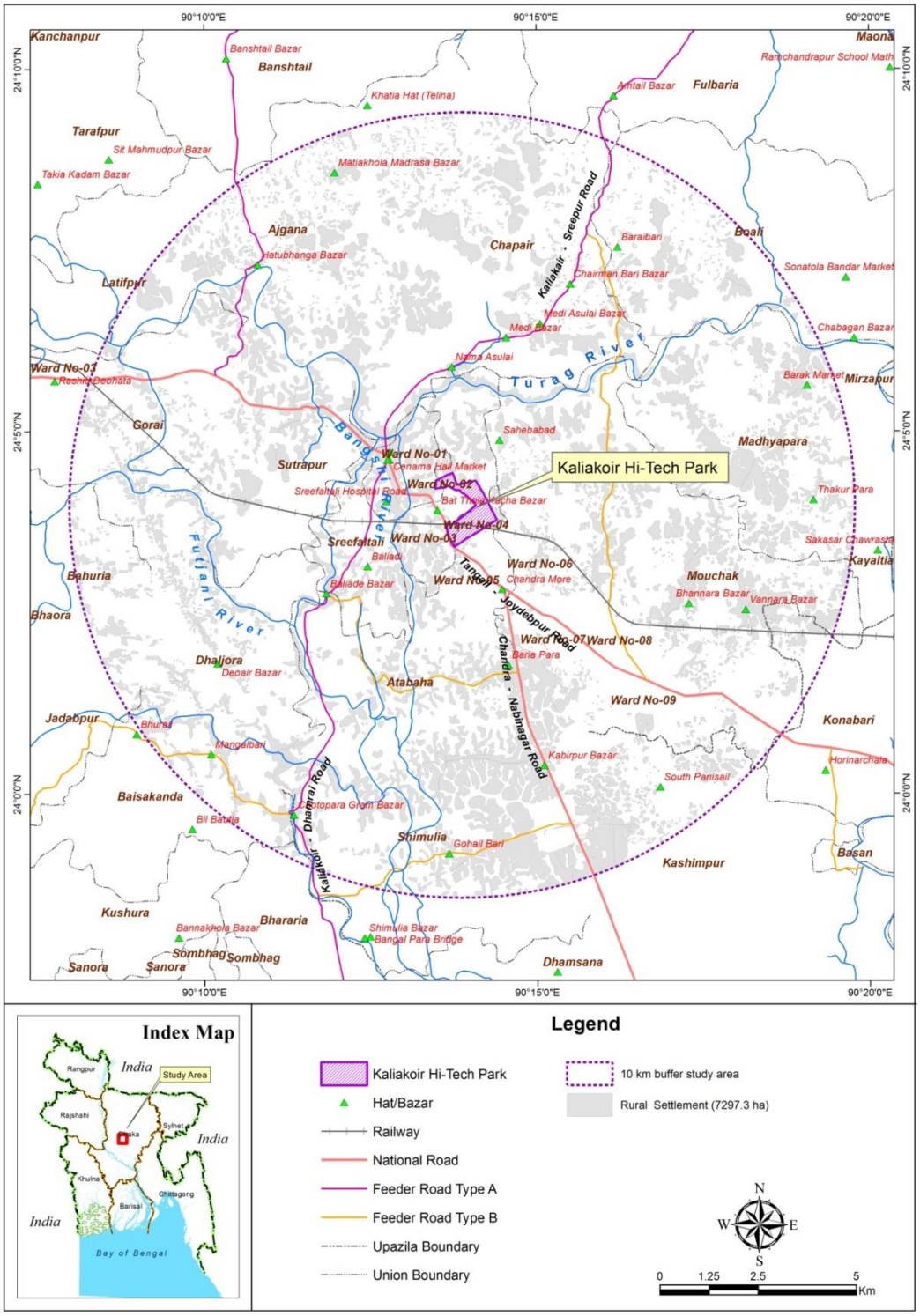


Figure 1.15-11: Settlement Pattern of the Study Area

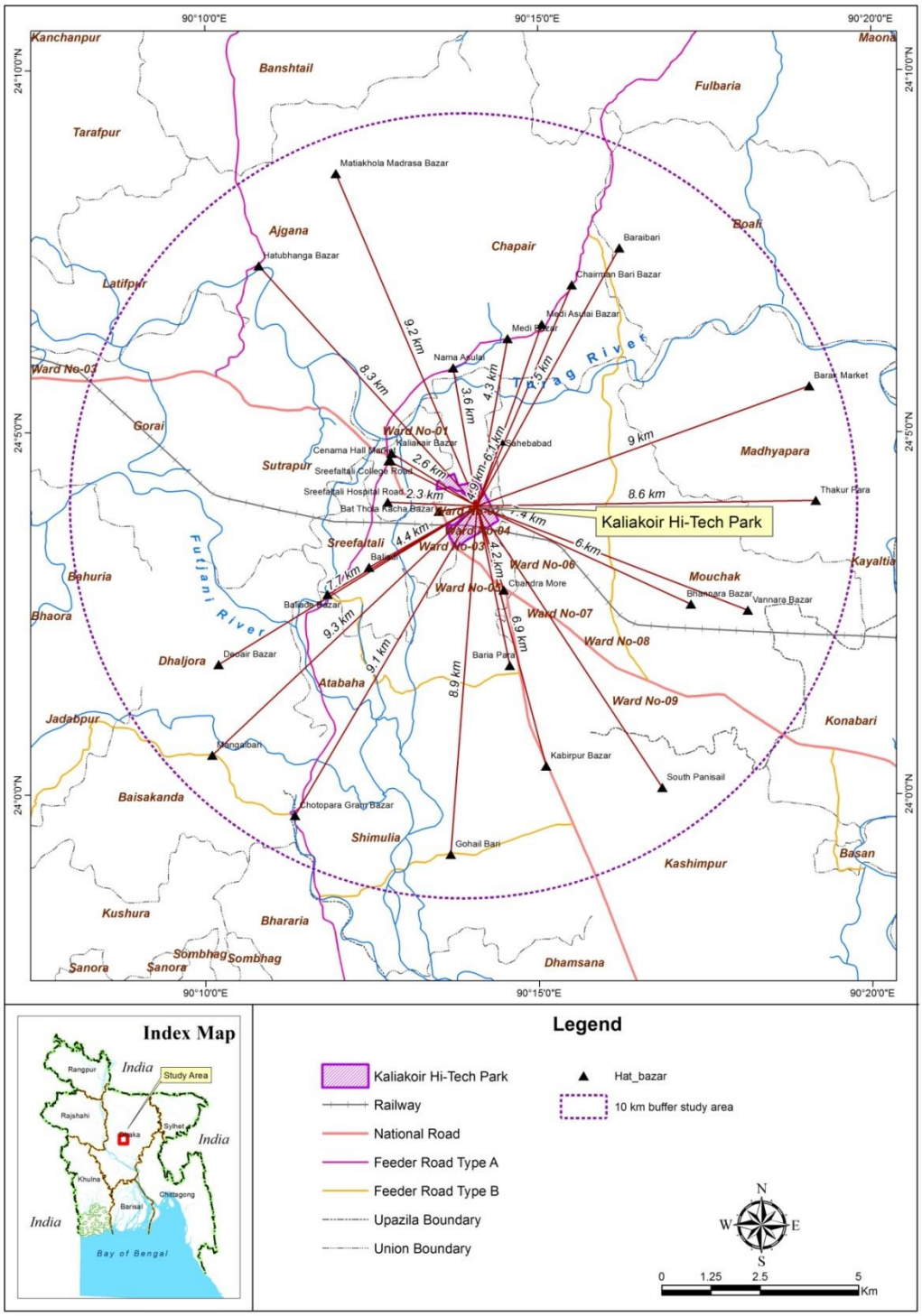


Figure 1.15-12 Distances of growth center and rural bazaar from the site

In the study area 33% households use non-sanitary latrines, 44% use non water-sealed sanitary latrines and 19% use sanitary water-sealed latrines. However, there are 4% houses, which have no sanitation facilities but tend to use sanitary facilities on shared basis and in some cases use open spaces (Figure 1.15-13).

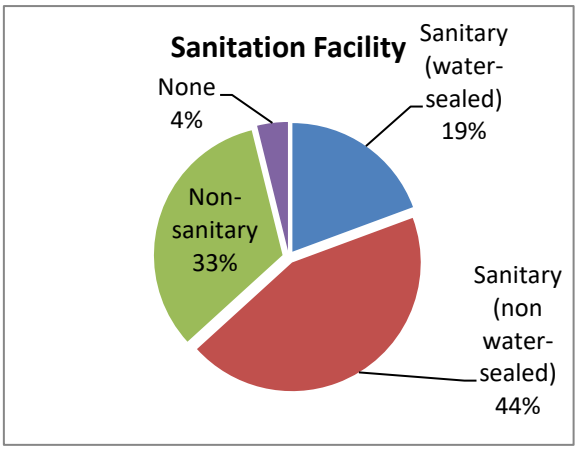


Figure 1.15-13 : Distribution of households by sanitation facilities

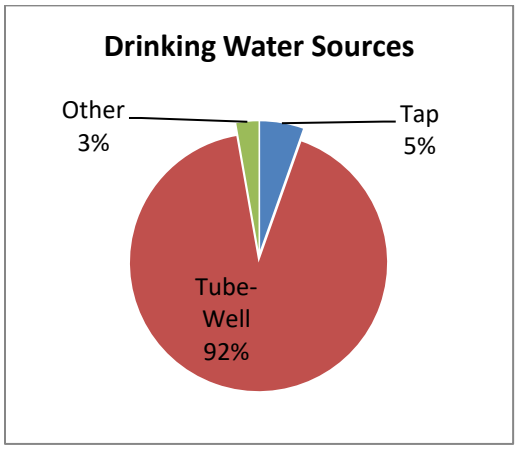


Figure 1.15-14: Distribution of households by sources of drinking water facilities

Source: Housing and Population Census, BBS, 2011

Collection of drinking water from tube-well is predominant (92%) throughout the study area. Supply of "tap water" is mainly used in municipal areas on rental basis. This supply system is dependent on abstraction of ground water. However, 3% households are still depending on open water bodies as sources of drinking water.

Fuel consumption shows that almost all houeholds located within the municipal area have gas supply. However, hoseuholds in rural area usually use firewood, cowdung, chips for fuel etc.

1.15.8 Social Safety Nets and Poverty Reduction Measures

The major social safety nets and poverty reduction programs initiated in the area include the Vulnerable Group Development, Food/Taka for Work (F/TFW), Food for Education/Cash for Education, Rural Maintenance Program (RMP), Old Age Allowance, Freedom Fighter Allowance and Integrated Poverty Reduction Program. These programs have created food security as well as social safety nets among the targeted poor households and vulnerable communities (Table 1.15-3).

Table 1.15-3: Households served by different social safety nets programs

Social Safety Net Programs	Households/Communities Served (%)
Vulnerable Group Development (VGD)	5
Food/Taka For Work (F/TFW) of PIO	3
Food for Education/Cash for Education	9
Rural Maintenance Programme (RMP)	5
Old Age Allowance	4
Freedom Fighter Allowance	2
Integrated Poverty Reduction Program of BRDB	5

Source: Field survey, 2016

A number of local, national and international NGOs are working in the Project area. The main activities of these NGOs are to operate micro credit programs among the rural poor and landless women/men. The major NGOs working in the area include BRAC (Bangladesh Rural Advancement Centre), ASA (Association for Social Advancement), Muslim Aid UK, CARE and

Grameen Bank etc (Table 1.15-4) about 30 percent of households are found to benefit from the NGOs interventions.

Table 1.15-4: NGOs and their programs in the study area

NGO	Type of Programs							
	Credit	Education	Water and Sanitation	Health	Human Rights	Gender	Children	Disaster
BRAC	✓	✓	✓	✓	✓	✓	✓	-
ASA	✓	✓	-	-	✓	✓	-	-
Grameen Bank	✓	✓	✓	-	✓	-	✓	-

Source: Field survey, 2016

1.15.9 Social Conflicts

There is no social conflicts are existing in the study area without some separated incidents (political and family related).

1.15.10 Gender Concern

Gender issue holds most important place in recent research question. It is found in the study area that women have very little contribution in income generating activities. However, they enjoy other rights like men such as education; health etc. male female literacy rate is almost equal in the study area. In some cases literacy rate is higher than national level.

Attendance rate at the age of six to ten years is commonly found that is primary level. Considering higher education attendance rate is going to be reduced for both sexes. In the study area, women's activities are considered trivial and tended to confine them to household chores only. Male members are responsible for providing all sorts of amenities for household members. They considered themselves as the sole bread earners in the family. Usually women's activities are recognized as secondary since they are not linked directly to income generating activities.

However, this scenario, though slowly, is changing nowadays. Women's literacy rate is increasing gradually. They can join social activities outside of their home. It is assumed that this will change in near future.

ANNEX-II: ANTICIPATED ENVIRONMENTAL AND SOCIAL IMPACTS

2.1 INTRODUCTION

As a part of the Environmental and Social Impact Assessment (ESIA), environmental impacts of the specific project activities on different ecological, physicochemical and human interest related parameters, both during the construction phase and the operation phase, have been identified and assessed. The proposed project involves construction of a Hi-Tech Park in Kaliakoir, Gazipur.

Detailed description of the project has been provided in Chapter 2 of this report. The baseline environment of areas within the surrounding of the project site has been presented in Chapter 4. This Chapter presents an assessment of the potential significant impact of the proposed project on the surrounding baseline environment during both construction and operational phases.

2.2 POTENTIAL SIGNIFICANT IMPACT

The entire land of the BHTC is government owned khas land. The Government through the ministry of ICT has developed the land and segregated into five blocks. Later the BTL has awarded block-3 through competitive bidding for developing the infrastructures including buildings and other ancillary facilities. Due to the land development there was no identified Project Affected Persons (PAPs) in the project area. BTL has received a developed land from the Government so the environmental impact due to land development would be beyond the scope of this report.

Potential significant environmental impacts from the development of the Hi-Tech Park have been identified with respect to the major activities to be carried out as part of this project these include:

a) Infrastructure (e.g., buildings, roads, drainage and cable network, and water supply system) development, and
b) Operational phase of the project.

All the major environmental parameters covering ecological, physico-chemical and human interest related aspects were considered in identifying the potential impacts due to the three major project activities listed above. Checklists of the environmental parameters for each of the major activities have been presented in Tables 2.2-4, 2.2-5 and 2.2-7. In the checklists, the magnitude of environmental impacts has been classified as none, low, minor, moderate and critical. Long-term and short-term impacts (identified as L and S, respectively) as well as reversible and irreversible (identified as R and I, respectively) have also been identified in the checklist.

Table 2.2-1: **Consequence (Impact) Severity Ranking (Project site level)**

Environmental Effects				
Low	**Minor**	**Moderate**	**Major**	**Critical**
No lasting effect. Low level impacts; on biological environment. Limited damage to minimal area of low significance	Minor effects on biological environment. Minor short medium term damage to small area of limited significance	Moderate effects on Biological environment but not affecting ecosystem function. Moderate short medium term widespread impacts	Serious environmental effects with some impairment of ecosystem function (e.g. displacement of species). Relative widespread medium – long term impacts.	Very serious environmental effects with impairment of ecosystem function. Long-term, widespread effects on significant

Environmental Effects				
Low	**Minor**	**Moderate**	**Major**	**Critical**
				environment (e.g. unique habitat, national park)

Table 2.2-2: Likelihood Ranking

Likelihood	Description	Frequency Description
Almost certain	Consequence expected to occur in most circumstances	High frequency of occurrence – occur more than once per month
Likely	Consequence will probably occur in most circumstances	Regular frequency. Event likely to occur at least once per year
Possible	Consequence should occur at some time	Occurs once every 1 – 10 years
Unlikely	Consequence could occur at some time	Unlikely to occur during life of operations – occurs once every 10 – 100 years
Rare	Consequence may occur under exceptional circumstances	Highly unlikely to occur during life of the operation. Occurs less than once every 100 years

Table 2.2-3: Risk Assessment Matrix

Likelihood/ Frequency	Consequence Severity				
	Low	**Minor**	**Moderate**	**Major**	**Critical**
Almost certain	High	High	Extreme	Extreme	Extreme
Likely	Moderate	High	High	Extreme	Extreme
Possible	Low	Moderate	High	Extreme	Extreme
Unlikely	Low	Low	Moderate	High	Extreme
Rare	Low	Low	Moderate	High	High

2.2.1 Environmental Impact during Construction Period

It has observed that there will be no severe adverse environmental impact due to project construction activities. Most of the adverse impacts listed in Table 2.2-4 are reversible in nature and could be mitigated or removed with appropriate environmental management. A number of positive impacts in the form of increased service facilities, employment, transportation of people and goods are expected during the construction phase.

Table 2.2-4 Checklist for Environmental Impacts resulting from Construction Activities

Environmental Parameters	Environmental Assessment						
	Positive Impact	No Impact	Adverse Impact				
			Low	Minor	Moderate	Major	Critical
A. Ecological							
Fisheries				S, R			
Aquatic Weeds				S, R			
Eutrophication				S, R			
Wetland				I			
Bushes/trees				I			
Animals			I				
Species Diversity		√					
Endangered Species		√					
B. Physico-chemical							
Erosion and siltation		√					

Environmental Parameters	Environmental Assessment						
	Positive Impact	No Impact	Adverse Impact				
			Low	Minor	Moderate	Major	Critical
Flooding			S, R				
Drainage congestion			S, R				
Air pollution				S, R			
Noise pollution					S, R		
Solid Waste					S, R		
Water pollution				S, R			
C. Human interest related							
Loss of agricultural land			I				
Resettlement		√					
Service facilities	S						
Health and Nutrition			S, R				
Navigation		√					
Transport	S						
Employment	S						
Land ownership pattern		√					
Landscape			S, R				
Industrial Activities	S						

Description of Potential Ecological Impacts:

Impact on Fauna including Fish:

Construction activities related to the proposed Hi-Tech Park project could have potential impacts (direct and indirect) on the existing aquatic and terrestrial fauna due to their highly sensitive and reactive behavior in response to disturbance that may occur at or near their habitat. Faunal species that are sensitive to direct (human activity and traffic) or indirect disturbance (noise) would be impacted most. Habitat disturbance would reduce habitat availability and effectiveness for a certain period for mammals, reptiles, amphibians, birds and their predators. There are also some possibilities of direct mortality and displacement of amphibians, reptiles, birds and mammals from the use of vehicle or machineries over terrestrial or aquatic faunal habitats. Quantification of these losses is difficult; however, the impact is expected to be low and short-term in nature.

Various type of project activities near fish habitats (e.g. lake) may also have some potential impact on fish e.g. mortality, disturbance of fish passage during monsoon, deposition of excavated soil on fish habitat (e.g. existing lake), contamination of water, destruction of shallow fish habitat or saturated ground by movement of project vehicles, etc. Impacts on fish could be quite difficult to assess immediately, but availability of some indicative fish species could be monitored by which impacts could be evaluated.

Impact on Amphibians:

Amphibians are more sensitive to the environmental changes due to their permeable skin and other biological features. Amphibians use both aquatic and terrestrial habitat for their survival

and changes in characteristics of habitat have a great impacts for their survival. Some of the project activities could have some impacts on existing amphibians such as:

- ✓ undergrowth or vegetation may be cleared for construction works, affecting amphibian habitat;
- ✓ project vehicle and materials may enter into the shallow freshwater bodies or saturated ground affecting habitat; and
- ✓ increased sediment load or contamination of water due to various project activities, also affecting habitat.

These activities may cause temporary or permanent disturbance of amphibian habitat. Impacts on amphibian population could be evaluated by monitoring the changes of species composition and richness and their relative abundance.

Impact on Aquatic Flora:

Due to proposed project activities (e.g. conversion of low land to high land), some aquatic flora may have to face potential adverse impacts. If project activities run over an aquatic floral habitat, partial or entire aquatic flora may be damaged or destroyed. People, vehicle and material movement over the aquatic floral habitat may cause damage or uproot them from the ground.

Impact on Terrestrial Flora:

Little undergrowth (no tree) with less terrestrial floral diversity exists in the proposed project site. This undergrowth should be removed for project completion. Terrestrial undergrowth has great contribution to the existing ecosystem, and clearing or removal of the undergrowth would also have some adverse impacts. On the other hand, the project study areas have moderate number of terrestrial habitat to support terrestrial floral species, though none of them are threatened in Bangladesh.

Terrestrial flora of the Project Area

Most of the floral species are planted by the local Govt. (roadside plantation) and local people (private plantation) for their livelihood, and these are common throughout the project study areas, and seem not to be impacted by this project.

Impact on Reptiles

Reptiles are sensitive animal and sometimes used as indicative species for bio-environmental assessment. Burrowing reptiles are sensitive and respond quickly to any man-made or natural activities/calamities. Special care should be taken before conducting any activity in and around the habitats of these animals. If the project activities are conducted during pre or post breeding season of the burrowing reptiles, the entire community could be affected seriously or their life cycle could be jeopardized. To evaluate impacts on reptilian species, relative abundance and changes in species composition could be used as indicators.

Potential Impact on Birds

Potential impacts of project activities on birds include disturbance due to project related actions and excessive human presence during bird's foraging, resting and nesting time that might result in reproductive disturbance / failure. Removal of floral (tree, herb and shrub) species for the proposed project would affect some bird habitat from where they collect food (insects), take rest and also build nests. Potential impacts for those bird species include:

- habitat destruction,
- temporary displacement due to increased human disturbance and vehicle movement, and
- nest abandonment and/or reproductive failure caused by project related disturbance.

Birds nest within the BHTC

Table 2.2-5 Summary of Environmental Matrix

Ecological Issues	Potential Impact (Consequence)	Consequence Severity Ranking	Impact Likelihood Ranking	Risk Rating
Flora	Minor impact to flora may occur. Construction of HTC may displace or remove terrestrial/ aquatic undergrowth /floral species; Such type of undergrowth is available in the proposed project adjacent areas. As these are grows naturally and seasonality, no plantation program required; hence no major effects are expected.	Low	Possible	Low
Fauna	Minor impacts (temporary displacement) to all types of fauna. Construction of HTC has negative impacts (e.g., habitat loss).	Low	Possible	Low

Ecological Issues	Potential Impact (Consequence)	Consequence Severity Ranking	Impact Likelihood Ranking	Risk Rating
	Since the activities are temporary in nature, no major or long-term effects are anticipated, except loss of some habitat.			
Fish	Low impact to fish community may occur; Minor impact may also occur due to deposition of excavated soil on fish habitat (e.g. existing lake), contamination of water, destruction of shallow fish habitat or saturated ground by movement of project vehicles, etc. But the impact is short term and reversible. The nearby fish communities will temporarily be impacted. The majority of impacts would be temporary in nature; fish may avoid the impacted areas during construction period, but return when it ceases.	Low	Possible	Low

Description of Potential Socio-economic Impacts:

Most important social parameters considered for assessment of social impacts of the proposed HTC project include loss of agricultural land and income, transportation and safety, employment and commercial activities. The effects of the project activities on these parameters have been evaluated.

Loss of Agricultural Land

Land acquisition has significant adverse social impacts, and therefore, special care needs to be taken to minimize land acquisition with proper compensation as per Government rules and regulations and World Bank policies. No land acquisition will be required for this HTC project since it is being implemented on Government own land.

Loss of Income

Loss of income may result from inability to use a particular piece of land/establishment (e.g., agricultural land; road-side shops) during the construction phase for income generation activities. Since, the HTC project is being implemented on Government owned land and there would be no direct loss of income as the project area is not being used for any income generating activities of the local people. But there may be minor inconveniences of the people to carry out their income generating activities around the project area. Efforts should be made to keep such disturbance to a minimum (e.g., scheduling construction keeping in mind agricultural/fishing practices in the area) and provide proper compensation for any unforeseen loss of income (if any).

Crossing of Roads

Road will be used to carry the HTC construction materials. Temporary disruption of road traffic and commutation is anticipated. Possible traffic congestion resulting from movement of vehicles carrying material and equipment should be addressed with proper traffic management, and

avoiding stockpiling of materials in a way that could hamper traffic movement. Traffic safety issues also should be given utmost importance.

Public Health and Safety Issues

Safety (including occupational safety) is an important issue during construction of HTC. Construction activities near village road could increase risks to pedestrian and vehicular movement. Scheduling of construction works and delivery of construction material and proper management of traffic are very important to minimize such impacts. Safety issues (particularly occupational health and safety) are also important for general construction activities, which should be addressed as part of occupational health and safety plan. Accident during construction phase is also an important issue. Proper measures including regular maintenance of equipment and use of protective gear are needed to reduce the risk of such accidents during the construction phase.

Employment

Some job opportunities will be created for labors as well as skilled manpower (including engineers) for construction of the proposed project. Construction of infrastructures will require relatively small number of skilled personnel and laborers.

Impact on Indigenous/tribal people

No indigenous or tribal people were observed in the project area and therefore World Bank OP 4.10 will not be triggered.

Description of Potential Physico-chemical Impacts:

Major physico-chemical parameters considered for assessment of environmental impacts of project activities include drainage congestion, air and noise pollution, sanitation and solid waste, water pollution. The effects of the project activities during construction phase on these parameters have been assessed.

Water Quality

The HTC has surface water body which is known as lake. And nearby Bangshi river which is almost 2km to the north-west is not directly connected to the HTC. The lake may be susceptible to pollution from construction related activities, e.g., accidental spills of chemicals (e.g. oil/grease), materials and contamination by discharge of wastes from workforce (e.g. from labor sheds) during the construction phase. Care should be taken to avoid such contamination, especially because many of these water bodies are important for fisheries, which could be adversely affected by water pollution. Construction activities will increase turbidity of the lake water. This would reduce light penetration, thereby interfering with the photosynthetic process; this may in turn adversely affect the aquatic ecosystem, including fisheries resources. However, since the construction will cover a relatively small area of the lake, these effects are not likely to be significant.

Noise and Air Pollution

Some noise and air pollution could result from excavation and other construction activities. Noise generated by construction activities will typically be for a short duration with minor adverse impact. During the construction phase of the proposed HTC project, the important sources of emissions would include those from the operations of construction equipment and machineries, vehicles carrying construction materials to the site and taking construction debris out of the site. If construction equipment, such as stone (aggregate) crushers is used at the site, this may result in significant emission of particulate matter during its operation. Since construction of the proposed HTC project would most likely involve significant earthworks, increase in particulate matter in the air from wind-blown dust is also a concern, especially considering the close proximity to the nearby residential area.

Sanitation and Solid Waste including e-waste

Problems related to sanitation and solid waste may result from improper/inappropriate facilities at the labor sheds. Lack of proper sanitation facilities for project people, including the labor/construction worker and absence of proper solid waste (e.g., food waste, construction debris) disposal facilities may create an unhealthy environment within and around the project sites. Use of unsanitary latrines and improper disposal of human waste would create environmental pollution and adversely affect health and wellbeing of the people at the construction site by increasing the risk of disease transmission. Construction debris and wastes to be generated during the construction phase would include scrap iron, steel, wooden frames, piping, and other solid wastes. Most of it will be generated toward the end of the construction phase during carrying out of the finishing works, while the site will be cleared of waste materials. The volume of such construction wastes is likely to be significant. Indiscriminate storage and disposal of these construction debris and wastes could create local water logging and ponding by blocking drainage lines and would be aesthetically displeasing.

Drainage Congestion

Since the construction phase involves significant earthwork, there are chances of stagnation and ponding of storm water if care is not taken for proper drainage of storm water.

Impact on Historical and Cultural Resources

The field surveys found no archaeological or historical sites that would be affected by the construction of the HTL. Buildings and properties of historical importance are very far away from the proposed site will not be directly impacted.

World Bank Operational Policy for Physical Cultural Resources (OP 4.11) will be triggered when the proposed construction inadvertently encountered any buried cultural deposits. In that case Fiber@Home and its contractor will halt construction in that vicinity and immediately follow the protocols suggested in Annex-VI.

2.2.2 Environmental Impact during Operation Period

It has observed that there will be no severe adverse environmental impact during the operation phase of the project. On the contrary a number of positive impacts in the form of service facilities

and employment, commercial activities, transportation of people and goods, etc. are expected. In addition, enhancement of fisheries resources would be possible through planned lake development, especially in Block-V. Plantation activities would make the Park area greener and would have a positive impact on the environment. Better physical and socio-economic environment is expected to improve the general health and nutrition of the people in and around the Park area.

Table 2.2-6 Checklist for Environmental Impacts resulting from Operational Phase of the Project

Environmental Parameters	Environmental Assessment						
	Positive Impact	No Impact	Adverse Impact				
			Low	Minor	Moderate	Major	Critical
A. Ecological							
Fisheries	L						
Aquatic Weeds		√					
Eutrophication			L				
Wetland		√					
Bushes/trees	L						
Animals		√					
Species Diversity		√					
Endangered Species		√					
B. Physico-chemical							
Erosion and siltation		√					
Flooding		√					
Drainage congestion		√					
Air pollution					S		
Noise pollution					S		
Solid Waste					S		
E-Waste					S		
Water pollution					S		
C. Human interest related							
Loss of agricultural land		√					
Resettlement		√					
Service facilities	L						
Health and Nutrition	L						
Navigation		√					
Transport	L						
Employment	L						
Land ownership pattern	L						
Landscape	L						
Industrial Activities	L						

Noise Impact

Prolonged exposure to high level of noise may cause significant damage to human hearing organ and may cause neurological damage. OSHA noise exposure limits for the work environment

provides a guideline for the time of noise exposure at the work environment which may be adopted to prepare an environmental management plan.

Noise assessment during the operational phase of HTC is important to understand the noise level of the working environment. Due to the generator there will be significant noise in the HTC.

Air Quality Impact:

As there will be generator for generating power supply to the HTC, so the exhaust emission needs to be monitored.

Water Quality Impact:

Water quality impact would be due to sewage discharge generated from residential areas, probable industrial wastewater (water used for washing may contain heavy metals, organic chemicals from industrial processing). Lake water quality should be checked periodically to make sure that the surface water quality is guided by the national and IFC guided standard and guidelines.

Solid Waste Impact:

The sources of solid waste at BHTC shall include residential, commercial, institutional, and IT/ITES industrial activities. All nonhazardous solid waste from a community that requires collection and transport to a processing or disposal site is called refuse or municipal solid waste (MSW).

Refuse includes garbage and rubbish. Garbage is mostly decomposable food waste; rubbish is mostly dry material such as glass, paper, cloth, or wood. Garbage is highly putrescible or decomposable, whereas rubbish is not. Trash is rubbish that includes bulky items such as old refrigerators, couches, or large tree stumps. Trash requires special collection and handling.

Construction and demolition (C&D) waste (or debris) is going to be a significant component of total solid waste quantities (about 20 percent in the United States) of BHTC, although it is not considered to be part of the MSW stream. However, because C&D waste is inert and nonhazardous, it is usually disposed of in municipal sanitary landfills.

E-Waste Impact:

Disposal of E-wastes without appropriate measures can cause environmental pollution. Lack of awareness or lack of cautionary information for handling or re-using of these expiry products can leave people expose to health hazards. E-waste is threatening the soil contents and causing land less productive to produce crops.

Health Hazard and Occupational Safety

Hazardous materials stored and used at combustion facilities in HTC include facility maintenance chemicals (e.g., paint certain types of lubricants, and cleaners). Handling and storage of these chemicals, accidental leakage and spilling would pose health and safety concerns for the persons involved. Besides, there would be other hazards related to non-ionizing radiation, heat, noise

inside the workplace, electrical hazards and fire and explosion hazards. A comprehensive health and safety guideline should be followed in order to reduce health hazard.

Beneficial Impacts, Employment and Commercial Activities

Overall, it can be concluded that no environmental component will be severely affected negatively as a result of the project activities. Socioeconomic environment can be considered to be affected positively as the project activities will create new job opportunities for the local people and local commerce and business will get a big boost from the project. All these impacts are likely to contribute to improve the quality of life of the local community, in addition to contributing to national economic growth by initiating "knowledge intensive" industrialization.

2.3 IMPACT EVALUATION

A simple semi-quantitative descriptive checklist method has been applied to evaluate the potential environmental impacts. Firstly, the activities during construction and operation were identified and listed in the impact table. Then the corresponding impacts on the specific ecological components (terrestrial and aquatic flora and fauna, fish), socio-economic parameters and physico-chemical environment attributes were evaluated based on the baseline scenario and an assessment of the typical interactions with HTC project activities. Assessments were made as to whether the impacts were positive (beneficial) or negative (harmful), short-term (short recovery time) or long-term (extended recovery time); and of high or low/moderate intensity. The results of the assessment are summarized in Tables 2.3-1, 2.3-2 & 2.3-3.

Table 2.3-1 Evaluation of ecological impacts ensuing from different project activities

Sources of Potential Impacts	Ecological Issues										
	Flora		Fish	Fauna							
				Amphibian		Reptile		Bird		Mammal	
	AQ	TR		AQ	TR	AQ	TR	AQ	TR	AQ	TR
A. Construction Phase											
Camp Setting	0	-1S	0	0	-1S	0	-1S	0	-1S	0	-1S
Access Road Construction for Camp	-1S	-1S	0	0	-1S	0	-1S	0	0	0	-1S
Land Clearing	-1S	-1S	0	-1S	-1S	-1S	-1S	0	-1S	0	-1S
Soil Excavation	-1S	-1S	-1S	-1S	-1S	0	-1S	0	0	0	-1S
Generation of Noise	0	0	-1S	-1S	-1S	-1S	-1S	-1S	-1S	-1S	-1S
Deterioration of Water Quality	0	0	-1S	-1S	-1S	-1S	0	-1S	0	-1S	0
Sewage Discharge on Soil/Water	-1S	0	-1S	0	-1S	0	0	0	0	0	0
B. Operation Phase											
Solid Waste Disposal	-1S	-1S	-1S	-1S	-1S	-1S	-1S	-1S	-1S	-1S	-1S
E-Waste Disposal	-1S	-1S	-1S	-1S	-1S	-1S	-1S	-1S	-1S	-1S	-1S

[Legend : AQ = Aquatic; TR = Terrestrial; 0 = No impact (negligible impact), 3 = High impact, 2 = moderate impact, 1 = Low impact, S = Short term impact, L = Long term impact, +/- = positive/negative impact]

Table 2.3-2: Socio-economic impacts from activities associated with the Construction and operation of HTC

Project Activities		Socio-economic Impacts				
		Loss of Land and income	Traffic (road and Rail)	Impact on indigenous/ tribal people	Public Health and safety	Employment and commercial activities
A. Construction Phase	Construction noise	0	0	0	-1S	0
	Labor camp setting	0	0	0	0	+2S
	Land clearing	0	0	0	0	+2S
	Soil excavation	0	0	0	-1S	+2S
	Piling work	0	0	0	-1S	+2S
	Concreting work	0	0	0	-1S	+2S
	Local road use	0	-1S	0	-1S	+1S
	Provision for safe water and sanitation facilities for workers	0	0	0	+2S	0
B. Operation Phase	Solid Waste Disposal	0	0	0	-1S	0
	Power Generator	0	0	0	-2S	0
	Waste Water Generation	0	0	0	-2S	0
	E-Waste Disposal	0	0	0	-1S	0

[+3 = High Positive Impact, +2 = Moderate positive impact, +1 = Low Positive Impact, 0 = No impact, -1 = Low Negative Impact, -2 = Moderate Negative Impact, -3 = High Negative Impact S = Short term impact, L= Long term impact]

Table 2.3-3: Physico-chemical impacts from activities associated with the construction and operation of HTC

Project Activities		Physico-chemical Impacts						
		Drainage congestion	Noise level	Air quality	Surface Water quality	Groundwater quality	Physical cultural	Soil quality
A. Construction Phase	Labor camp setting and its operation	0	0	0	-1S	-1S	0	0
	Access road construction	-1S	-1S	-1S	-1S	0	0	0
	Land clearing	-1S	0	0	0	0	0	0
	Soil excavation	-2S	-2S	-2S	-1S	0	-1S	-1S
	Piling work	0	-2S	-1S	-1S	-1S	-1S	0
	Concreting work	0	-2S	-1S	0	0	0	0
	Provision for safe water and sanitation facilities for workers	0	0	0	0	0	0	0
B. Operation Phase	Solid Waste Disposal	0	0	0	-1L	-2L	0	-2L
	Power Generation	0	-2S	-2S	0	0	0	0
	Waste Water Generation	0	0	0	-2S	0	0	0
	E-Waste Disposal	0	0	0	-1L	-2L	0	-2L

[+3 = High Positive Impact, +2 = Moderate positive impact, +1 = Low Positive Impact, 0 = No impact, -1 = Low Negative Impact, -2 = Moderate Negative Impact, -3 = High Negative Impact S = Short term impact, L= Long term impact]

2.4 NO PROJECT SCENARIO

The "**no action alternative**" would have no negative impacts on the existing environmental and social resources but the positive socio-economic and beneficial commercial impacts would also not be realized as well. All these impacts are likely to contribute to improve the quality of life of the local community, in addition to contributing to national economic growth by initiating the "knowledge intensive" industrialization.

ANNEX-III: INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

3.1 INTRODUCTION

Participation is a process, through which stakeholders influence and share control over development initiatives, the decisions and the resources, which affects them. Participation of stakeholders in the projects is also a primary requirement in developing an appropriate management plan that addresses project's requirement and suited to the needs of the stakeholders. Stakeholder's involvement is also vastly increases the probability of successful implementation of management plan. In order to make consultation and disclosure process effective and fruitful, comprehensive planning is required to assure that local government, NGOs, host population and project staff interacts regularly and purposefully, throughout all stages of the project and contribute toward a common goal.

Public opinion has been collected through interview and focus group discussion meeting. For better understanding the socio-economic and environmental condition one focus group discussions were held with the local people in the closest settlement area of the BHTC. Interview was held with different government official representatives.

3.2 APPROACH AND METHODOLOGY FOR CONSULTATION

The approach undertaken for consultation involved the following key processes.

- Mapping and Identification of key stakeholders such as primary (direct project influence) and secondary (indirect project influence) stakeholders;
- Undertaking interviews and focus group discussions (FGD) with the respective stakeholders;
- Assessing the influence and impact of the project on these stakeholder groups; and
- Summarizing of key findings and observations from the consultations.

3.3 STAKEHOLDER ASSESSMENT

A stakeholder is defined as "a person, group, or organization that has direct or indirect stake in a project/organization because it can affect or be affected by the Project or its Proponent's actions, objectives, and policies". Stakeholders vary in terms of degree of interest, influence and control they have over the Project or the proponent. In the present study, all the stakeholders have been primarily categorized into two categories that have been identified as:

- Primary Stakeholders: include people, groups, institutions that either have a direct influence on the project or are directly impacted (positively or adversely) by the project and its activities; and
- Secondary stakeholders: are those that have a bearing on the project and its activities by the virtue of their being closely linked or associated with the primary stakeholders and due to the influence they have on the primary stakeholder groups.
- Apart from categorization, the stakeholders have also been classified in accordance with the level of influence they have over the project as well as their priority to the project proponent in terms of importance.
- The influence and priority have both been primarily rates as:

- ✓ High Influence/Priority: This implies a high degree of influence of the stakeholder on the project in terms of participation and decision making or high priority for project proponent to engage that stakeholder.
- ✓ Medium Influence/Priority: This implies a moderate level of influence and participation of the stakeholder in the project as well as a priority level for project proponent to engage the stakeholder who are neither highly critical nor are insignificant in terms of influence.
- ✓ Low Influence/Priority: This implies a low degree of influence of the stakeholder on the project in terms of participation and decision making or low priority for project proponent to engage that stakeholder.

Based on the above attributes, the following Table 3.3-1 delineates the stakeholders identified for the project and their analysis.

Table 3.3-1: Stakeholder Mapping for the Project

Stakeholders	Category of stakeholder	Brief profile	Overall influence on the project	Basis of Influence Rating
Project Management				
Fiber@home Ltd.	Primary	Fiber@home Ltd. is the primary project proponent own a controlling stake of 100% in the project	Highest	• Are the primary project proponents • Responsible for operation of this project • Primary financial beneficiaries • Responsible for all the project related risks and impact liabilities
Community				
Local Community	Primary	• Primarily includes adjacent community to the BHTC especially Bakhtarpur	Medium	• No major restrictions around the project site especially with respect to grazing land • Project bring development to the area • Increase in employment opportunities and preference in job • Minimize impact
Regulatory/Administrative Authorities & Agencies				
Dept. of Environment, Bangladesh	Primary	The Department of Environment is the primary government regulatory authority for Environmental protection in Bangladesh.	High	• Responsible for monitoring project's Environmental compliance throughout the project lifecycle

Stakeholders	Category of stakeholder	Brief profile	Overall influence on the project	Basis of Influence Rating
Other Regulatory & Permitting Authorities	Primary		High	• Agencies required for obtaining permits and licenses for operation of the project • Primary involvement during operation phases
Political Administration				
Upazilla (sub District Level) Political Administration	Secondary	Elected representative of people at sub-district level for a fixed tenure	Medium	• Key linkage between the community and the project proponent
Union leaders & local representatives	Secondary	Elected representative at union level i.e. village level for a fixed tenure	Medium	• Plays important role in providing public opinion and sentiment on the project • Empowered to provide consent and authorization for establishment of project on behalf of the community

3.4 SUMMARY OF CONSULTATION

The details of consultations held with issues raised or discussed and suggestions provided by the respective stakeholders are presented in Table-3.4-1 and Photographs are presented in ANNEX-VII.

Table 3.4-1Details of Consultations Held for the Project

Date	Stakeholder Details	Details of participants	Issues discussed/raised	Response/ Suggestions made
11/06/2016	Fiber@home Ltd.	1. Engr. Abul Hasan Rizvi Site Engineer, BHTC Cell No.:01740648337 2. Mr. Saiful Islam Site Manager, BHTC Cell No.: 01723940247	• Benefit from the project • Any local people involvement during construction of the HTC • Any impact due to the HTC	• This project will help the nation to contributing to national economic growth by initiating the "knowledge intensive" industrialization. • Local people are getting priority for getting employed in the construction works. • No impact has been foreseen due to this hi-tech park
11/06/2016	Auto Rice Mill, Bakhtarpur, Kaliakor,	1. Md. Azhar Ali, Businessman Cell No.: 01726460202	• Benefit from the project • Any impact due to the HTC	• It is a national asset and we require more to improve our information technology.

Date	Stakeholder Details	Details of participants	Issues discussed/raised	Response/ Suggestions made
	Gazipur			• Till present no impact recorded or any complain raise during the construction of the HTC.
11/06/2016	Forest Check Station, Kaliakoir, Gazipur	1. Md. Anowar Hossain, Forest Guard Cell No.: 01977959036	• Understanding and Broad overview of the Sal forest of Gazipur • Information on the trees grown in the area • Any direct impact in forest due to the establishment of the HTC.	• Maiaboti, Nim, Gaejon, Chamkathal etc. should be planted in the hi-tech park area. These plants will stay around 200 years. • The Hi-Tech park is bounded with a boundary wall and for this the Sal forest will not be affected by their activities.
11/06/2016	Jatir Pita Bangabandhu Govt. High School	1. Md. Masum Hossain Student Class-X Village-Uttar Bakhtarpur	• Understanding about the Hi-Tech Park • Expectations from the HTC authority • Any local people involvement in the HTC project • Any impact or complain arise due to the HTC	• Information technology business center will develop in a Park environment • This HTC will help to get a good IT related job. • Local peoples are involving during the construction work of this HTC. • No complain so far heard about the HTC.
11/06/2016	Local People of the Bakhtarpur Village	1. Md. Farooq Cell No.: 01721615987 2. Shahzuddin Cell No.: 01854900151 3. Md. Billal Hossain Cell No.: 01683125547 4. Md. Harez Mia 5. Md. Maznu Miah 6. Sohrab Cell No.: 01990224316	• Benefit from the project • Any impact due to the HTC	• It is a national asset and we require more to improve our information technology. • Till present no impact recorded or any complain raise during the construction of the HTC.

3.5 FOCUS GROUP DISCUSSION

Discussions were held with the local communities closed to the HTC. One focus group discussion was held in the Bakhtarpur village on 26th April 2019. The overall outputs from the FGD are given below.

- Local people knows the project activities of the BTL;

- Safety of the Construction work should be improved so that the nearby residences are not affected;
- Job opportunity should be created for the local people so that they can get job in the Construction and Operation phases;
- This project will open job opportunity for the jobless young people of the country.

Table-3.4-2 Participant list of the FGD

Sl. No.	Name of the Participants	Profession	Contact Information
1.	Mohammad Abdul Amir	Farmer	Bakhtarpur Village
2.	Mr. Saizuddin Sikder	Farmer	Ditto
3.	Mohammad Sohel rana	Small Shopkeeper	+8801713579382
4.	Mohammad Alamgir	Day laborer	Bakhtarpur Village
5.	Ram Chandra Shill	Barber	+8801935199485
6.	Mohammad Hasan	Garments Worker	+8801775407664
7.	Mr. Suman	Student	Bakhtarpur High School
8.	Mohammad Abdul Matin	Auto Rickshaw Driver	+8801835541064
9.	Mr. Zakir Hossain	Staff Bus Driver of Apex Group	+8801825906687

3.6 PUBLIC DISCLOSURE

The final ESIA report will need to be disclosed in an accessible place (e.g. local government offices, libraries, community centers, etc.), and a summary translated into local language (Bengali) for the project-affected people and other stakeholders. The World Bank will post the final ESIA document on its website so affected people, other stakeholders, and the general public can provide meaningful inputs into the project design and implementation. As a part of the disclosure, all versions (Bengali and English) should be available at the project office as well as the BHTC's website. In addition, hard copies of summary Bangla versions of ESIA should be available in publicly accessible locations in project area of influence.

ANNEX-IV: MITIGATIONS MEASURES AND ESMP

4.1 INTRODUCTION

Bangladesh Technosity Limited (BTL) has been awarded to design, develop and operate Block-3 of BHTC Project. Block-3 is a 40 acres of land where BTL will develop facilities for industries like IT/ ITES, BPO and Software Development, Hardware and Accessories Manufacturers, Data Center, Multimedia & Animation, Electronic Industry, Bio-Technology, Robotic Engineering, Telecommunications, R& D, Renewable energy, Automobile, Education & Training Institutes. The master plan of Block-3 prepared by BTL includes development of the allocated land and construction of a number of multi-tenant buildings (MTB), convention hall, data center, office spaces for IT/ITES, dormitories, food court, training facility, amphitheater, recreational facilities etc.

The significant environmental impacts of project activities during construction and operational phases have been presented in Chapter-6. As discussed in Chapter-6, there would be some short-term and long-term adverse effects due to project activities during the construction and operation phases. This chapter summarizes the mitigation and abatement measures in order to minimize or eliminate these impacts. It also presents an environment and social management plan (ESMP), including a monitoring program and the resources and institutional setup for implementation of the ESMP. Since no adverse social impacts (loss of land and associated income, harmful effects on social structure or tribal people etc.) are anticipated in this project, a Resettlement Action Plan (RAP) will not be applicable. Since the other social impacts (e.g. traffic, public safety, impact of outside workers etc.) are minor, they have been discussed as a part of the EMP and a separate social management plan (SMP) was not judged necessary. Finally this chapter discusses occupational health and safety and risk management issues in the park and proposes separate plans for each of them.

4.2 MITIGATION MEASURES DURING CONSTRUCTION PHASE

The mitigation measures corresponding to specific adverse impacts during construction phase, along with assignment of responsibilities for their implementation are listed in Table-4.2-1. The measures presented in Table 4.2-1 are aimed at minimizing the effects of the possible adverse impacts and enhancing the positive impacts. The table shows that most of the adverse impacts could be minimized or even removed if appropriate mitigation measures are taken. However, a post project monitoring program needs to be put in place to ascertain that the potential impacts have been predicted adequately and that suggested mitigation measures are effective in minimizing adverse impacts on the environment.

Table 4.2-1Potentially significant Environmental Impact during construction phase and mitigation measures

Activity/Issues	Potentially Significant Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties
- Ground preparation according to the topographical	- Susceptible to soil erosion leading to clogging of drains and sewers.	- The soil erosion problem should be addressed during the project design and construction stages when the necessary control measures would be considered and incorporated in the	Contractor (Supervised by BTL)

Activity/Issues	Potentially Significant Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties
survey, which will involve cutting of some part of the terrain to attain the required level. - Cutting/ clearing of trees/ bushes for the construction work	- Loss of plants/ vegetation and flora/ fauna habitat	project design and implementation. The soil on site will be investigated prior to site preparation for building construction and appropriate safety procedures developed to reduce the occurrence of increased soil erosion. - Measures taken to control erosion will include clearing and grading the ground surface within approved work limits, stripping the top soil layer from the subsoil, stockpiling the removed soil in approved areas to be retrieved during landscaping and site restoration, - Clearing the nearby drainage systems and replanting the original vegetation after construction is completed	
- Influx of workers	- Generation of sewage and solid waste - Possible spread of disease from workers	- Construction of sanitary latrine and septic tank system (one latrine for 20 persons) - Erecting "no litter" sign, provision of waste bins/cans, where appropriate - Waste minimization, recycle and reuse - Proper disposal of solid waste (in designated waste bins) - Clean bill of health a condition for employment - Regular medical monitoring of workers	Ditto
Generation of Excavated Materials and Construction Wastes	- Soil contamination - Drainage congestion	- All solid waste should be appropriately disposed of in drums or dumpsters within the project area. - Stacking and disposal of such material should not disturb the surrounding land use. - No waste shall be disposed of into waterways, their beds, or in immediate proximity to them. Neither shall any waste be dumped into wetlands and flood plains. - Should be disposed of at the designated disposal site identified and approved by the Kaliakoir Pouroshova.	Ditto
Hydrology and Water resources impact	- Increased surface run off, because of increased paved surfaces resulting in possible flooding in nearby areas - Increase pollutants transport from the surrounding area to surface and underground water resources	- Storm water will be managed for surface runoff controls by constructing site drainage system connected to the existing storm water system, allowing for cross drainage diversion structures and a site-specific drainage plan for the project.	Ditto
Impact on Air Quality	- Dust generation	- All loose material, either stacked or transported, shall be kept on site for the shortest possible time and provided with suitable covering, such as tarpaulin - Water sprinkling shall be done at the location where dust generation is anticipated	Ditto

Activity/Issues	Potentially Significant Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties
		- To minimize the occupational health hazard, proper personal protective gears i.e. dust masks shall be provided to the workers - To control vehicular emissions, all motor vehicles and/or construction equipment shall comply with all pertinent National regulations relative to exhaust emission controls and safety	
Noise pollution	- Causes nuisance in the project area and nearby settlements	- Silencers and mufflers should be affixed to the exhaust systems of all mechanical engines/ equipment being used at the project site - Avoid using of construction equipment producing excessive noise during school hours and also at night - Isolation of the source and sensitive receptors during the construction phase should be undertaken to minimize the impacts of noise and vibration - To prevent any occupational hazard, ear muffs/ ear plugs shall be provided to the workers working around or operating noise creating equipment and machinery which emitting high noise levels	Ditto
Traffic congestion	- Increase in local traffic and thereby possible creation of traffic jam - Communication problem	- Schedule deliveries of material/ equipment during non-school hours and after regular working hours, in consultation with the Traffic Department - Arrange for regulation of traffic movement during project construction along affected roads - Employ flagman, slow down traffic and provide adequate signs/ lights for traffic management and to avoid accidents; take assistance from police, where appropriate, for traffic control/ security - Arrange for road signals for alerting drivers to the dangers of passing on affected roads	Ditto
Water pollution	- Soil contamination and Groundwater contamination	- During the construction phase, run-off from the site will not be allowed to stand (water logging), or enter directly into the roadside drains. In order to reduce runoff contamination to ground water, sediment and grease traps should be used to intercept run-off from drainage areas	Ditto
Sanitation, solid waste and E-waste	- Generation of sewage and solid waste - Generation of hazardous solid and electronic wastes - Health of workers	- Strategically located and maintained portable latrine facilities must be made available for construction workers - Adequate number of separate collection bins for biodegradable and non-biodegradable waste shall be provided. Waste from such containers shall be collected separately on a daily basis - Erection of "no litter" sign - Waste minimization, recycle and reuse principles to be followed - Garden waste comprises of fallen leaves and other vegetative material. These shall be collected at a secured location, in order to	Ditto

Activity/Issues	Potentially Significant Impacts	Proposed Mitigation and Enhancement Measures	Responsible Parties
		prevent surface runoff that may lead to the choking of drains - Special arrangements should be made for safe disposal of hazardous materials like paint residues, solvents, diesel fuel etc. - Workers awareness - Clean bill of health a condition for employment - Raising awareness about hygiene practices among workers - Regular medical monitoring of workers	
Ecological Impact	- Removal of vegetation cover at the top soil - Cutting of Tress	- Clearing and grading the ground surface within approved work limit to control loss of biodiversity - Stripping the top soil layer from the subsoil, stockpiling the removed soil in approved areas to be retrievable for landscaping and site restoration around the building structure - Clearing the nearby drainage systems and replanting the original vegetation after construction is completed. - The surrounding areas will be replanted with grass and flowers, and other locally available plants and native trees.	Ditto
Safety hazard	- Risk of accidents, injuries	- Take adequate measures to ensure safety/stability of structures - Follow standard safety protocols. - Provision of protective gears (e.g. uniform, helmet, boots etc.) and first aid facilities.	Ditto
Employment opportunity	- Employment of work/ labor force/ economy of the area	- Employ local people in the project activities as much as possible. - Promote supply from local suppliers	Ditto

4.3 MITIGATION MEASURES DURING OPERATION PHASE

Most of the environmental parameters will experience beneficial effects during the operation phase of the HTC project. Efforts should be made to enhance these beneficial impacts, which may include incentives for proper growth of industries in the area. The Park management authority (BTL) should be responsible for overall environmental management during operation phase of the project. The environmental management during the operation phase should primarily be focused on addressing the following issues:

- Water Pollution
- Air Pollution
- Solid Waste
- E-waste
- Noise Pollution
- Traffic Problem

- Employment opportunity
- Fire Safety

Table 4.3-1 summarizes the potentially significant environmental impacts during operation phase, the measures needed to eliminate or offset adverse impacts and enhance positive impacts. The Environmental Management and Monitoring Plan and Monitoring Schedule have been presented in Section 4.4. As mentioned earlier, the implementation schedule for environmental management and monitoring during the construction phase will be prepared by the Contractor as part of construction contract following recommended mitigation measures of potentially significant impacts given in Table 4.2-1. Resources required for implementation of mitigation and enhancement measures and monitoring during construction will be borne by the Contractor. Most of the mitigation and enhancement measures identified for operation phase are listed in Table 4.3-1.

Table 4.3-1 Potentially significant environmental impact during operation phase and mitigation measures

Activity/ Issues	Potential impacts	Proposed mitigation and enhancement measures	Responsible parties
Water pollution	Drainage congestion	- Provision of adequate drainage system, and reuse option should be made to reduce surface run off - Rain water harvesting provisions may be made, which will adequately replenish the local aquifer. - Drainage system installed at the project site shall be periodically cleaned and maintained to ensure proper water flow - Waste water treatment facilities	BTL and Lease Holders
Air pollution	Poor air quality due to vehicular emission (SOX, NOX, COX, HC)	- Proper maintenance of the internal roads - Adequate greenbelt will be developed and maintained - Regular check of proper technical conditions of vehicles and equipment shall be conducted to minimize emissions to atmosphere	BTL and Lease Holders
Solid waste	Soil contamination as well as attraction of insects and bad odor due to improper handling and disposal of Solid Waste	- Solid wastes from project activity will be stored in closed containers for different types of wastes (e.g. domestic solid wastes, packaging wastes). Domestic solid wastes should be stored in a temporary storage area until Pourashava collect them.	Kaliakoir Pouroshova and BHTC management
E-Waste	1. Lead, barium and other heavy metals leaching into the ground water and release of toxic phosphor 2. Air emissions and discharge into rivers of glass dust, tin, lead, brominated dioxin, beryllium cadmium, and mercury	- Electronic wastes from project activity and manufactures will be stored in closed containers for different types of wastes (e.g. Cathode ray tubes (computer monitors, ATM, video cameras, and more), Printed circuit board (image behind table – a thin plate on which chips and other electronic	Re-Tem* in association with BTL and Lease Holders

Activity/ Issues	Potential impacts	Proposed mitigation and enhancement measures	Responsible parties
	3. PAHs, heavy metals, brominated flame retardants discharged directly into rivers acidifying fish and flora. Tin and lead contamination of surface and groundwater. Air emissions of brominated dioxins, heavy metals, and PAHs 4. Emissions of brominated dioxins, heavy metals and hydrocarbons 5. PAHs released into air, water and soil.	components are placed), Chips and other gold plated components), Plastics from printers, keyboards, monitors, etc. and Computer wires should be stored in a temporary storage area until Pourashava collect them.	
Noise pollution	Generation of high level of noise from vehicles which cause nuisance to the surroundings	- All the equipment to be used should be designed to have a noise level not exceeding 70 dBA as per the requirement of ECR 1997. - Discourage unnecessary honking within the project complex.	BTL and Lease Holders
Traffic problem	Presence of high tech manufacturing unit will add traffic to burden the existing roads.	- Traffic management should be in place to ease the movement of emergency vehicles/ambulances going in and out of the facility. - Special traffic management signs shall be installed to regulate and maintain smooth traffic flow and avoid traffic jams as a result of increased traffic flow to the project.	BTL, Lease Holders and Traffic Police
Employment opportunity	Employment of work/ labor force/ economy of the area	- Employ local people as much as possible and promote to boost local economy.	BTL and Lease Holders
Fire Safety	Risk of severe injuries and loss of lives Damage to property	- Post emergency exit plans on strategic conspicuous locations on every floor - Provide adequate provision of fire escapes - Add fire ladders and extra gates to fire ladders, remove objects blocking escape routes and keep these obstruction free at all times - Place adequate emergency escape signs (direction plates), illuminate signs and routes - Install smoke control system - Install pressurization system to feed fresh air - Place fire hoses and mobile fire extinguishers inside buildings - Provide training and make arrangement for regular fire drill	BTL and Lease Holders

*Note:*BHTPA and Re-Tem Corporation, Japan inked a memorandum of understanding (MoU) at a city hotel on 1st October 2015. The Re-Tem will cooperate about all kind of waste management of the Hi-tech city.*

4.4 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

4.4.1 Scope of ESMP

The primary objective of the environmental management and monitoring is to record environmental impacts resulting from the project activities and to ensure implementation of the "mitigation measures" identified earlier in order to reduce adverse impacts and enhance positive impacts from specific project activities. Besides, it would also address any unexpected or unforeseen environmental impacts that may arise during construction and operation phases of the project. The ESMP should clearly layout:

a) the measures to be taken during both construction and operation phases of the project to eliminate or offset adverse environmental impacts, or reduce them to acceptable levels;
b) the actions needed to implement these measures; and
c) monitoring plan to assess the effectiveness of the mitigation measures employed.

Environmental management and monitoring activities for the HTC project could be divided into management and monitoring:

i. during construction phase, and
ii. during operation phase

4.4.2 Work Plans and Schedules

Construction Phase:

The environmental management program should be carried out as an integrated part of the project planning and execution. It must not be seen merely as an activity limited to monitoring and regulating activities against a pre-determined checklist of required actions. Rather it must interact dynamically as project implementation proceeds, dealing flexibly with environmental impacts, both expected and unexpected.

For this purpose, it is recommended that the Project Coordinator for this specific project should take the overall responsibility of environmental management and monitoring. The Project coordinator will form a team or project management unit (PMU) with required manpower and expertise to ensure proper environmental monitoring, as specified in the following sub-section, and to take appropriate measures to mitigate any adverse impact and to enhance beneficial impacts, resulting from the project activities. For this purpose, he will engage an environmental and social specialist in the PMU who will assist him these activities. The Project Coordinator through its team will make sure that the Contractor undertake and implement appropriate measures as stipulated in the contract document, or as directed by the Project Coordinator to ensure proper environmental management of the project activities. Figure-4.4-1 shows the ESMP organogram for the construction period of the BHTC. It should be emphasized that local communities should be involved in the management of activities that have potential impacts on them (e.g., traffic congestion in the surrounding areas). They should be properly consulted before taking any management decision that may affect them. Environmental management is likely to be most successful if such decisions are taken in consultation with the local community. The

environmental management during the construction phase should primarily be focused on addressing the possible negative impacts arising from:

(a) Cutting/ clearing of trees/ vegetation in the project site for preparation of land for construction
(b) Air pollution
(c) Traffic/communication problems
(d) Noise pollution
(e) Drainage congestion
(f) Water and soil pollution
(g) Employment of labor force giving priority to local people

The environmental management should also focus on enhancing the possible beneficial impacts arising from employment of local workforce for construction works. In addition, the PMU should set up a procedure to address complaints and grievances (e.g., receiving formal complaints/ grievances, arrange hearing involving all stakeholders and keeping records of such hearings, device and implement mitigation measures). However, the complaints and grievances redress procedure will not preempt age aggrieved person's/ group's right to seek redress in the courts of law. The monitoring plan and monitoring schedule has been presented in the subsequent sections.

Operation Phase:

Most of the environmental parameters will experience beneficial effects during the operation phase of the HTC project. Efforts should be made to enhance these beneficial impacts, which may include incentives for proper growth of industries in the area. The park management authority (BTL) will form an Environmental Management Unit (EMU) for overall environmental management during operation phase of the project. Organogram of the ESMP of the HTC is shown in Figure 4.4-2. The issues which should be considered with utmost priority during operation phase of environmental management are: (a) Air pollution (b) Management of solid and hazardous waste (c) Noise pollution (d) Traffic congestion (e) Health care facility (f) Employment opportunity (g) Safety issues related to fire (h) Impact to Water resources.

In addition, the procedure to address complaints and grievances (noted above) should also be in place during operational phase. Table 4.3-1 summarizes the potentially significant environmental impacts during operation phase, the measures needed to eliminate or offset adverse impacts and enhance positive impacts. The monitoring plan and monitoring schedule has been presented in subsequent sections. Most of the mitigation and enhancement measures identified for operation phase (Table 4.3-1 will have to be addressed during the design phase and resources required will be within the estimated cost of the park construction.

Solid Waste Management of BHTC:

Solid-waste management, the collecting, treating, and disposing of solid material that is discarded because it has served its purpose or is no longer useful. Improper disposal of municipal solid waste can create unsanitary conditions, and these conditions in turn can lead to

pollution of the environment and to outbreaks of vector-borne disease—that is, diseases spread by rodents and insects. The tasks of solid-waste management present complex technical challenges. They also pose a wide variety of administrative, economic, and social problems that must be managed and solved.

Solid-Waste Characteristics

Composition and properties

The sources of solid waste at BHTC shall include residential, commercial, institutional, and IT/ITES industrial activities. All nonhazardous solid waste from a community that requires collection and transport to a processing or disposal site is called refuse or municipal solid waste (MSW).

Refuse includes garbage and rubbish. Garbage is mostly decomposable food waste; rubbish is mostly dry material such as glass, paper, cloth, or wood. Garbage is highly putrescible or decomposable, whereas rubbish is not. Trash is rubbish that includes bulky items such as old refrigerators, couches, or large tree stumps. Trash requires special collection and handling.

Construction and demolition (C&D) waste (or debris) is going to be a significant component of total solid waste quantities (about 20 percent in the United States) of BHTC, although it is not considered to be part of the MSW stream. However, because C&D waste is inert and nonhazardous, it is usually disposed of in municipal sanitary landfills.

Another type of solid waste, perhaps is going to be the fastest-growing component in BHTC, is electronic waste, or e-waste, which includes discarded computer equipment, televisions, telephones, and a variety of other electronic devices. Concern over this type of waste is escalating. Lead, mercury, and cadmium are among the materials of concern in electronic devices, and governmental policies may be required to regulate their recycling and disposal. *The detail of the e-waste management is discussed in the next section of this report.*

Generation and storage

At BHTC, rates of solid-waste generation will vary widely depending on the type of the Business of the users. Anticipated Municipal refuse could be generated at an average rate of approximately 1 kg (2.2 pounds) per person per day. This estimation includes refuse from commercial, institutional, and IT/ITES based industrial as well as residential sources. The actual rates of refuse generation must be carefully determined when authority plans for a specific solid-waste management project.

BHTC will require household refuse to be stored in durable, easily cleaned containers with tight-fitting covers in order to minimize rodent or insect infestation and offensive odours. Galvanized metal or plastic containers of about 115-litre (30-gallon) capacity could be used along with larger containers that can be mechanically lifted and emptied into collection trucks. Plastic bags could be used as liners or as disposable containers for curbside collection. Where large quantities of refuse are going to be generated—such as at shopping centres, hotels, or apartment building zone

of BHTC—dumpsters may be used for temporary storage until the waste is collected. In Large Commercial Buildings, on-site compactors could be used to reduce the waste volume.

Solid-Waste Collection

Collecting and transporting

Proper solid-waste collection is a labour-intensive activity, accounting for approximately three-quarters of the total cost of solid-waste management. Manpower of Gazipur City Corporation (GCC) could be assigned to the task, but sometimes it might be more economical to deploy Local private companies to do the work under contract to the BHTPA or for private collectors to be paid by individual Space owners. A driver and one or two loaders could serve each collection vehicle. These could be typically trucks of the enclosed, compacting type, with capacities up to 30 cubic meters (40 cubic yards). Loading can be done from the front, rear, or side. Compaction reduces the volume of refuse in the truck to less than half of its loose volume.

The task of selecting an optimal collection route could be a complex problem at BHTC, as it might be a densely populated area. An optimal route is one that results in the most efficient use of labour and equipment, and selecting such a route requires the application of detail analyses of the Locality that account for all the many design variables in a large and complex network. Variables include frequency of collection, haulage distance, type of service, and climate.

Refuse collection could be planned for at least once per week because of the rapid decomposition of food waste. The amount of garbage in the refuse of an individual user unit can be reduced by garbage grinders, or garbage disposals. Ground garbage puts an extra load on sewerage systems, but this should be accommodated. In BHTC source separation and recycling programs need to be conducted, in which residential user and businesses separate recyclable materials from garbage and place them in separate containers for collection.

Transfer stations

As the final destination of the refuse could be far from the BHTC, one or more transfer stations may be necessary. A transfer station is a central facility where refuse from many collection vehicles is combined into a larger vehicle, such as a tractor-trailer unit. Closed compactor-type trailers could also be used, but they must be equipped with ejector mechanisms. A storage discharge type of station, where refuse is first emptied into a storage pit or onto a platform, and then machinery is used to hoist or push the solid waste into the transport vehicle, could be used in this case.

Overall, the BHTC authority will take care of the generated solid waste of BTL.

Human Waste Management Plan for BHTC

Human waste, also known as human excreta, is a waste type usually used to refer to byproducts of digestion, such as feces and urine. There are many different ways in which human waste can be collected, treated and disposed or reused, depending on the sanitation system that is in place. In BHTC flush toilets, where the human waste is mixed with water, transported and treated

in sewage treatment plants (STP) will be used. Due to unavailability of municipal sewage systems at BHTC, BTL shall use septic tank systems and each Establishment in BHTC shall have its own Septic Tank as STP.

A septic system is a highly efficient, self-contained, underground wastewater treatment system. Because septic systems treat and dispose of wastewater onsite, they will be more economical than centralized sewer systems in BHTC, where lot sizes are larger and users are different and spaced widely apart. Septic systems are also simple in design, which make them generally less expensive to install and maintain and septic systems don't require the installation of miles of sewer lines, making them less disruptive to the environment.

A septic system consists of two main parts-a septic tank and a drain field. The septic tank is a watertight box, usually made of concrete or fiberglass, with an inlet and outlet pipe. Wastewater flows from the user to the septic tank through the sewer pipe. The septic tank treats the wastewater naturally by holding it in the tank long enough for solids and liquids to separate. The wastewater forms three layers inside the tank. Solids lighter than water (such as greases and oils) float to the top forming a layer of scum. Solids heavier than water settle at the bottom of the tank forming a layer of sludge. This leaves a middle layer of partially clarified wastewater.

The layers of sludge and scum remain in the septic tank where bacteria found naturally in the wastewater work to break the solids down. The sludge and scum that cannot be broken down are retained in the tank until the tank is pumped. The layer of clarified liquid will flow from the septic tank to the waste water drainage system of BHTC.

Implementation Schedule:

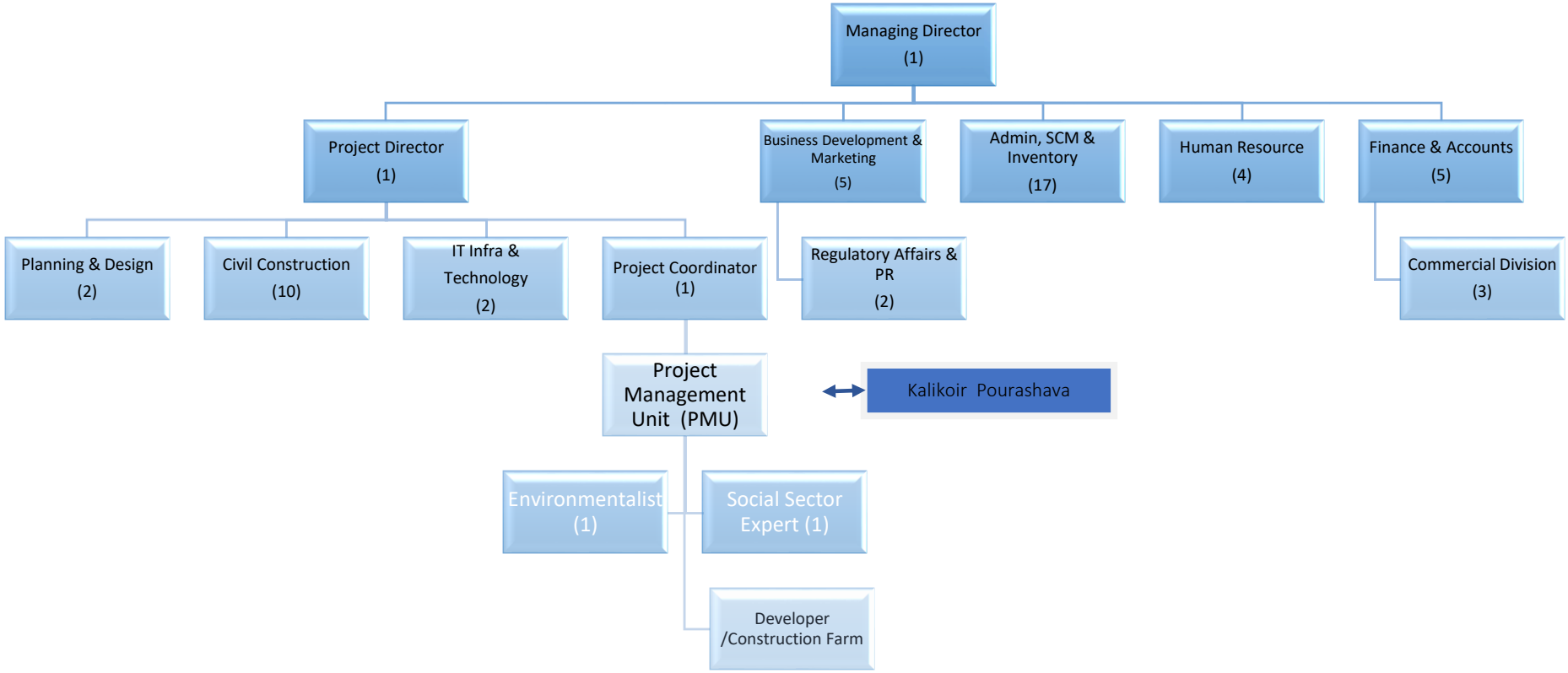
An implementation schedule for environmental management and monitoring during the construction phase will be prepared by the Contractor as part of construction contract following recommended mitigation measures of potentially significant impacts. During the operation phase the EMU will prepare the monitoring reports. Table 4.4-1 shows a tentative plan for environmental reporting. These reports should be shared with Project Implementation Unit (PIU) of the IPFF and the World Bank from time to time.

Table 4.4-1 Environmental monitoring reporting schedule

Stage/Topic	Frequency/Stage	Contributors
Initial review	Before start of work	BTL, Consultant
Routine Progress Report	Quarterly	Environmentalist and Social Sector Expert
Specific Problems and Solutions	As required	Environmentalist and Social Sector Expert
Mid-term Review: - review of activities - possible modification to procedure and/or overall plan	Approximate mid-way through the project	Consultant
Final Review	Toward the end of the project	BTL, Consultant, Contractor

Yearly Environmental Management Report for World Bank	Every Year	BTL

Figure 4.4-1 ESMP Organogram for Construction Phase of the BHTC



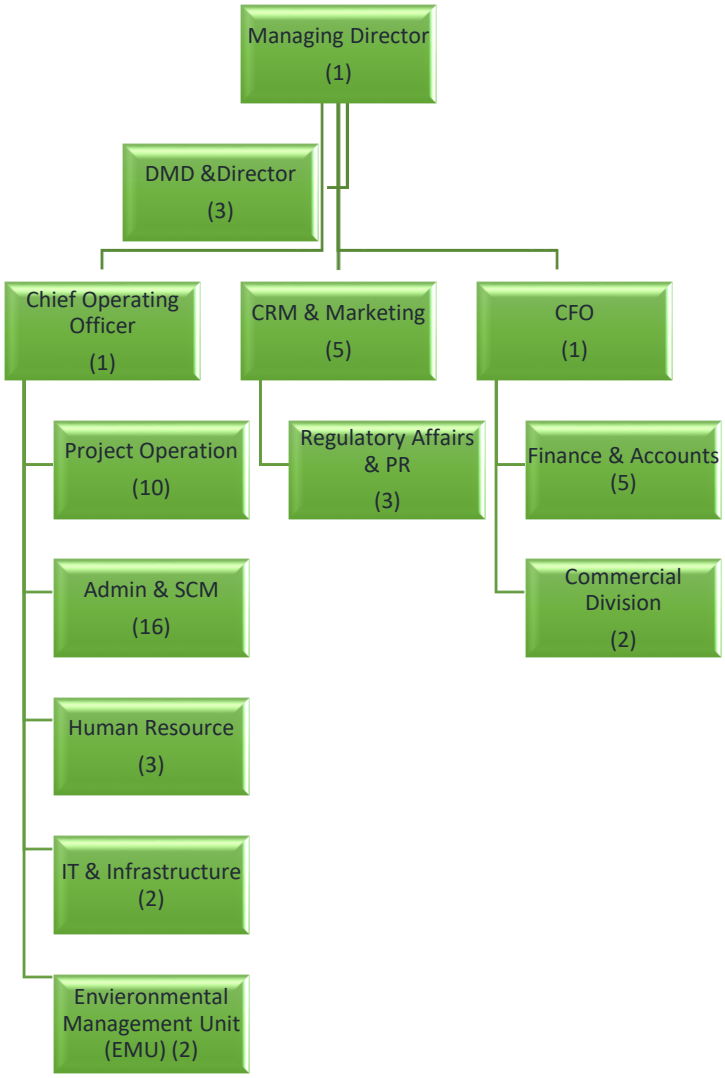


Figure 4.4-2 ESMP Organogram for Operation Phase of the BHTC

4.4.3 Environmental Monitoring During Construction Phase

Monitoring plan should also include regular reviews of the impacts that cannot be adequately assessed before the start of the works, or which arise unexpectedly, along with appropriate measures to mitigate any negative impacts and/or enhancing beneficial impacts. This section outlines the main environmental parameters to be monitored, timing of the monitoring work and the recommended frequency of monitoring during the construction phase of the project. Specific monitoring requirements for the environmental issues during construction phase listed in Table 4.4-2 are presented in Table 4.4-3.

Table 4.4-2 Monitoring issues/ requirements during Construction phase of the project

Environmental Issue	Monitoring requirements/issues
Air pollution	- Construction materials should be properly covered while hauled and stored, roads properly cleaned and water sprayed in order to minimize concentration of dust in air. - Use of equipment like stone crushers (for concreting work), which produce excessive noise as well as generate particulate matter, must not be used close to human settlement. - During trench construction activities, the topsoil removed should be placed in a location that ensures little or no fugitive dust formation from stockpile. - Concentration of particulate matter within and around the project site should be measured, at least once every three months, and air quality management plan should be revised, if needed.
Noise pollution	- Equipment producing excessive noise should not be operated after dark. - Use of equipment like stone crushers (for concreting work), which produce excessive noise as well as particulate matter, must not be used at the site. - Vehicle movement to and from the site should be properly managed in order to ensure that this causes minimum disturbance to the people living in the surrounding areas. - Noise levels along the perimeters of the project area should be monitored during the construction period and any defective equipment or vehicle removed from activities immediately.
Traffic congestion	- Hauling of materials and equipment to and from project sites should preferably be done after the regular working hours, so that it causes minimum disturbances to the regular traffic in and around the project site. - Contractor should take responsibility of proper traffic flow and management within the immediate vicinity of the project site.
Drainage congestion	- Appropriate measures should be taken to avoid temporary drainage congestion during construction activities
Impacts to Water Resources	- During excavation activities, the topsoil removed should be placed in a location that ensures no turbidity impacts to nearby water resources. - Should the contractor vacate the area leaving stockpiled material a suitable penalty (fine and removal cost) should be levied to remedy the situation. - Wastewater from workers' camp should be well managed.

Table 4.4-3 shows monitoring plan during construction phase of the project. The monitoring plan includes the parameters to be monitored, the time location and frequency of monitoring and the assignment of responsibilities. As can be seen from Table 4.4-2, monitoring is primarily the responsibility of the Contractor. The Contractor will perform these monitoring activities as prescribed in Table 4.4-2 and will directly report the results to the Project Director. The Project Director will examine the performance of the contractor in carrying out these activities.

Table 4.4-3 Monitoring parameters and frequency during construction phase

Monitoring	Period/Location	Parameters to be monitored	Monitoring Frequency and responsibilities	Resources Required
Noise Level	Baseline One set of measurements at property boundaries of selected critical locations (the nearby residential plot, other residential areas, highways etc.) prior to commencing activities. One set of measurements at the same locations during construction activities	Equivalent Noise level (L_{eq}) with GPS location, wind speed and direction	Spot checking in a monthly basis; Contractor's Responsibility	Noise level meter, GPS;
Air Quality (dust particles/ particulate matter)	Baseline Only at selected critical locations downwind of site activities (prior to commencement of work) and in close proximity to human receptors (specially the nearby residential plot). Only at selected critical locations downwind of site activities (during construction activities) and in close proximity to human receptors	PM_{10}, $PM_{2.5}$ with GPS location, wind speed and direction	Once in three months or as deemed by the Project Coordinator; Contractor's Responsibility	PM sampling device*, GPS Wind speed/direction data to be collected from local BMD station
Surface Water Quality	Baseline: One measurement from a location of the project site of HTC lake and the downstream of the Bangshi river. One measurement from the same location during construction activities.	Turbidity, Total Suspended Solids, Dissolved Oxygen, oil and grease, BOD, COD	Monthly and as directed by the Project team leader; Contractor's Responsibility	Laboratory facilities for water/ wastewater analysis
Ground water quality	Chemical Analysis of Tube-well water used as drinking water source for the workers	Routine drinking water parameters	Once in six months; Contractor's Responsibility	Laboratory facilities for water/ wastewater analysis
Soil Quality	Sample randomly selected at one or two locations within the project site	Selected heavy metals (Pb, Cr, Cd)	Once in six months; Contractor's Responsibility	Laboratory facilities for soil sample analysis
General site condition	Baseline: Visual survey (once) of proposed site before commencement of work. Visual survey of the project site during the entire period of construction	General site condition, traffic condition, pedestrian movement, vegetation clearance etc. by visual survey (photographs)	Weekly and as directed by the Project team leader; Contractor's Responsibility	Digital camera

Monitoring	Period/Location	Parameters to be monitored	Monitoring Frequency and responsibilities	Resources Required
House-keeping activities, Safety measures during construction	Visual survey of the project site during the entire period of construction	Construction debris management, road traffic/ river traffic management, management of flammable materials (if any), use of Personal Protective Equipment by workers etc.	Weekly and as directed by the Project team leader; Contractor's Responsibility	Digital camera

Note:*PM-sampling has to be done with USEPA-approved FRM-based or equivalent PM sampling device. The Project Coordinator will decide actual monitoring time and location.

The measured noise levels should conform to the national noise level standards as well as the IFC guidelines for different areas (residential, silent zone etc.) as applicable. Noise level during construction activities should be within the limits of exposure prescribed in the OSHA guidelines. The measured air quality should be within the limits of the national ambient air quality standards as well as those mentioned in the IFC guidelines for particulate matters in the air. The surface water quality parameters measured should be within the limits of Bangladesh Standards for inland water quality. The drinking water quality parameters should be within Bangladesh drinking water quality standards.

4.4.4 Environmental Monitoring During Operation Phase

Environmental monitoring during operation phase must address the concerns of air and noise pollution as well as solid/liquid waste generated from the Hi-Tech park facility. This would be mainly the responsibility of BTL. Specific monitoring requirements for the environmental issues during operation phase listed in Table 4.4-4 are presented in Table 4.4-5.

Table 4.4-4: Monitoring issues/requirements during Operation phase of the project

Environmental Issue	Monitoring requirements/issues
Air pollution	- Ambient air quality should be monitored at different locations around the HTC site within a 5-km radius
Noise pollution	- Indoor noise environment should also be assessed as a part of the occupational health and safety plan
Traffic congestion	- Hauling of materials and equipment to and from project sites should preferably be done after the regular working hours, so that it causes minimum disturbances to the regular traffic in and around the project site. - Contractor should take responsibility of proper traffic flow and management within the immediate vicinity of the project site.
Impacts to Water Resources	- Lake water quality i.e. Dissolved Oxygen, oil and grease etc. should be monitored. - The groundwater level along with the selected drinking water quality parameters (e.g., pH, Color, Turbidity, TDS, Ammonia, Nitrate, Phosphate, As, Fe, Mn and Coliforms) may be monitored since the groundwater would still be used for drinking purpose for the BTL officials.

Environmental Issue	Monitoring requirements/issues
Management of Solid Waste	- Amount of solid waste generated from the facility should be documented - The hazardous nature of the waste should be assessed before final disposal at a landfill

Table 4.4-5 Monitoring parameters and frequency during Operation Phase

Monitoring	Period/Location	Parameters to be monitored	Monitoring Frequency and responsibilities	Resources Required
Noise Level	Baseline One set of measurements at property boundaries of selected critical locations (the nearby residential plot, other residential areas, highways etc.) prior to commencing activities.	Equivalent Noise level (L_{eq}) with GPS location, wind speed and direction	Spot checking in a monthly basis; BTL's Responsibility	Noise level meter, GPS;
Ambient Air Quality (particulate matter)	Baseline At the HTC gate.	SPM, PM_{10}, $PM_{2.5}$, SOx, NOx, CO, VOC with GPS location, wind speed and direction	Once in three months or as deemed by the EMU; BTL's Responsibility	PM sampling device*, GPS Wind speed/direction data to be collected from local BMD station. **CAMS is required to monitor the continuous air quality.
Surface Water Quality	Baseline: One measurement from a location of the project site of HTC lake.	Turbidity, Total Suspended Solids, Dissolved Oxygen, oil and grease, BOD, COD	Quarterly and as directed by the EMU; BTL's Responsibility	Laboratory facilities for water/ wastewater analysis
Ground water quality	Chemical Analysis of Tube-well water used as drinking water source for the officials	Routine drinking water parameters	Quarterly and as directed by the EMU; BTL's Responsibility	Laboratory facilities for water/ wastewater analysis
Soil Quality	Sample randomly selected at one location within the HTC site.	Selected heavy metals (Pb, Cr, Cd)	Once in a year; as directed by the EMU; BTL's Responsibility	Laboratory facilities for soil sample analysis
Management of Solid Waste	Visual survey of the HTC Complex during operation.	Solid Waste Management of the HTC	Weekly and as directed by the EMU; BTL's Responsibility in collaboration with Kalikoir Hi-Tech Park	Digital camera
Management of Waste Water	Visual survey of the HTC	BOD, COD, TSS, TKN, Ammonia Nitorgen, Total	Twice in a year	Laboratory facilities for water/

Monitoring	Period/Location	Parameters to be monitored	Monitoring Frequency and responsibilities	Resources Required
Treatment Plant		Phosphorous and Oil and Grease		wastewater analysis
Management of Sewage Treatment Plant	Visual survey of the HTC	Sewage Management of the HTC	Once in a Year	Kaliakoir Pourashava Support would be required
Safety measures during Operation	Visual survey of the HTC Complex during operation.	Road traffic management, management of flammable materials (if any), use of Personal Protective Equipment by HTC officials etc.	Weekly and as directed by the EMU; BTL's Responsibility	Digital camera

Note: * PM-sampling has to be done with USEPA-approved FRM-based or equivalent PM sampling device. The Project Coordinator will decide actual monitoring time and location. Actual monitoring time and location will be decided by the proposed Environmental Management Unit (EMU).During the operation phase, the monitoring may be carried out by the EMU through its own staff and equipment, if available, or can be out-sourced to a competent Contractor. ** Continuous monitoring if a CAMS is established.

4.4.5 Estimation of Cost of EMP

Many of the activities to be carried out as a part of EMP would not involve any additional direct cost e.g., employing local work force, where appropriate; keeping subproject vehicles in good operating condition; scheduling deliveries of materials/ goods in off-peak hours; good housekeeping, avoiding spills; etc. Medical examination can be performed by in-house medical doctors. On the other hand, a number of activities would require additional cost. Environmental monitoring during construction phase would involve direct cost. At the same time, a number mitigation measures (including health and safety measures) would require additional cost; these include medical examination, water sprinkling on surfaces, protective gear etc. Table 4.4-6 provides method of estimation of costs of different items of EMP. It is advised that the BTL authorities develop in-house capacity of monitoring some of these environmental parameters such as laboratory facilities for analyzing water/wastewater samples etc.

Table 4.4-6 Method/basis of estimation of cost of Monitoring

Monitoring Item	Basis of Cost/Estimated Cost
Noise level	Prevailing rate (~Tk. 5,000/- per measurement per day)
Ambient Air Quality	Prevailing rate (~ Tk. 40,000/- per measurement)
CAMS (Meteorological instrumentation with continuous data recorder)	3,000,000/-*
Routine Drinking water quality parameters	Prevailing rate (~Tk. 8,500/- per sample)
Surface Water quality (Turbidity, Total	Prevailing rate (~Tk. 8,000/- per sample)

Monitoring Item	Basis of Cost/Estimated Cost
Suspended Solids, Total Solids, Dissolved Oxygen, Oil and grease, BOD, COD)	
Waste Water Quality (BOD, COD, TSS, TKN, Ammonia Nitrogen, Total Phosphorous and Oil and Grease)	Prevailing rate (~Tk. 30,000/- per sample)
Soil Quality (Heavy metals Pb, Cr, Cd)	Prevailing rate (~Tk. 6,000/- per sample)
Water sprinkling on aggregate	Latest PWD/LGED rate (if available)/A fixed rate per cubic meter of aggregate per day
Protective gear	Contractor to quote rate of different items of works considering the provision of adequate protective gear for workers, in accordance to the conditions of contract, specified in the Tender Document

*Meteorological Instrument with data recorder will be purchased in the 1st year of operation.

Yearly Budget for the Construction & operation phases of the project would be:

Yearly Environmental management budget during the Construction phase	= 800,000.00BDT
Yearly Operational budget for Environmental management	= 600,000.00BDT

4.5 OCCUPATIONAL HEALTH AND SAFETY PLAN

Occupational health and safety means preventing accidents and work related ill health. Improved health and safety management can bring significant benefits to the business. It reduces individual and human costs of accidents and ill health, direct and indirect cost to the business, improves customer perception and company profile and workers' morale. Under occupational health hazards, one can group several categories of working conditions impairing the health conditions of workers, though this impairment is slow. Safety relates more to health hazards that results from accidents and can cause instantaneous impairment of the workers' health.

4.5.1 General Requirements

In Bangladesh the main law related to occupational health and safety is Labor Law 2006. The law has provisions on occupational hygiene, occupational diseases, industrial accidents, protection of women and young persons in dangerous occupation. The salient features of the general requirements for the workers' health and safety stated in this law is presented in Table 4.5-1.

4.5.2 Workplace Environmental Quality

The proposed project has several phases the construction of infrastructure and operation of the etc.

Health Hazards

The construction phase includes site preparation and hi-tech park construction, access road construction etc. The health hazards associated with these activities are mainly due to dust and noise pollution. Excessive noise contributes to loss of hearing and triggers physiological and psychological body changes. Dust pollution can cause eye and respiratory irritation and in some cases allergic reactions. The inhalation of exhaust gases from vehicles and machinery are also harmful for health. Stress can be caused by working in shifts, high work load, poor living condition of workers etc.

Table 4.5-1 General requirement for workers' health and safety

Issue	Requirements
Health and Hygiene	- Cleanliness - Ventilation and temperature - Dust and fumes - Disposal of wastes and effluents - Overcrowding - Illumination - Latrines and urinals - Spittoons and dustbins
Safety	- Safety for building and equipment - Precautions in case of fire - Fencing of machinery - Floor, stair and passage way - Work on or near machinery in motion - Carrying of excessive weights
Compensation for accidents at work	- Owner's responsibility for compensation - Amount of compensation - Report on fatal accident and treatment - Compensation on contract and contract registration - Appeal
Dust and Fumes	- Any dust or fumes or other impurities likely to be injurious to - the workers, effective measures shall be taken to prevent its - accumulation and its inhalation by workers
Overcrowding	- No work room in any factory shall be overcrowded - At least five hundred cubic feet of space shall be provided for every worker employed in a work room
Latrines and urinals	- Sufficient latrines and urinals shall be provided - Shall be maintained in clean and sanitary condition - Shall be adequately lighted and ventilated
Precautions in case of fire	- Shall be provided with means of escape in case of fire - Effective measures shall be taken to ensure that all the workers are familiar with the means of escape - Firefighting apparatus should be provide and maintained
First aid	- Provided and maintained first aid facility

Issue	Requirements
	- One for every one hundred and fifty workers - Shall be kept with a responsible trained person who shall be available during the working hours - In every facility where five hundred or more workers are employed, a dispensary shall be provided and maintained
Disposal of wastes and effluents	- Provide with proper disposal system for solid waste and effluents. - In case of a factory where no public sewerage system exists, prior approval of the arrangements should be made for the disposal of wastes and effluents
Occupational and poisoning diseases	16 occupational diseases notifiable to the Chief Inspector of Factories: 1. lead poisoning 2. lead tetraethyl poisoning 3.phosphorous poisoning 4.mercury poisoning 5. manganese poisoning 6. Arsenic poisoning 7. poisoning by nitrous fume 4. carbon di sulfide poisoning 9. benzene poisoning 10. chrome ulceration 11. Anthrax 12.silicosis 13. poisoning by halogens 14. Primary epitheliomatous cancer of the skin 15. toxic anemia 16. Pathological manifestation due to radium or x-rays
Compensation	- If personal injury is caused to workmen by accident arising in the course of employment, employer shall be liable to pay compensation - 36 occupational diseases for compensation payable - Monthly payment as compensation for temporary disablement are 1. Compensation should be paid for the period of disablement or for one year whichever period is shorter 2. Such compensation shall be paid at the rate of full monthly wages for the first two months 3. Two thirds of the monthly wages for the next two months and at the rate of the half of the monthly wages for the subsequent months 4. In case of chronic occupational diseases , half of the monthly wages during the period of disablement for a maximum period of two years shall be paid

A quantification of the measure of severity in health hazards is not well defined. They are slow acting and cumulative, their effects may not be visible for years. During Hi-Tech park construction and operation phase, use of chemicals (paints, solvents, thinners etc) batteries, welding materials, lubricants etc. may contribute to health hazards to the workers. These substances may be carcinogenic or detrimental in other ways. Use of industrial solvents can cause anemia, liver and kidney damage, cardiovascular diseases and neurological disorder.

Remedial Measures

To minimize the hazards arising from the activities at different phases of park construction and operation, the following measures should be taken:

- employees should be informed of the potential health impacts they are facing
- the employer should inform his employees of these potential hazards, arrange proper medical examination prior to and during employment, as well as tests and analyses necessary for the detection of diseases
- works with volatile toxic chemicals should be undertaken in a well-ventilated place

- laborers handling offensive toxic chemicals should be provided with and forced to use protective clothing
- workers exposed to an excessive amount of noise should be provided with protective gear and be relieved frequently from their post
- workers exposed to large amounts of dust should be provided with adequate protective gear
- frequent spraying of water should be undertaken to minimize dust pollution
- persons undertaking construction and installation works should have access to amenities for their welfare and personal hygiene needs such as sanitary toilets, potable drinking water, washing facilities, shelter sheds etc.
- proper disposal of waste and sullage should be arranged
- health education and information on hygiene should be provided to the workers
- regular checks on food quality should be arranged within the work site

Safety

Safety implies the reduction of risk of accidents at the work site. Accident prevention is more valuable than any mitigatory or compensatory measures. This may be achieved through strict rules and procedures for the execution of specific tasks, enforcement of the rules, and discipline amongst workers, maintenance of machineries used and by providing all necessary gear or equipment that may enhance the safety of the workers.

The following guidelines should be followed to maintain the safety of the workers:

- workers have to be informed about the possible damage or hazards related to their respective jobs
- if pedestrian, traffic or plant movements at or near the site are affected by construction works, the person with control of the construction project must ensure that these movements are safely managed so as to eliminate or otherwise to control any associated health and safety risks
- must ensure sufficient lighting in the area where a person performs construction work or may be required to pass through, including access ways and emergency exit or passage without risk to health and safety
- construction site needs to provide safe access to and egress from all places where they may be required to work or pass through. This includes the provision of emergency access and egress route that must be free from obstructions
- adequate perimeter fencing should be installed on the site before construction work commences and that should be maintained during the construction work and signs should be placed which is clearly visible from outside the site including emergency telephone numbers.
- must ensure that electrical installations materials, equipment and apparatus are designed, installed, used, maintained and tested to eliminate the risk of electrical shock, burns, fire or explosion.

- construction site should be kept orderly and tidy. Access ways should be kept clear of materials and debris and maintained in a non-slippery condition. Materials should be stored in an orderly manner so that it does not pose any risk to the health or safety of any person
- arrangements of first aid facility should me made accessible when construction work is being undertaken.

4.5.3 Hazardous Material Handling and Storage

During construction of the park, commercially available chemicals (paints, thinners, etc.) will be used and stored in the construction area. Hence small amount of unused or spent chemicals (used paints, motor oils) will be generated. Operation and maintenance of the HTC also may generate some hazardous wastes. However this is not often the case and the following set of storage guidelines should be adopted:

- the storage place must be sheltered from rain and other water sources and if possible , away from heat sources
- the storage place must have a ground cover
- the storage place must have an exhaust ventilation system in order to avoid gas accumulation
- the storage place must have a restricted access and be identified as a hazardous material storing place
- any other lead materials which may eventually arise, such as plumbing, should be conveniently packaged and stored in accordance with its characteristics

4.5.4 Training

Training is an integral part of a preventive strategy. The target groups requiring training should be managers, supervisors, and technicians and related staff who may be exposed to risk at work. The following issues should be addressed in training of the managers, staff and workers:

- Workers should be trained to use the engineering controls where installed
- Arrange workplace consultation on noise control
- Workers should participate in training and contribute to the noise management strategy
- Employee representatives should represent the views of workers to management about occupational health and safety and report to workers about management policy
- Persons likely to be exposed to risks should be provided with information and instruction in safety procedures associated with the park at the work place.
- Relevant health and safety information should be provided to persons involved in construction and operation of the park.
- Information on emergency procedures relating to the park should be displayed in a manner that can be readily observed by persons who may be affected.
- Training should be provided to use firefighting equipment when necessary.
- Facility staff needs to be trained in the safety procedures that are to be implemented during unloading, transfer and storage of hazardous materials.

4.5.5 Record Keeping and Reporting

Record keeping and reporting is one of the requirements of any QA/QC system and essentially of a good management tool. Properly maintained records of construction, installation, training, equipment maintenance, operation, fault detection and remedy can help in reducing risks of accidents, legal costs and thereby overall cost of operation of a HTC. Records also help in identifying causes of any accident and elimination of the same accident in future. Records may be maintained for the proposed HTC as follows.

Hi-Tech Park Construction

A person with control of a construction project or control of construction work should retain records for a reasonable period after the completion of the construction project of the occupational health and safety induction training and any other training given to persons directly engaged or trained by them to undertake construction work on the project.

Hi-Tech Park Operation

During operation of the HTC, arrangements should be made to keep records on any relevant tests, maintenance, inspection and alteration of the Park, and make those records available to any employee or relevant health and safety representative.

Noise

Audiometric test records of employees should be kept during the employee's period of employment and longer as necessary, as they may provide a useful reference for workers' compensation. The records should be kept in a safe, secure place and held as confidential documents.

Hazardous Substances

Assessment reports which indicate a need for monitoring and/or health surveillance together with the results of monitoring and/or health surveillance shall be kept as records in a suitable form for at least 30 years from the date of the last entry made. Retention for a period of at least 30 years is necessary because some health effects, such as cancers, may take a long time to become evident. The information kept will be valuable in epidemiological studies and for developing effective control strategies.

All other records, including assessment reports not indicating a need for monitoring and/or health surveillance and records of induction and training, shall be maintained for at least five years in a suitable form.

4.6 CONTRACTOR REQUIRMENT

Apart from the provisions under “General Specification” and “Particular Specification” for different sub-project components, the following special environmental clauses (SECs) shall be included in the Tender Document under General/Particular Specification. These clauses are

aimed at ensuring that the Contractor carries out his responsibility of implementing the EMP and other environmental and safety measures.

Environmental Management Plan (EMP): The Contractor shall carry out all mitigation and enhancement measures (including those related to mitigation of air/noise/water pollution; drainage/traffic congestion) as specified in the Environmental Management Plan (EMP), annexed to his Contract. This includes Table4.2-1 (mitigation measures during construction) and Table 4.4-3 (Environmental monitoring plan during construction phase)

Temporary Works: The Contractor shall make sure that all equipment and safeguards required for the construction work such as temporary stair, ladder, ramp, scaffold, hoist, run away, barricade, chute, lift, etc. are 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.

Occupational Health and Safety:

The Contractor shall-

- observe and maintain standards of Health and Safety towards all of his employees not less than those laid down by the national standards or statutory regulations.
- provide all appropriate protective clothing and equipment for the work to be done and ensure its proper use. Where required, safety nets, the contractor shall provide belts, harnesses and lines. The "safety directives for work equipment" and "safety directives for protective gears", as specified in the Occupational Health and Safety Guidelines shall be followed.
- provide and maintain in prominent and well-marked positions all necessary first-aid equipment, medical supplies and other related facilities. A sufficient number of trained personnel will be required to be available at all times to render first aid.
- provide or ensure that appropriate safety and/or health signs are in place at their work sites where hazards cannot be avoided or reduced.
- report to the Engineer promptly and in writing particulars of any accident or unusual or unforeseen occurrences on the site, whether these are likely to affect progress of the work or not.

Disposal and Pollution:

The Contractor shall-

- not dispose any waste, rubbish or offensive matter in any place not approved by the Engineer or Statutory Authority having jurisdiction. The Contractor shall not discharge into any watercourse oil, solids, noxious or floating materials.
- take all reasonable precautions to keep public or private roads clean of any spillage or droppings from his vehicles or equipment. Any spillage or droppings, which accrue, shall be cleaned without delay to the satisfaction of the Engineer.

- provide waste bins/ cans for collection of solid waste at appropriate locations (as directed by the Engineer), and ensure proper transfer/disposal of solid waste.

4.7 CONCLUDING REMARKS

Apart from the services mentioned above, the Environmental Management Unit (EMU) must ensure that all staffs working within the HTC are oriented, through orientation programs, about the do's and don'ts during emergencies as well as overall environmental aspects and issues related to HTC operations. It is however, to be emphasized that the emergency response plan (ERP) outlined in the Chapter-10 is to be used as guide only and that the Environmental Management Unit and the Emergency Response Cell shall develop their own environmental management system (EMS) following other international guidelines and standards.

ANNEX-V: EMERGENCY RESPONSEMANAGEMENT PLAN

5.1 INTRODUCTION

Emergency response plans are developed to address a range of plausible risk scenarios and emphasize the tasks required to respond to a physical event. The emergency response plan (ERP) for the proposed HTC has been developed listing various actions to be performed in a very short period of time in a predetermined sequence if it is to deal effectively and efficiently with any emergency, major accident or natural disaster. The primary objective of the plan is to keep the loss of life, material, machinery/equipment damage, and impacts on the environment to minimum.

5.2 EMERGENCY RESPONSE CELL

It is highly recommended that an Emergency Response Cell (ERC) adequately equipped with highly trained manpower and appropriate gears is established within the Park complex in order to effectively implement the emergency response plan.

The main functions of the emergency response cell should include the following:

- Identification of various types of emergencies
- Identification of groups, communities, and areas those are vulnerable to different kinds of emergencies
- Preparing service teams for various operations within the organization through extensive training
- Establishment of early detection system for emergencies
- Developing reliable, instant information communication system
- Mobilizing all units in the complex within a very short time to address any emergency

5.3 EMERGENCY PREPAREDNESS

The ERC headed by a trained Manager should establish an Emergency Control Room with links to all building control rooms and all other services. The ERC shall work as a team of the following officials:

- Emergency Manager (Team Leader),
- Security and Safety Officer,
- Chief Medical Officer, and
- Public Relations Officer

The Senior Environmental Engineer of the proposed Environmental Management Unit for the BHTC with adequate skills of facing emergency situation can act as the Emergency Manager of ERC. The Emergency Manager (EM) shall have the privilege of shutting down the building, which are affected or may further deteriorate damages, in case of an emergency.

The EM however, shall have to report to the Chief of the HTC of such an event without any delay.

The team will be responsible for preparing and executing a specific emergency response plan for the HTC complex. The team should meet at regular intervals to update the plan, based on HTC emergency data and changes in support agencies.

The team should undertake some trial runs, e.g. fire drill, in order to be fully prepared and to improve upon the communication links, response time, availability and workability of emergency gears and other critical factors.

Upon receiving information about an accident, the ERC team will assemble in the Emergency Control Room within the shortest possible time and formulate emergency control procedure.

5.4 FIRE FIGHTING SERVICES

- The Security and Safety officer will be the commanding officer of the firefighting services. The Security and Safety officer will head a fire fighting team of trained officers and workers. The size of the team should be determined by the HTC considering requirement of all existing and proposed buildings within the complex.
- Adequate firefighting equipment e.g. fire extinguishers of different types appropriate for different strategic locations must be planned according to requirements of existing and future buildings in the complex.
- Depending on the scale of emergency, the firefighting team will work in close association with security and maintenance personnel of the complex. Additional assistance may also be sought from outside fire stations when required.
- Preparedness is extremely important for efficient and effective firefighting services at the time of emergency. This can be better achieved by organizing fire drills at regular intervals, e.g. once every two weeks during dry summer months and once every two months during wet months involving all team members, all other service groups, all staff of the HTC complex, and utilizing all firefighting gears.

5.5 EMERGENCY MEDICAL SERVICES

- The Medical Officer will be responsible for providing medical services within the HTC at the time of any emergency. The services should also be rendered to people living in the close vicinity of the complex and affected by any accident within the park complex.
- The existing Medical Center of the HTC must be equipped with adequate medical personnel and equipment for providing emergency services in addition to normal Medicare services to population of the complex.
- A team of well-trained Medical Officers specializing in burn injury, orthopedics, electrocution, chemical toxicity or poisoning, and shock treatment must be available at the HTC Medical Center. The number of officers may be determined considering the total number of staff and their family members in the complex. Special attention must be given to child injury treatment.

The following services must be on alert at all times in the Park complex.

- First aid services for attending patients on the spot. The Medical Center should provide training on first aid services to some designated staffs of important areas of operation, for immediate attention to the injured.
- Ambulance services for transport of casualties from spot to Medical Center of the Park, and from Medical Center to outside hospital, as necessary. Facilities for transportation of fatalities to appropriate hospital or to relatives or to the police following prescribed procedure should be available.
- All potential areas for emergency/ accidents in the park complex must have an information chart including contact phone numbers of relevant services.

5.6 RESCUE SERVICES

Without going for additional manpower, the rescue team can be formed with potential staffs of the HTC, e.g. from medical services, security services and firefighting services, for conducting rescue operations following an emergency. The Security and Safety Officer will be responsible for formulating rescue plan and guiding the team as well. Important functions include:

- Cut-off electricity, fuel or water supply to accident spots
- Rescue people from debris of collapsed structures
- Demolish damaged structures that may endanger human lives
- Rescue people from fire areas with adequate protection
- Assist other services promptly to save human lives
- Salvage equipment from debris
- Isolate damaged equipment or machineries that may endanger human lives
- Provide repair services as appropriate to restore operations

5.7 SECURITY SERVICES

The HTC will have a strong independent security team headed by the Security and Safety Officer and will be responsible for the overall security of the Park complex, its equipment, machineries, buildings, utilities, and the community living within the complex. The security office shall maintain liaison with other emergency services at the time of emergency and during normal hours.

The Security and Safety Officer shall communicate with local police and other law enforcing agencies and seek assistance as may be needed during an emergency. In particular they will ensure that all roads are unobstructed during emergencies.

5.8 PUBLIC RELATIONS SERVICES

The Public Relations Officer (PRO) of the HTC will be responsible for communicating emergency related information to concerned officials within the complex. The PRO however, will consult the Emergency Manager before communication with outside agencies. The PRO will be responsible for warning people in and around the complex against potential fire hazards, or possible chemical contamination of water. The PRO will keep close contact with

outside local community and provide direction, and participate along with management team in the welfare services for the affected communities.

ANNEX-VI: GRIEVANCE READDRESS MECHANISM

6.1 INTRODUCTION

Experience from past projects shows that project implementation is a complex process involving numerous interested and aggrieved parties giving rise to likely instances of conflict, allegations, etc. Most of the conflicts and allegations appear not to be of a serious nature but may snowball into a bigger issue if not given adequate attention from the beginning itself.

Some of the potential points that could give rise to grievances could be related to compensation payment, improper estimation of affected assets, failure to fulfill commitments, poor management of construction activities, inappropriate planning of vehicle movement, and cultural conflicts between migrant workers and local communities etc.

Therefore, it is imperative to have an internal mechanism in place where the aggrieved party/s can lodge their complaints and get it amicably settled prior to approaching the formal mode of solution available to them i.e. access to legal system through courts. In order to provide a formal forum to the aggrieved parties to deal with issues arising out of project, it is proposed that a joint grievance redress mechanism be instituted for both environmental and social related issues.

The proposed Grievance Redress mechanism (GRM) will be developed for the Project in order to settle as many disputes as possible through consultations. Such a mechanism is important as it is expected that most cases, if not all, would be resolved amicably; and the process, as a whole, will promote dispute settlement through mediation to reduce litigation. However, the options of legal recourse will not be restricted in any way by the project proponent.

6.2 OBJECTIVES OF GRIEVANCE REDRESS MECHANISM

The basic objective of the GRM shall be to provide an accessible mechanism to the affected people, community and any stakeholder(s) having stake in the project to raise their issues and grievances as well as concerns. The Grievance Redress Cell (GRC) shall be officially recognized "non-judicial" body that will seek to resolve non-judicial disputes arising out of various matters related to the implementation of the ESMP, as well as other aspects of the project, as may deemed fit to be raised before the GRC.

The fundamental objective of GRM is to resolve any resettlement and environmental related grievances locally in consultation with the aggrieved party to facilitate smooth implementation of the EMP. Another important objective is to democratize the development process at the local level and to establish accountability towards the stakeholders.

6.3 COMPOSITION OF GRC AND ULC

It is suggested to have two levels of grievance redress mechanism for the project, viz. Grievance redress Cell (GRC) at the project level and another at Union level committee (ULC). The aim of having two levels of grievance redress mechanism is to provide a higher forum to the aggrieved party, if the same is not satisfied with the decision of GRC.

GRC will be driven internally by BHTC and shall have the following representation to ensure fair and timely solution to the grievances:

- Community officer serving as grievance officer;
- BHTC Environment and social officer
- Project management representative;
- BHTC EHS representative;

The composition of ULC will have the following members:

- Kaliakoir Union Parishad Chairman or his representative
- BHTC Project Manager
- BHTC Environment and social officer
- Local elected Union Member
- Representative of affected people and women

The normal route to be followed for any grievance shall be GRC, and in case not satisfied then to ULC; however, the grievances can be directly taken to ULC too. The ULC shall be empowered to take a decision which is binding on BHTC and considered final. However, the decision of ULC is not binding on aggrieved person; he or she can take the legal course if not satisfied with the outcome of GRC decision.

The representation in the committee makes project affected persons to have trust and build confidence in the system. The grievance redress committee reports its plan and activities to the Implementation committee.

GRC will maintain a Complaints Database, which will contain all the information on complaints or grievances received from the communities or other stakeholders. This would include: the type of complaint, location, time, actions to address these complaints, and final outcome.

The procedures to be followed and adopted by the grievance redress should be transparent and simple to understand or uniform process for registering complaints provide project affected persons with free access to the procedures. The response time between activating the procedure and reaching a resolution should be as short as possible. An effective monitoring system will inform project management about the frequency and nature of grievances. GRC will arrange half yearly meetings where the activities and the outcomes/measures taken according to the Complaints Database are to be monitored and reviewed by third party consultant to ensure the required transparency. In addition to the above, if there are any grievances related to social or environmental management issues in the project area, the GRC will record these grievances and suggestions and pass it on to the relevant consultant for necessary action and follow up.

In case a dispute is not resolved by arbitrational tribunal, then if any of the Party disagrees, the aggrieved party has the right to appeal to the ordinary courts of law.

However, the preferred option of dispute settlement ought to be the option of settling the dispute amicably because recourse to courts may take a very long time even years before a final decision is made and therefore, should not be the preferred option for both parties concerned.

A grievance form is presented below and hard copies of both English and Bangla will be made available at the HTC project office.

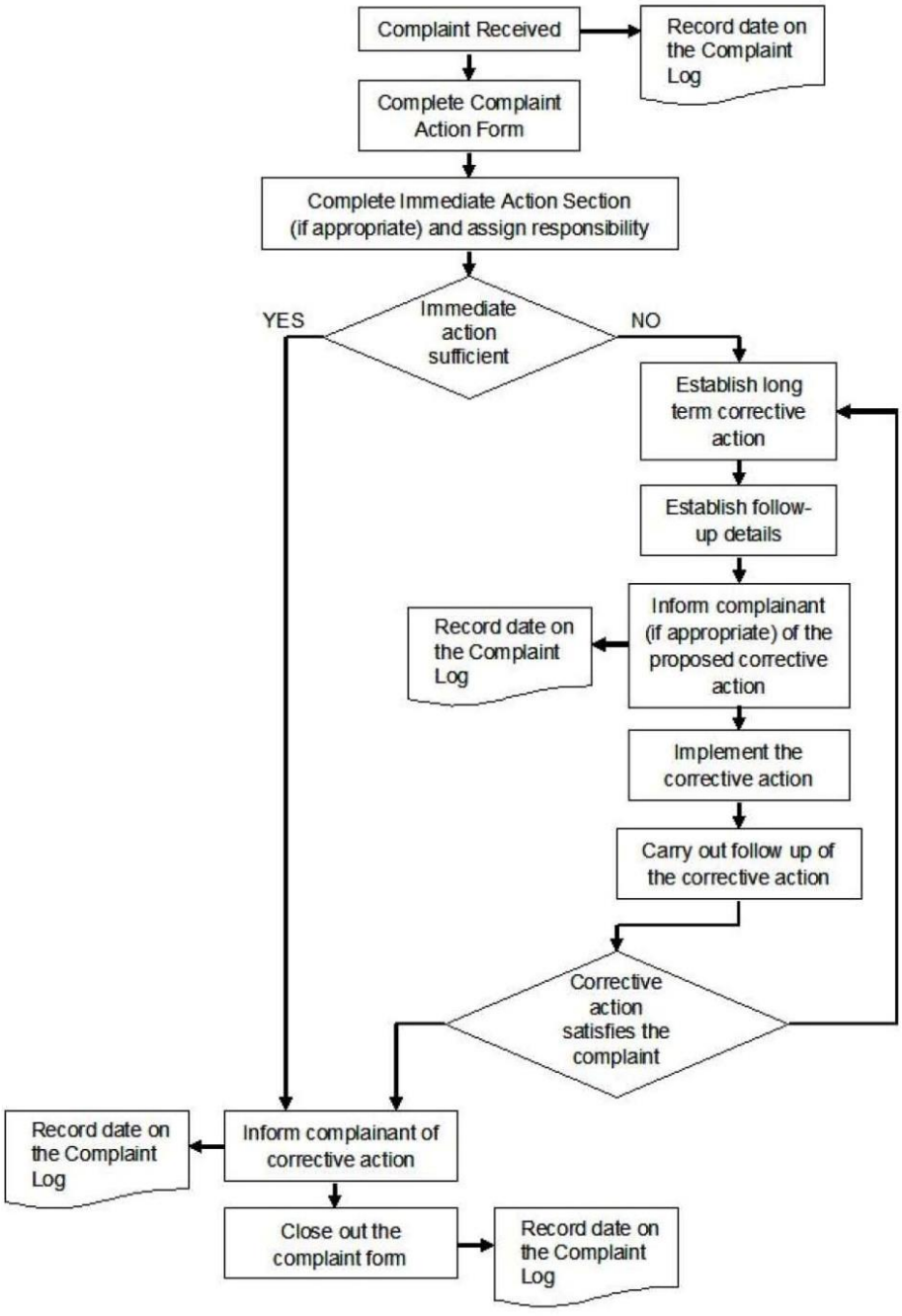


Figure 6.3-1 Flow Chart of Grievance Procedure

Table 6.3-1: Sample Grievance Reporting Form

Reference No.	Date:
Contact Details	Name

	Address
	Telephone Number/Cell Number:
	Email:
How would you prefer to be contacted (please tick box)	▪ By Phone ▪ By Email
Details of your Grievance: (Please describe the problems, how it happened, when , where, and how many times, as relevant)	
What is your suggested resolution for the grievance?	
Signature of complainant/ Thump impression of complainant	Signature of person filling the form (BHTC Representative)

ANNEX-VII: ENVIRONMENTAL AUDIT CHECKLIST

ENVIRONMENTAL AUDIT

Environment Audit can be defined as ' methodical process to verify and evaluate environment performance of an organization in terms of regulatory compliance and/or its own set of environment goals which go beyond the minimum legislative requirement, on a regular basis. An Audit report is prepared based on the current situation of the BTL and project site scenario following the assessment of the checklists listed below.

SECTION 1 - ENVIRONMENTAL MANAGEMENT SYSTEMS AUDIT CHECKLIST
SECTION 2 - SITE AUDIT CHECKLIST
SECTION 3 – GAP IDENTIFICATION AND RECOMMENDED REMEDIAL MEASURES

SECTION 1 – ENVIRONMENTAL MANAGEMENT SYSTEMS AUDIT CHECKLIST

Sl.	Management	Issues	Yes/No	Comments
1	**Management Issues**	a. Are the environmental management responsibilities clearly assigned?	**Yes**	
		b. Is there an ESIA document available for the facility approved by the DOE?	No	DOE has provided EIA approval. Need to take ECC from DOE.
		c. Does your company have a systematic documentation process by which the current environmental activities including trainings are recorded?	No	
		d. Does your company have a budget for Environmental activities?	Yes	
		e. Does your company regularly produce environmental reports (6 monthly)?	No	
		f. Do your company has a grievance redress system for the stakeholders?	Yes	
		g. Are the responsibilities of the Chief Executive of your company in regard to the environment adequately documented and agreed with the relevant authorities?	yes	
2	**Training and awareness**	a. Has your company conducted a Training Needs Analysis (TNA) for environmental management including Ecological Sustainable Development issues?	Yes	
		b. Does your company provide necessary training for the employees	Yes	
		c. How does your company assess the adequacy of resources and training of staff with designated responsibilities for environmental management and/or protection?	Yes	Following the ESMS
		d. Are employees encouraged to take the initiative, submit suggestions for improvement, and to suggest actions or policies to reduce your company's environmental impact?	Yes	
		e. Does the training include response to emergencies and drills, and working with external agencies such as fire brigade?	No	
3	**Documentation**	a. Has your company established and maintained procedures for controlling all key documents?	Yes	
		b. Are the procedures adequate so that the documents can be located, are at relevant locations essential to the effective functioning of the EMS, are periodically reviewed and revised as necessary and approved for adequacy by those authorized to approve alterations to documentation?	Yes	

Sl.	Management	Issues	Yes/No	Comments
4	**Monitoring and Measurement**	a. Does your company have procedures to regularly monitor and measure the significant operations and activities that can have a significant impact on the environment?	Yes	
		b. Does your company have systematic and documented procedures to evaluate compliance with relevant environmental legislation and regulations?	Yes	

SECTION 2 - SITE AUDIT CHECKLIST

The following table provides a starting point for assisting auditors in preparing for a site audit. In most cases additional questions supporting information and clarification from site staff will be necessary. As much information should be gathered in advance of the site visit. Verify that the items are present or documented, in particular environmental impact and risk assessments, operating permits and other licenses during Audit Preliminary Meeting and Site Inspection.

Sl.	Site Audit	Issues	Yes/No	Comments
	Site Inspection (Walk-Around)	a. Is the site well organized and maintained in good condition?	Yes	
	Air Emissions	a. Are site processes and operations free of significant fugitive air emissions?	Yes	
	Water Discharges	a. If the site's discharge of liquid effluent to ground, surface water (including streams, rivers and lakes) meet DOE standard?	Yes	
	Solid & Hazardous Waste	a. Does your company have an inventory of both hazardous and Non-hazardous waste?	Yes	
		b. Does the site have details of where wastes are finally disposed of (including by waste)?	Yes	
		c. Does the plant produce any hazardous waste?	No	
	Storage	a. Are containers storing hazardous materials: i. In good condition fit for purpose labelled properly? ii. Are liquid hazardous materials stored as follows: • On impervious surface? • With secondary containment (capable of volume of the largest stored container prevailing regulations and guidance)?	No	
		b. Are storage areas: i. well maintained; ii. clearly identified; iii. protected from weather as necessary?	Yes	
	Emergency planning and community relations	a. Are the site emergency procedures regularly reviewed and exercised?	Yes	
		b. Is the chain of incident commander responsibility clearly defined?	Yes	
		Hazardous substances a. Is there a program to eliminate, or if not possible reduce the use of hazardous substances? b. Is there a list of the hazardous substances on site, plus information on handling, disposal, MSDS etc. c. Does your company, routinely or in specific circumstances, track chemical use through materials accounting or some other method as distinct from, or in addition to, tracking environmental releases?	NO	Site does not contain any hazardous substances.
	Legacy Issues	Are there any legacy issues (e.g., dumps of wastes) for the site?	No	

SECTION 3 – GAP IDENTIFICATION AND RECOMMENDED REMEDIAL MEASURES

Sl.	Issues	Current Status	Remedial Measures
1.	Documentation	Lack of systematic documentation process	Systematic documentation process need to be started as per the ESIA report.
2.	Reporting	Not producing half yearly environmental reports	Following the ESIA report Half-yearly report need to be produced.
3.	ECC	No approved EIA for DOE	Need to Get ECC from DOE with a comprehensive EIA study doc.

ANNEXE-VIII: BHTC MASTER PLAN LAYOUT

KALIAKOIR	
	Acre
Site Extent	275.69
Alternate Road	4.52
33KV Pylon with Buffer	3.57
Railway with Buffor	4.97

Description	Total Area		Saleable Area		Non Saleable Area	
	in Acres	in %	in Acres	in %	in Acres	in %
Category A						
A. Industries						
MTB	16.10	6.13%	16.10	6.13%		
IT/ITES	35.33	13.45%	35.33	13.45%		
Hardware	9.32	3.55%	9.32	3.55%		
B.Customs,Security, Admin, entrance plaza	1.86	0.71%			1.86	0.71%
C.WareHouse	5.26	2.00%	5.26	2.00%		
Category A	67.87	25.84%	66.01	25.13%	1.86	0.71%
Category B						
D. Entrance Plaza	0.70	0.27%	0.35	0.13%	0.35	0.13%
E. Residential						
Dormitory	1.52	0.58%	1.52	0.58%		
High Rise	8.69	3.31%	8.69	3.31%		
Mid Rise	8.17	3.11%	8.17	3.11%		
Single Family Villas	14.88	5.67%	14.88	5.67%		
Mixed use	3.44	1.31%	3.44	1.31%		
Servant Quarters	1.81	0.69%	1.81	0.69%		
F. Commercial & CBD	7.32	2.79%	7.32	2.79%		
G. Institutions, Social Amenities, Sports & Recreation						
University	25.60	9.75%	25.60	9.75%		
Recreations	5.73	2.18%			5.73	2.18%
Hospital	3.17	1.21%			3.17	1.21%
School	7.16	2.73%	7.16	2.73%		
H. Existing Admin Building	0.87	0.33%			0.87	0.33%
I. Training Centre	10.22	3.89%	10.22	3.89%		
Category B	99.28	37.80%	88.16	33.89%	10.12	3.90%
J. Road	35.67	13.54%			35.67	13.54%
K. Utility	14.10	5.37%	7.05	2.68%	7.05	2.68%
L. Greenery	45.81	17.44%			45.81	17.44%
GRAND TOTAL	262.83	100.00%	162.22	61.77%	100.41	38.23%

LEGEND

- MTB
- IT/ITES
- Sub Station, STP,SWM,WTP/OHT
- Hardware Industry
- Admin/Security/Custom
- Logistics
- School
- University
- Training Centre
- Railway Area
- Road
- Hospital
- Recreation
- Single Family Villas
- Commercial
- Mid Rise Residential
- Servant Quarters,Dormitory
- High Rise Residential
- Mixed Use
- Water Body
- Greenery

ANNEXE-IX: TEST RESULT OF SURFACE AND GROUND WATER QUALITY

ANNEXE-X: TEST RESULT OF AMBIENT AIR QUALITY OF THE STUDY AREA

ATOMIC ENERGY CENTRE

4, KAZI NAZRUL ISLAM AVENUE, P.O. BOX NO. 164,
DHAKA-1000, BANGLADESH

FAX : 880-2-8613051,
E-MAIL: aecd@citechco.net
Tel. No. : 880-2-8617946

Ref No: Request letter dated 12/04/19, BETS/WSE/0516-(06)-1 DATE: 29/04/2019

TEST RESULTS OF AMBIENT AIR QUALITY MONITORING

SAMPLEING SITE DESCRIPTION

1. **Sampling location** : **Kaliakoir Hi-tech Park Project of BTL**

2. **Date of sampling** : **20-29 April, 2019**

ANALYSIS

The particulate matters, PM_{10}, $PM_{2.5}$ concentrations were measured by collecting samples on Teflon filters using Airmetric portable samplers and subsequent gravimetric analysis using microbalance. The SO_2 and NO_2 samples were collected on impinger (For SO_2 the absorbing reagent is mercuric chloride and sodium chloride and for NO_2, the absorbing reagent is sodium hydroxide and sodium arsenite) using GENT sampler and CO concentrations were determined using Gas Badge Pro monitor.

RESULTS

Sampling Date		PM_{10}	$PM_{2.5}$	SOx	NOx	CO
		$\mu g/m^3$ (24h average)			mg/m³ (1h average)	
22/04/19		137	83.3	21	0.066	<0.3
24/04/19		236	118	25	0.076	<0.3
26/04/19		138	69.2	23	0.072	<0.3
28/04/19		142	72.4	23	0.068	<0.3
BNAAQS	24h average ($\mu g/m^3$)	150	65	365	-	40 mg/m³
	Annual ($\mu g/m^3$)	50	15	-	100	-
WHO	24h average ($\mu g/m^3$)	50	25		200 (1h average)	10,000
	Annual ($\mu g/m^3$)	20	10		40	-

Note: The $PM_{2.5}$ concentrations are higher than BNAAQS due to seasonal effect (pre-monsoon season).

Begum

29/04/2019

(Dr. Bilkis Ara Begum)
Director, Atomic Energy Centre, Dhaka

ANNEXE-XI: TEST RESULTS OF NOISE LEVEL OF THE STUDY AREA

ATOMIC ENERGY CENTRE

4, KAZI NAZRUL ISLAM AVENUE, P.O. BOX NO. 164,
DHAKA-1000, BANGLADESH

FAX : 880-2-8613051,
E-MAIL: aecd@citechco.net
Tel. No. : 880-2-8617946

Ref No: Request letter dated 09/06/16, BETS/WSE/0516-(06)-1 DATE: 15/06/2016

NOISE LEVEL AT PROJECT SITES

SAMPLEING SITE DESCRIPTION

1. Sampling locations : Kalikoir Hi-tech Park Project of BTL

2. Date of sampling : 10-11 June, 2016

NOISE LEVEL MONITORING

The noise level is monitored using Sound Level Meter (Model No SL 4012) which is calibrated using Tenma 72-945 (NEDA-1604 IEC-6F22). The noise levels at project sites are presented in Table 1. The noise levels of plants sites are lower than the ECR 1997.

Table 1: Sound monitoring at the Project site

Direction	6am	2pm	10pm
	dB		
Northeast	41.8±3.0	43.7±1.7	42.7±2.4
Southeast	49.5±4.2	45.1±2.5	48.9±1.8
Southwest	49.1±0.8	47.8±1.9	53.2±1.8
Northwest	43.8±1.5	48.3±0.3	47.4±3.1
ECR 1997 (Industrial area)	***75*** **Day time (6am – 9pm)**	***75*** **Day time (6am – 9pm)**	***70*** **Night time (9pm-6am)**

OBSERVATIONS

- Noise level monitoring data is compliant with the National Noise Level Standards (ECR 1997) of Project site.

Begum
15/06/16
(Dr. Bilkis Ara Begum)
Head, Chemistry Division

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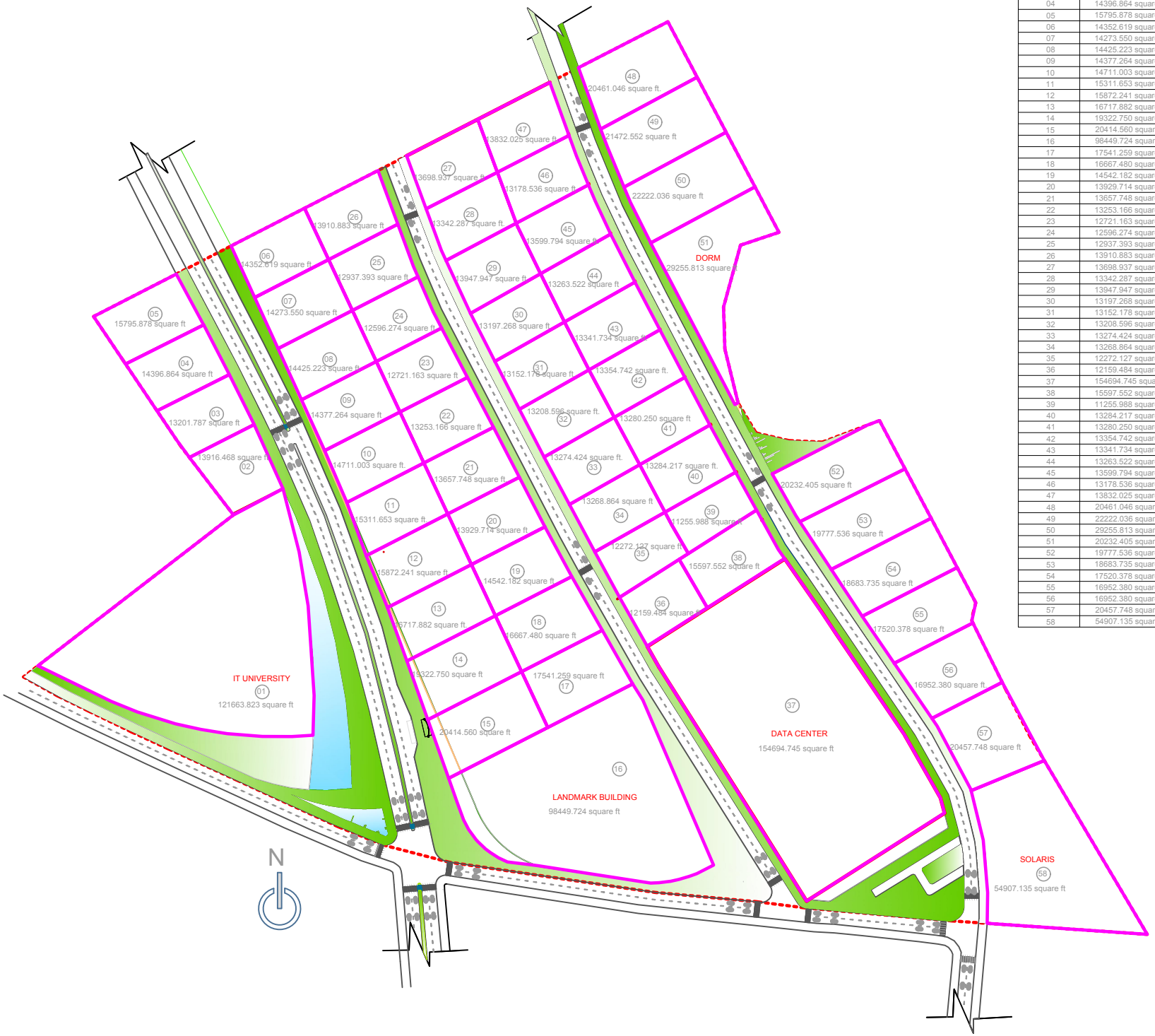
ANNEXE-XII: BLOCK-3 AREA CHART

BHTC BLOCK-3 AREA CHART

PLOT NO.	SQUARE FEET
01	121663.823 square ft
02	13916.468 square ft
03	13201.787 square ft
04	14396.864 square ft
05	15795.878 square ft
06	14352.619 square ft
07	14273.550 square ft
08	14425.223 square ft
09	14377.264 square ft
10	14711.003 square ft.
11	15311.653 square ft.
12	15872.241 square ft
13	16717.882 square ft.
14	19322.750 square ft
15	20414.560 square ft
16	98449.724 square ft
17	17541.259 square ft
18	16667.480 square ft
19	14542.182 square ft
20	13929.714 square ft
21	13657.748 square ft.
22	13253.166 square ft
23	12721.163 square ft
24	12596.274 square ft
25	12937.393 square ft
26	13910.883 square ft
27	13698.937 square ft
28	13342.287 square ft.
29	13947.947 square ft.
30	13197.268 square ft
31	13152.178 square ft.
32	13208.596 square ft.
33	13274.424 square ft.
34	13268.864 square ft
35	12272.127 square ft
36	12159.484 square ft
37	154694.745 square ft
38	15597.552 square ft
39	11255.988 square ft
40	13284.217 square ft.
41	13280.250 square ft
42	13354.742 square ft.
43	13341.734 square ft.
44	13263.522 square ft
45	13599.794 square ft.
46	13178.536 square ft
47	13832.025 square ft.
48	20461.046 square ft.
49	22222.036 square ft
50	29255.813 square ft
51	20232.405 square ft
52	19777.536 square ft
53	18683.735 square ft
54	17520.378 square ft
55	16952.380 square ft.
56	16952.380 square ft.
57	20457.748 square ft
58	54907.135 square ft



ANNEXE-XIII: TEST RESULT OF SOIL OF THE STUDY AREA

Government of the Peoples Republic of Bangladesh
Soil Resource Development Institute
Central Laboratory
Krishi Khamar Sarak, Dhaka.

No-Lab/44(2)/03/ 282 Date : 20/07/16

To

Md. Zahidul Islam Miah
Water Quality Specialist
Water Supply, Sanitation and Environment Department
BETS Consulting Services Limited
House No-10, Road No-135,
Gulshan-1, Dhaka-1212.

Subject: **Analytical results of 02 soil samples (Kaliakoir Hi-tech Park Project).**

The analytical results of soil samples sent by you are attached herewith.

Lab No.	Soil sample No.	pH	Organic Matter	Total Nitrogen	Potassium	Calcium	Magnesium	Phosphorus	Zinc
			%		meq/100g soil			µg/g (ppm)	
2835	1) ID # BTL-S-01	6.1	0.54	0.027	0.20	13.57	3.74	2.44	0.57
		Slightly Acidic	Very Low	Very Low	Medium	Very High	Very High	Very Low	Low
2836	2) ID # BTL-S-02	6.3	2.96	0.148	0.60	14.00	2.63	13.29	7.63
		Slightly Acidic	Medium	Low	Very High	Very High	Very High	Medium	Very High

20/7/16

(Md.Nazmul Hasan)
Principal Scientific Officer
Phone : 9110507
Email: hasanmnazmul@gmail.com

Copy:
1. Office Copy.

soil result.4

ANNEXE-XIV: CHANCE FIND PROCEDURES FOR PROTECTION OF CULTURAL PROPERTY

CHANCE FIND PROCEDURES FOR PROTECTION OF CULTURAL PROPERTY

Works could impact sites of social, sacred, religious, or heritage value. "Chance find" procedures would apply when those sites are identified during the design phase or during the actual construction period and the related activity will not be eligible for financing under the project.

1. Cultural property include monuments, structures, works of art, or sites of significance points of view, and are defined as sites and structures having archaeological, historical, architectural, or religious significance, and natural sites with cultural values. This includes cemeteries, graveyards and graves.

2. The list of negative subproject attributes, which would make a subproject ineligible for support, includes any activity that would adversely impact cultural property.

3. In the event of finding of finding properties of cultural value during construction, the following procedures for identification, protection from theft, and treatment of discovered artifacts should be followed and included in standard bidding documents.

(a) Stop the construction activities in the area of the chance find;

(b) Delineate the discovered site or area;

(c) Secure the site to prevent any damage or loss of removable objects;

(d) Notify the supervisory Engineer who in turn will notify the local authorities (city corporations) and the Department of Archaeology, Bangladesh. The Department of Archaeology of Bangladesh is mandated to protect archaeological relics and antiquities in the country as per the Antiquities Act 1968. The contacts for the Department can be found in: http://www.archaeology.gov.bd/contactus.php

(e) The Department of Archaeology, Bangladesh would be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures.

(f) Decisions on how to handle the finding shall be taken by the Department of Archaeology, Bangladesh. This could include changes in the layout (such as when finding an irremovable remain of cultural or archeological importance), conservation, restoration and salvage.

(g) Implementation for the authority decision concerning the management of the finding shall be communicated in writing by the Department of Archaeology, Bangladesh.

(h) Construction work could resume only after permission is given from the Department of Archaeology, Bangladesh concerning safeguard of the heritage.

4. These procedures must be referred to as standard provisions in construction contracts. During project supervision, the Site Engineer shall monitor the above regulations relating to the treatment of any chance find encountered are observed.

Relevant findings will be recorded in World Bank Supervision Reports and Implementation Completion Reports will assess the overall effectiveness of the project's cultural property mitigation, management, and activities, as appropriate.

ANNEXE-XV: PHOTOGRAPHS OF PUBLIC CONSULTATION



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Public Consultation in 2016

Public Consultation in 2019

ANNEXE-XVI: EHS GUIDELINES BOTH GENERAL AND SPECIFIC ONE FOR SEMICONDUCTOR AND ELECTRONIC MANUFACTURING OF WBG (IFC)

Environmental, Health, and Safety Guidelines for Semiconductors & Other Electronics Manufacturing

Introduction

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP)[1]. When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These industry sector EHS guidelines are designed to be used together with the **General EHS Guidelines** document, which provides guidance to users on common EHS issues potentially applicable to all industry sectors. For complex projects, use of multiple industry-sector guidelines may be necessary. A complete list of industry-sector guidelines can be found at: www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them.

The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variables, such as host country context, assimilative capacity of the environment, and other project factors, are taken into account. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons.

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.

Applicability

The EHS Guidelines for Semiconductors and Other Electronics Manufacturing include information relevant to semiconductors and other electronics manufacturing projects and facilities**.** It does not include information about the extraction of raw materials, assembly of general components, manufacturing of screens for the assembly of internal components within the plastic structure, or production of standard connectors. Annex A contains a full description of industry activities for this sector. This document is organized according to the following sections:

Section 1.0 — Industry-Specific Impacts and Management
Section 2.0 — Performance Indicators and Monitoring
Section 3.0 — References
Annex A — General Description of Industry Activities

[1] Defined as the exercise of professional skill, diligence, prudence and foresight that would be reasonably expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally. The circumstances that skilled and experienced professionals may find when evaluating the range of pollution prevention and control techniques available to a project may include, but are not limited to, varying levels of environmental degradation and environmental assimilative capacity as well as varying levels of financial and technical feasibility.

1.0 Industry-Specific Impacts and Management

The following section provides a summary of EHS issues associated with semiconductors and other electronic manufacturing that occur during the operational phase, along with recommendations for their management. Recommendations for the management of EHS issues common to most large industrial facilities during the construction and decommissioning phases are provided in the **General EHS Guidelines**.

1.1 Environment

Environmental issues in semiconductors and other electronics manufacturing projects primarily include the following:

- Hazardous material use and waste management
- Air emissions
- Wastewater
- Energy use
- General process modifications

Hazardous Materials and Wastes

Almost all processes in semiconductors and other electronics manufacturing generate hazardous or potentially hazardous wastes, such as spent deionized water (containing inorganic acid), spent solvents and developers (e.g., iso-paraffinic hydrocarbons), spent cleaning solutions, sludges from wastewater treatment, spent epoxy material (printed circuit board [PCB] and semiconductor manufacturing), spent cyanide solutions (electroplating), and soldering fluxes and metals residue (printed circuit board assembly [PCBA]).

In addition to the relevant measures on hazardous materials management indicated in the **General EHS Guidelines,** specific pollution prevention techniques include process modifications and substitutes as follows:[2]

- Implementing process or equipment modifications, including:[3]
  - Regenerate plating baths by activated carbon filtration to remove built-up organic contaminants, which reduces the volume of plating baths to be disposed of and reduces the need for new chemicals;
  - Adopt automated gas cabinet systems to control fugitive emissions of gases from cylinders, particularly during changes;
  - Use of lead solder replacements with substitutes, such as tin alloys and other lead-free solders;
- Raw material substitution or elimination—for example, substitution of cyanide plating solutions (for gold plating in PCB industry) with acid sulfate copper, gold sulfite, and electroless nickel; replacing Cr VI with Cr III plating baths (PCB manufacturing, although the use of chromic plating baths is obsolete);
- Hazardous substance and waste segregation, separation, and preparation—for example, segregation of wastewater sludge by metal contaminants enhances waste recovery; storage of plating chemicals to segregate incompatible substances, such as cyanides from acids, and oxidizing agents from combustibles;
- Metal recovering and recycling, primarily in the semiconductor and PCBA sectors —for example, recovering copper and precious metals by electrolytic process; removing and recovering copper and tin from

[2] The use of lead, mercury, cadmium, chromium (Cr VI), polybrominated biphenyls, and polybrominated diphenyl ethers should be restricted or phased out as described by European Union (2003a and 2003b). Use of chlorofluorocarbons and trichloroethylene are phased out. Restrictions to the use of perfluorooctane sulfonates are being considered through the amendment of EU Council Directive 76/769/EEC (COM/2005/0618 final - COD 2005/0244). Voluntary measures to limit the use and the releases of perfluorooctane sulfonates have been adopted by the World Semiconductor Council (WSC) and the Semiconductor Equipment and Materials International (SEMI).

[3] Additional information is presented in Annex A.

boards by electrolysis-chemical precipitation; recovery of arsenic and gallium from gallium arsenide (GaAs) processing wastes (through thermal separation of GaAs solid wastes and recovery from GaAs polishing wastes);

- Reduce releases of perfluorooctane sulfonates (PFOS) in semiconductor manufacturing by phasing out non-critical uses of PFOS-based substances, such as some etching mixtures for which substitutes exist. For critical PFOS uses where no alternatives exist, such as shorter wavelength technologies used in the manufacture of semiconductors, controlled disposal of wastes should be carried out, particularly if incineration is involved.[4]

Hazardous materials management is discussed in the **General EHS Guidelines**. Specific measures for this sector include:

- Process chemicals storage areas should be regularly checked to identify leaks;
- Underground piping should be in a double pipe, with a means of identifying leaks from the inner pipe;
- Pipework carrying hazardous materials should be constructed of compatible materials and should be sufficiently supported, clearly labeled, and installed with high-quality joints. Piping should also be designed with low point drains, high point vents, and isolation valves every 30 meters maximum;
- Waste spill containment trays should be used.

Solid and hazardous waste management is discussed in the **General EHS Guidelines**. In this sector include, all wastes with hazardous properties (such as spent deionized water, spent solvents, spent cleaning solutions, sludges from wastewater treatment, spent epoxy material, and spent cyanide solutions, among others) should be clearly labeled and stored separately from general waste in dedicated and contained storage areas that are chemically resistant. Safe storage and containment are essential due to the high reactivity and toxicity of industry waste and by-products, as also discussed in the following section on occupational health and safety;

Air Emissions

The main emissions of concern generated by the semiconductors and electronics manufacturing industry include greenhouse gases, toxic, reactive, and corrosive substances (for example, acid fumes, dopant, cleaning gases, and volatile organic compounds [VOCs]), resulting from diffusion, cleaning, and wet-etching processes.[5]

There are three types of abatement systems for toxic and hazardous gases:

- Point-of-use (POU) systems that are relatively small and typically dedicated to a single process tool. These systems can remove up to 99.99 percent of effluent gases. For example, a POU scrubber can remove arsine to less than 50 ppb. Six basic technology types are used for POU abatement of gaseous and particulate pollutants, including perfluorocarbon compounds (PFCs), as follows:
  - Wet scrubbing in semiconductor manufacturing, although it has a limited treatment range. Wet scrubbers are also used to treat acid gases and by-products of combustion/oxidation treatment;
  - Hot chemical beds in semiconductor manufacturing;

[4] PFOS is on the list of chemical substances that display toxic, persistent and bioaccumulative properties, and therefore is being considered for inclusion in the list of persistent organic pollutants (POPs) of the Stockholm Convention. As indicated above, the industry sector (WSC and SEMI) completed a voluntary global agreement that describes elimination of all but critical uses and requires incineration of all non-wastewater emissions that contain PFOS. This agreement can be found at http://www.sia-online.org/pre_stat.cfm?ID=294

[5] Approximately 30 hazardous air pollutants have been identified by the US Environmental Protection Agency in semiconductors manufacturing, although it is estimated that more than 90 percent of all emissions are hydrochloric acid, hydrofluoric acid, propylene glycol ethers and their acetates, methanol, and xylenes.

- Combustion / oxidation through fuel burners or electrically heated chambers, often combined with wet scrubbers (semiconductor and PCBA manufacturing);
- Plasma reactors in semiconductor manufacturing, although they have a limited treatment range and require additional downstream abatement units;
- Cold adsorbers in PCBA industry;
- Traps, filters, cyclones, and precipitators in PCBA industry for removing solids and condensing vapors from exhaust stream.

- House systems that are relatively much larger and placed outside a fab (semiconductors foundry) and can handle high flow rates of effluents from many different sources;
- Emergency release scrubbers suitable for handling a large and sudden release of toxic gases are usually dedicated to the exhaust ventilation of gas cylinder storage areas. Emergency release scrubbers are aimed at preventing uncontrolled releases. However, most toxic gases can be controlled in special cabinets that are scrubbed or scrammed to atmosphere after careful monitoring of gas concentration to ensure that the gases are safely released with no impact on health and environment.

Perfluorocarbon Compounds and Other Greenhouse Gases

PFCs—including CF_4, C_2F_6, and C_3F_8—nitrogen trifluoride (NF_3), HFC-23 (CHF_3), and sulfur hexafluoride (SF_6) are used in semiconductor manufacturing, as cleaning gases in chemical vapor deposition (CVD) systems, in plasma etching, and, primarily, in thin film transistor-liquid crystal display (TFT-LCD) screens manufacturing. The main environmental issue associated with PFCs is their high global warming potential (GWP), which is linked to their long atmospheric life.[6]

PFC emission reduction and control techniques include the following:[7]

- Process optimization, especially in CVD cleaning processes;
- Chemical substitution, for example, using c-C_4F_8 or NF_3 as a drop-in alternative chamber cleaning gas instead of C_2F_6 in a modified CVD chamber, minimizing atmospheric emission;
- Abatement, through dissociation of the molecules into non-PFC by-products, by combustion, catalytic decomposition, or plasma destruction systems (the latter is applicable to etch tools only, less than or equal to 200 mm). Thermal destruction technology can be applied to chamber cleaning and etching processes within a fab (POU applications) or fab-wide (end-of-pipe applications);
- Capture and reuse of PFCs from exhaust streams, which is, however, a technically and economically challenging process.
- Additional information on the management of greenhouse gases is discussed in the **General EHS Guidelines**.

Acid Fumes

Potential emissions of acid fumes (mainly, hydrochloric acid and hydrofluoric acid) are related to the following processes in semiconductor manufacturing and PCBA industry:

- Cleaning, etching, and resist-stripping operations in semiconductors manufacturing;
- Etching, during which hydrogen chloride vapors may be released;

[6] In May 2005, the members of the World Semiconductor Council agreed to reduce PFC emissions by at least 10 percent from the baseline value (of 1995 for European, American, and Japanese associations; 1997 for the Korean association; and 1998 for Taiwan) by 2010.

[7] Additional information on emission reductions of PCFs through a variety of emission control technologies is provided in Intergovernmental Panel on Climate Change (2000).

- Cleaning, surface preparations, cupric chloride etching, and plating in PCB manufacturing.

Sulfuric acid aerosol emissions are also associated with the treatment of wafers with acid-etching mixtures. The most commonly used mixture contains sulfuric acid and hydrogen peroxide.

Acid fume emissions are reduced through the installation of horizontal (cross-flow) wet scrubbers or vertical (counterflow) wet scrubbers. Pollution prevention measures also include the following:

- Use of a mist suppressant on bath solution surfaces and use of wetting agents (surfactants);
- Reprocessing sulfuric acid used during wafer fabrication through heating and distillation to purify the acid stream; which is recovered and pumped back into wet stations;
- Installation of plating bath covers and meshpad mist eliminators.

Volatile Organic Compounds

Volatile organic compounds (VOCs) are primarily used in semiconductor manufacturing and PCBA industry. VOCs may be released in most cleaning and photolithography processes, during resist-drying, developing, and resist-stripping operations. Usually, VOC emissions are adsorbed onto activated carbon systems to facilitate recovery and / or treated by thermal oxidizers. Applicable pollution control techniques or add-on control devices used to control emissions consist of the following:

- Regenerative thermal oxidizers, which are usually practical when process exhaust stream volumetric flow rates are above about 3,000 scfm;
- Zeolite rotor concentrators with recuperative thermal oxidizers, which are used to concentrate dilute VOC streams prior to sending them to a destruction or recovery device;
- Fixed bed carbon adsorption with steam stripping for VOC recovery (either reuse or recycling off site);
- Fluidized bed carbon adsorption with hot nitrogen desorption and VOC recovery (either reuse or recycling off site);
- Fluidized bed polymer adsorption with hot nitrogen regeneration and VOC recovery where practical or with recuperative thermal oxidizers.

Nitrogen Oxides

As in other industrial sectors, NO_x emissions in semiconductors manufacturing include by-products of combustion processes. These by-products are derived from heating system boilers, emergency standby power generators, and thermal oxidizers that reduce VOC emissions. Relevant emission prevention and control technologies are presented in the **General EHS Guidelines**.

Dust

Drilling and routing processes during PCB manufacture generate significant amounts of dust, while semiconductor and PCBA industries are not significant emitters of dust. Some limited dust is generated by laser cutting, trimming, chemical mechanical polishing and backgrinding process in semiconductors manufacturing, as well as from the manufacturing of magnetic devices and passive components. Recommended control measures include:

- Water sedimentation systems
- Abatement with bag filters or electrostatic precipitators

Energy Consumption

Because there are many thermal processes and wafers handling is highly mechanized, semiconductor manufacturing involves significant energy use, which demands optimal energy consumption. The use of specialized equipment, which combines improved performance efficiency and energy efficiency should be implemented, for example:

- Air-handling equipment that controls humidity and temperature, allowing up to 25 percent of energy saved;
- High-efficiency chillers; and
- Recovering heat from water condensers that use heat exchangers may allow a modern industrial facility to save up to 40 percent of its needs.

Advanced technologies in emissions abatement also provide new equipment with enhanced abatement efficiency and lower energy consumption.

Wastewater

Industrial Process Wastewater

Wastewater effluents may be impacted by organic and inorganic compounds, such as metals, acids and alkalis, cyanides and suspended solids. To minimize both water use and potential discharge impacts, rinse water should be recovered to return treated water to the process for reuse.

Process wastewater may include organic compounds, particularly non-chlorinated solvents (e.g. pyrrole-based, amine-based, fluoro / ether-based resists, isopropyl alcohol, and tetramethylammonium hydroxide) from a number of semiconductor and PCBA manufacturing steps, including cleaning, resist drying, developing, and resist stripping; metals from metallization and CMP processes; acids and alkalis from spent cleaning solutions, process operations such as etching, cleaning, and metallization, among others; cyanides from metallization processes, and suspended solids from film residues and metallic particles (derived from photolithography, metallization, backgrinding, and dicing processes).

Process Wastewater Treatment

Since the semiconductors and electronics manufacturing operations use a diverse range of raw materials, chemicals and processes, wastewater treatment may require the use of unit operations specific to the manufacturing process in use and the specific contaminant. Techniques for treating industrial process wastewater in this sector include (i) source segregation and pretreatment of wastewater streams containing high concentrations of non-biodegradable compounds using phase separation such as solvent recovery, air stripping, chemical oxidation, adsorption processes, etc. (ii) reduction in heavy metals using chemical precipitation, coagulation and flocculation, electrochemical recovery, ion exchange, etc. (iii) chemical oxidation of cyanides; and (iv) dewatering and disposal of residuals in designated hazardous waste landfills. Additional engineering controls may be required for (i) advanced metals removal using membrane filtration or other physical/chemical treatment technologies, (ii) removal of recalcitrant organics and halogenated organics using activated carbon or advanced chemical oxidation, (iii) reduction in effluent toxicity using appropriate technology (such as reverse osmosis, ion exchange, activated carbon, etc.), and (iv) containment and treatment of volatile organics stripped from various unit operations in the wastewater treatment system.

Management of industrial wastewater and examples of treatment approaches are discussed in the **General EHS Guidelines**. Through use of these technologies and good practice techniques for wastewater management, facilities should meet the Guideline Values for wastewater discharge as indicated in the relevant table of Section 2 of this industry sector document.

Other Wastewater Streams & Water Consumption

Guidance on the management of non-contaminated wastewater from utility operations, non-contaminated stormwater, and sanitary sewage is provided in the **General EHS Guidelines**. Contaminated streams should be routed to the treatment system for industrial process wastewater. Recommendations to reduce water consumption, especially where it may be a limited natural resource, are provided in the **General EHS Guidelines**.

Printed Circuit Board (PCB) Manufacturing

Several pollution prevention measures have been developed in the PCB manufacturing process described in Annex A. Examples of process modifications with environmental benefits include:

- *Board manufacture*: surface mount technology (SMT) rather than plated through-hole technology, injection molded substrate, additive plating;
- *Cleaning and surface preparation*: use of non-chelating cleaners, extend bath life, improve rinse efficiency, counter current cleaning, and recycle/reuse cleaners and rinses;
- *Pattern printing and masking*: aqueous processable resist, screen printing to replace photolithography, ink-jet printing, dry photoresist, recycle/reuse photoresist strippers, segregate streams, and recover metals;
- *Electroplating and electroless plating*: replace by mechanical board production, non-cyanide baths, extend bath life, recycle/reuse cleaners and rinses, improve rinse efficiency, countercurrent rinsing, segregate streams, and recover metals.
- *Etching*: use differential plating, non-chelated etchants and non-chrome etchant, pattern versus panel plating, additive versus subtractive process, and recycle/reuse etchants;
- Metal recovery by regenerative electrowinning and ion-exchange technologies results in a near zero effluent discharge for segregated metal bearing streams. Heavy metals are recovered to metal sheets, which eliminate 95% of sludge disposal. Metal-bearing sludges that are not treated for recovery of metals should be disposed in secure landfills.

1.2 Occupational Health and Safety

Occupational health and safety hazards in semiconductors and other electronic manufacturing projects primarily include the following:

- Exposure to material released by substrates during handling or mechanical manipulation;
- Exposure to hazardous process chemicals, including metallic powders;
- Physical hazards and exposure to energy hazards (kinetic, electrical, pneumatic and hydraulic);
- Exposure to Ionizing and nonionizing radiation and lasers.

Substrates

While silicon-based semiconductor substrates (silicon dioxide) are non toxic dust arising from their manufacture and use can be hazardous. However GaAs and indium phosphide (InP) substrates pose more serious health and physical impacts. The most common exposure pathway for GaAs and InP is inhalation of particulates. Because of the high toxicity of arsenic and indium, both of these compounds have low occupational exposure levels. InP is flammable and can react with water vapor and acids to form phosphine, a toxic and flammable gas. GaAs is a hazard when ground, cut, or polished.

Prevention and control of these hazards involve the adoption of engineering and administrative controls to safeguard workers. The following precautions in use are commonly adopted:

- Use of local extraction from grinding or wet lapping. These operations should be done wet, and residues should be carefully rinsed. Dry grinding or lapping of GaAs should be avoided;
- Extraction and ventilation should be used for all processes involving these substrates, including cutting, grinding, polishing or etching operations;
- Clothes should be periodically cleaned to prevent contamination, and good hygiene practices should be promoted;
- Excessive heating should be avoided, and contact with strong acid reducing agents to produce highly toxic arsine or phosphine gas should be carefully avoided;
- Arsine and phosphine feedstocks should be housed in reduced-pressure containers.

Hazardous Process Chemicals

The semiconductors and electronics manufacturing process may include the use of numerous potentially hazardous chemicals.[8] Metallic powders also may be present in the manufacture of passive components and magnetic devices. Material-specific chemical protection programs should be developed and implemented as described detailed in the **General EHS Guideline**. Worker should be protected from exposure to process chemicals including but not limited to: acids, bases, solvents, metals powders and metal sludge as well as toxic, cryogenic and pyrophoric gases. Additional, sector specific recommendations include:

- Substitutions of hazardous materials, such as ethylene-based glycol ethers, with less hazardous substitutes in semiconductor manufacturing;
- If silane (SiH_4) or other potentially hazardous gases (e.g., HF, H_2) are used in semiconductor manufacturing, installation of integrated alarm systems with gas detectors and alarms set at regulatory or industry established safety margins;
- Use of isolated, automated, manufacturing systems to prevent worker exposure when hazardous chemical substitution is not feasible in both semiconductor and PCB assembly industry;
- Use of engineering controls such as dust and vapor extraction and ventilation systems to remove airborne compounds from work area should be installed in both semiconductor and PCB assembly industry.

Physical Hazards and Energy Hazards

Physical hazards potentially present in semiconductor and electronic manufacturing include the movement of heavy objects—for example, large wafer carriers (especially for the 300 mm wafer size) and final packaged products, and work in proximity to automated equipment. General recommendations for the prevention and management of physical and energy (including kinetic, electrical, pneumatic and hydraulic) hazards in the workplace are presented in the **General EHS Guidelines.**

Ionizing and Non-ionizing Radiation and Lasers

The manufacturing process may include sources of ionizing radiation such as x-rays, gamma rays, and alpha and beta particles, all of which are characterized by a short wavelength and high energy. Potential types of nonionizing radiation in the manufacturing process may include radio frequency radiation (used in equipment producing plasma), UV radiation, infrared radiation, and visible light. Non-ionizing radiation may be

[8] A sample list includes: acetone, ammonia, ammonium hydroxide, arsine, boron trifluoride, carbon dioxide chlorine, chlorine trifluoride, diborane, dichlorosilane, disilane, fluorine, gallium arsenide, germane, hydrochloric acid, hydrofluoric acid, hydrogen, indium phosphide, methane, nitric acid, nitric oxide, nitrogen fluoride, nitrous oxide, ozone, phosphorus oxychloride, phosphine, phosphoric acid, silane, sulfuric acid, tetrafluoro methane, trichlorosilane, trimethyl arsenic, and trimethyl Indium.

produced by some types of high-powered heaters, test equipment, and high-powered antennas.

Lasers are classified by their ability to damage the eyes or skin. If directed or reflected on an object, laser light can be partially absorbed, raising the temperature and causing an alteration of the exposed material.

Exposures to radiation sources should be prevented through use of protective enclosures and interlock for source equipment, and worker training in the importance and maintenance of these enclosures and interlocks. Additional information of radiation exposure is presented in the **General EHS Guidelines.**

Engineering controls, such as protective housing with interlocks, protective filter installations, and system interlocks, should be installed to prevent hazards from laser use.

1.3 Community Health and Safety

Community health and safety impacts during the operation, construction and decommissioning of semiconductors and other electronics manufacturing plants are similar to those of most industrial facilities and are discussed in the **General EHS Guidelines**.

2.0 Performance Indicators and Industry Benchmarks

2.1 Environment

Emissions and Effluent Guidelines

Tables 1 and 2 present effluent and emission guidelines for this sector. Guideline values for process emissions and effluents in this sector are indicative of good international industry practice as reflected in relevant standards of countries with recognized regulatory frameworks. These guidelines are achievable under normal operating conditions in appropriately designed and operated facilities through the application of pollution prevention and control techniques discussed in the preceding sections of this document. These levels should be achieved, without dilution, at least 95 percent of the time that the plant or unit is operating, to be calculated as a proportion of annual operating hours. Deviation from these levels in consideration of specific, local project conditions should be justified in the environmental assessment.

Effluent guidelines are applicable for direct discharges of treated effluents to surface waters for general use. Site-specific discharge levels may be established based on the availability and conditions in use of publicly operated sewage collection and treatment systems or, if discharged directly to surface waters, on the receiving water use classification as described in the **General EHS Guidelines**.

Emissions guidelines are applicable to process emissions. Combustion source emissions guidelines associated with heat - and power-generation activities from sources with a heat input capacity equal to or lower than 50 MWth are addressed in the **General EHS Guidelines** with larger power source emissions addressed in the **EHS Guidelines for Thermal Power**. Guidance on ambient considerations based on the total load of emissions is provided in the **General EHS Guidelines**.

Table 1. Effluent levels		
Pollutants	**Units**	**Guideline Value**
pH	—	6–9
COD	mg/L	160
BOD_5	mg/L	50
Total suspended solids	mg/L	50
Oil and grease	mg/L	10
Total phosphorus	mg/L	2
Fluoride	mg/L	5
Ammonia	mg/L	10
Cyanide (total)	mg/L	1
Cyanide (free)	mg/L	0.1
AOX (adsorbable organic bound halogens)	mg/L	0.5
Arsenic	mg/L	0.1
Chromium (hexavalent)	mg/L	0.1
Chromium (total)	mg/L	0.5
Cadmium	mg/L	0.1
Copper	mg/L	0.5
Lead	mg/L	0.1
Mercury	mg/L	0.01
Nickel	mg/L	0.5
Tin	mg/L	2
Silver	mg/L	0.1
Selenium	mg/L	1
Zinc	mg/L	2
Temperature increase	°C	<3[a]

[a] At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity.

Table 2. Air emission levels[c]		
Pollutants	**Units**	**Guideline Value**
VOC[a]	mg/Nm^3	20
Organic HAP[b]	Ppmv	20
Inorganic HAP[b]	Ppmv	0.42
HCl	mg/Nm^3	10
HF	mg/Nm^3	5
Phosphine	mg/Nm^3	0.5
Arsine and As compounds	mg/Nm^3	0.5
Ammonia	mg/Nm^3	30
Acetone	mg/Nm^3	150

NOTES:
[a] Applicable to surface cleaning processes.
[b] Industry-specific hazardous air pollutants (HAPs) include: antimony compounds, arsenic compounds, arsine, carbon tetrachloride, catechol, chlorine, chromium compounds, ethyl acrilate, ethylbenzene, ethylene glycol, hydrochloric acid, hydrofluoric acid, lead compounds, methanol, methyl isobutyl ketone, methylene chloride, nickel compounds, perchloroethylene, phosphine, phosphorous, toluene, 1,1,1-trichloroethane, trichloroethylene (phased-out), xylenes. Current industry practice is not to use ethylbenzene, toluene, xylene, methylene chloride, carbon tetrachloride, chromium compounds, perchloroethylene, 1,1,1-trichloroethane, or trichloroethylene.
[c] At 3 percent O_2.

Resource Use and Waste Generation

Table 3 provides examples of resource consumption indicators for energy and water, in addition to waste generation in this sector. Industry benchmark values are provided for comparative purposes only and individual projects should target continual improvement in these areas.

Table 3. Water and energy consumption and waste generation

Inputs per unit of product	Unit	Industry benchmark
Water **Wet bench ultrapure water (UPW) use**	l/300-mm wafer pass	42
UPW consumption	l/200-mm wafer	4 000–8 000
Net feed water use	l/cm^2	8–10
Fab UPW use	l/cm^2	4–6
Energy **Total fab tools**	kWh/cm^2 per wafer out	0.3–0.4
Total fab support systems		0.5–0.6
Outputs per unit of product	**Unit**	**Industry benchmark**
Waste[a] **Hazardous liquid waste recycle and reuse**	*%*	*80*
Solid waste recycle and reuse	*%*	*85*

NOTES:
[a] The semiconductor manufacturers should aim at realizing a "zero waste" plant.
Source: International Technology Roadmap for Semiconductors (2005).

Environmental Monitoring

Environmental monitoring programs for this sector should be implemented to address all activities that have been identified to have potentially significant impacts on the environment, during normal operations and upset conditions. Environmental monitoring activities should be based on direct or indirect indicators of emissions, effluents, and resource use applicable to the particular project.

Monitoring frequency should be sufficient to provide representative data for the parameter being monitored. Monitoring should be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Additional guidance on applicable sampling and analytical methods for emissions and effluents is provided in the **General EHS Guidelines.**

2.2 Occupational Health and Safety

Occupational Health and Safety Guidelines

Occupational health and safety performance should be evaluated against internationally published exposure guidelines, of which examples include the Threshold Limit Value (TLV®) occupational exposure guidelines and Biological Exposure Indices (BEIs®) published by American Conference of Governmental Industrial Hygienists (ACGIH),[9] the Pocket Guide to Chemical Hazards published by the United States National Institute for Occupational Health and Safety (NIOSH),[10] Permissible Exposure Limits (PELs) published by the Occupational Safety and Health Administration of the United States (OSHA),[11] Indicative Occupational Exposure Limit Values published by European Union member states,[12] or other similar sources.

[9] Available at: http://www.acgih.org/TLV/ and http://www.acgih.org/store/
[10] Available at: http://www.cdc.gov/niosh/npg/
[11] Available at: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992
[12] Available at: http://europe.osha.eu.int/good_practice/risks/ds/oel/

Accident and Fatality Rates

Projects should try to reduce the number of accidents among project workers (whether directly employed or subcontracted) to a rate of zero, especially accidents that could result in lost work time, different levels of disability, or even fatalities. Facility rates may be benchmarked against the performance of facilities in this sector in developed countries through consultation with published sources (e.g. US Bureau of Labor Statistics and UK Health and Safety Executive)13.

Occupational Health and Safety Monitoring

The working environment should be monitored for occupational hazards relevant to the specific project. Monitoring should be designed and implemented by accredited professions[14] as part of an occupational health and safety monitoring program. Facilities should also maintain a record of occupational accidents and diseases and dangerous occurrences and accidents. Additional guidance on occupational health and safety monitoring programs is provided in the **General EHS Guidelines**.

[13] Available at: http://www.bls.gov/iif/ and http://www.hse.gov.uk/statistics/index.htm

[14] Accredited professions may include certified industrial hygienists, registered occupational hygienists, or certified safety professionals, or their equivalent.

3.0 References and Additional Sources

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Annex A: General Description of Industry Activities

The electronics industry includes the manufacturing of semiconductors, printed circuit boards (PCBs), printed wiring assemblies (PWAs), screens, passive components, and magnetic devices.

Semiconductors Manufacturing

Semiconductors manufacturing uses silicon, silicon carbide (SiC), gallium arsenide (GaAs), metals, chemicals, water, and energy. The purity of all materials must be very high, so specialty gas systems, automated chemical handling systems, and clean dry air (CDA) systems in the clean rooms are essential, especially in photolithography. An ultrapure water (UPW) system is also necessary, because semiconductor manufacturing needs a large volume of UPW, primarily in wet-cleaning processes, but also in acid etching, solvent processes, and tool-cleaning processes. Many new fabs are reducing water consumption by recycling an important portion of the wastewater that is derived from rinsing steps. This process does not add significantly to water contaminants. Because integrated circuits are becoming smaller, vibration control and foundation design of the facility have become more significant.

The manufacturing process includes hundreds of operations that are performed layer by layer on a solid crystalline material, mainly silicon, and more recently on silicon carbide (SiC). Gallium arsenide (GaAs) is used for many military and commercial applications, including lasers, light-emitting diodes (LED), and communication devices (for example, cellular phones use GaAs chips as microwave oscillators).

Semiconductor manufacturing includes two basic series of operations: manufacturing of semiconductor wafers and Assembly, Packaging, and Test (APT), which is the assembly of wafers into usable integrated circuits.

Figure A.1 (last page) summarizes the main steps in semiconductors manufacturing, highlighting inputs of chemicals and other fluids, and emissions / effluents / waste generation points.

Semiconductor wafer manufacture needs a uniform crystalline multilayer structure of silicon (silicon wafer), which is obtained using controlled techniques, such as chemical vapor deposition (CVD) or molecular beam epitaxy (MBE). Subsequently, a thin layer of silicon dioxide, which insulates and protects the silicon, is formed over the silicon wafer by heat treatment in a high temperature furnace (900°C to 1,200°C). Then, the wafer is uniformly coated with a thin light-sensitive material, called photoresist (positive or negative), and is exposed to ultraviolet light or x-rays passing through a glass mask or stencil, previously created with the circuit pattern.

Positive photoresist becomes soluble in the exposed areas and can be removed by chemical developers, revealing the pattern of the photoresist made by the mask on the silicon dioxide (developing). Silicon dioxide is then removed through wet or dry etching: the former treatment uses acids, bases, or caustic solutions; the latter, also called plasma etching, uses a reactive ionized gas and provides a higher resolution and less wastes. The excess photoresist is finally removed by solvent or plasma stripping. By repeating the steps (up to 25 to 30 times) from silicon oxidation through photoresist removal and using different masks, different regions are formed on the layers and are insulated from each other. This entire process is called photolithography or microlithography.

The use of plasma etching of silicon nitride, a dry process, in Metal Oxide Semiconductor (MOS) technology, allows replacing the hot corrosive phosphoric acid (H_3PO_4) wet process, and provides reductions in generated waste, and better safety for workers, while reducing the number of processing steps.

To change the conductivity of silicon regions, dopants are introduced by diffusion or ion implantation. Diffusion can be gaseous or nongaseous, and it is performed in a high temperature environment. Ion implantation consists of a bombardment of the exposed areas of silicon with accelerated ions. Selective interconnection of different regions and layers on the wafer is obtained through metallization: a dielectric material is deposited and patterned in damascene processing; then the features are filled with aluminum alloys under vacuum or copper by electroplating or electrochemical deposition (ECD). The excess copper is removed with chemical mechanical polishing (CMP) or planarization. Other metallization techniques, especially with copper, include physical vapor deposition (PVD) and atomic layer deposition (ALD). Finally, a surface layer of oxide or polyamide is applied over the wafer surface through passivation to provide a circuit protective seal.

Very thin semiconductors are needed in new applications; therefore, the wafer thickness is reduced by backgrinding or stress relief. Each finished wafer may contain hundreds of chips that are all electrically tested (measurement) before being cut into individual chips with an ultrathin diamond blade (dicing) and marked. After electrical testing, each chip is mounted on a metal or ceramic frame, connected with thin gold wires, and encapsulated for mechanical support and protection against external environment. The final package can contain one or several connected chips.

Nanotechnology and Micro-electromechanical Systems

Nanotechnology involves the creation of functional structures on an atomic or molecular scale, with at least one characteristic dimension measured in nanometers. Evaporation of some metal oxide powders (ZnO, Ga_2O_3, SnO_2, and so on) at high temperature allows synthesizing nano-belts and nano-wires of the same metal oxides. The resulting semiconductors are generally used as sensors, transducers, or in other applications for electronic and optoelectronic devices.

Microelectromechanical systems (MEMS) are essentially made of microtransducers (for example, microsensors for temperature, pressure, chemical substances, and radiation). Their fabrication techniques are similar to those used for chips. Materials used in MEMS production are diverse, with specific electrical properties, but they also have selected mechanical and thermal or chemical properties. Silicon is used most often.

The most common production technology for MEMS devices involves deposition and pattern of a silicon oxide layer, followed by deposition and pattern of a polysilicon layer and removal of the oxide layer, allowing the polysilicon layer to move as a cantilever, which usually is performed in hydrofluoridric acid mixtures.

Cutting and separating processes are critical, because the movable parts on the MEMS device are fragile. Device testing is application specific, and assembly of MEMS devices is generally demanding because of their fragility. Packaging is again application specific, but all packages are aimed at protecting the die from environmental effects, without preventing access to the environmental parameters that are essential to proper operation (for example, application for a pressure sensor in airbags). MEMS devices are used in many industrial sectors, including inter alia the automotive, industrial control, office equipment, aerospace, medical, and communications sectors.

Printed Circuit Board (PCB) Manufacturing

PCB manufacturing is related to the etching and pattern plating of circuits on base materials, which are often layered. PCBs can be single-sided, double-sided, multilayer, and flexible. Additive, semi-additive, or subtractive technologies can be used, although the subtractive technology is most commonly applied. Board preparation consists of cleaning, laminating, and drilling

holes; chemical and mechanical cleaning is required before electroless plating. The imaging step allows circuit patterns to be transferred onto the board through the photolithography process or screen printing; electroplating (usually copper) is then used to thicken the conductive layers and to protect them against corrosion or erosion. In solder coating (or hot air solder leveling), the PCB is dipped into a molten solder, typically a low melting alloy (for example, lead-free tin alloys). The excess solder is eliminated by hot air leveling. PCB manufacturing includes final production steps in which electrical tests, dimensional and visual inspections, packaging, and labeling are performed.

Printed Circuit Board Assembly (PCBA) Manufacturing

PCBs are essentially formed by a base, which is made of pressed epoxy resin, Teflon™, fiberglass, or ceramic, on which semiconductors (silicon, silicon carbide, or GaAs) and passive components are mounted. Specific electrical components are attached and soldered on PCBs. A chemical flux is typically used to clean the board and ease the following solder connection. Soldering can be performed by different techniques, including wave soldering, surface mount technology (SMT) and hand soldering. In the PCB assembly process, non-ozone depleting alternatives are available for cleaning printed circuit board assemblies including, for example, other organic solvents, hydrocarbon/surfactant blends, alcohols, and organic solvent blends), and aqueous and semi-aqueous processes. Currently, the flux residue is removed with deionized water; Freon 113 (CFC-113) and trichloroethane (TCA), now banned, were used previously. The industry has shown that even sophisticated PCB assemblies can be made without cleaning by using low residue fluxes that leave very little in the way of contamination on the boards.

Screen Manufacturing

Flat panel displays are classified in a projection and direct view group, which is further classified in emissive and nonemissive subgroups. The most popular flat panel display is the liquid crystal display (LCD), in which the liquid crystal (LC) arrangement is controlled through an electric field. What the viewer sees depends on the LC molecular arrangements. A color filter and a thin film transistor (TFT) are aligned and sealed together, with a spacer between them; LCs are injected and the end seal is formed. Finally, the polarizer, tape carrier package, electronics, backlight, and chassis are assembled.

Organic light-emitting displays (OLEDs) have a simple structure and are solid state displays, because they have no vacuum, liquid, or gas inside. OLEDs use small molecules of luminance material that are deposited by vacuum evaporation. Polymer LEDs (PLEDs) use polymers of luminance materials usually deposited by ink-jet printing or spin coating. To improve their performance, a TFT is added. The OLEDs have the advantages of simple production process, high optical efficiency, and low voltage drive, but they have a short lifespan.

Passive Components Manufacturing

The main technology used for passive components manufacturing is the pressing and/or sintering of powders—alumina (Al_2O_3), aluminum nitride (AlN), and so on—to obtain ceramics with insulating, conducting, or piezoelectric characteristics. The most common manufacture is the production of ceramic insulating substrates (Al_2O_3, AlN) for integrated microcircuits.

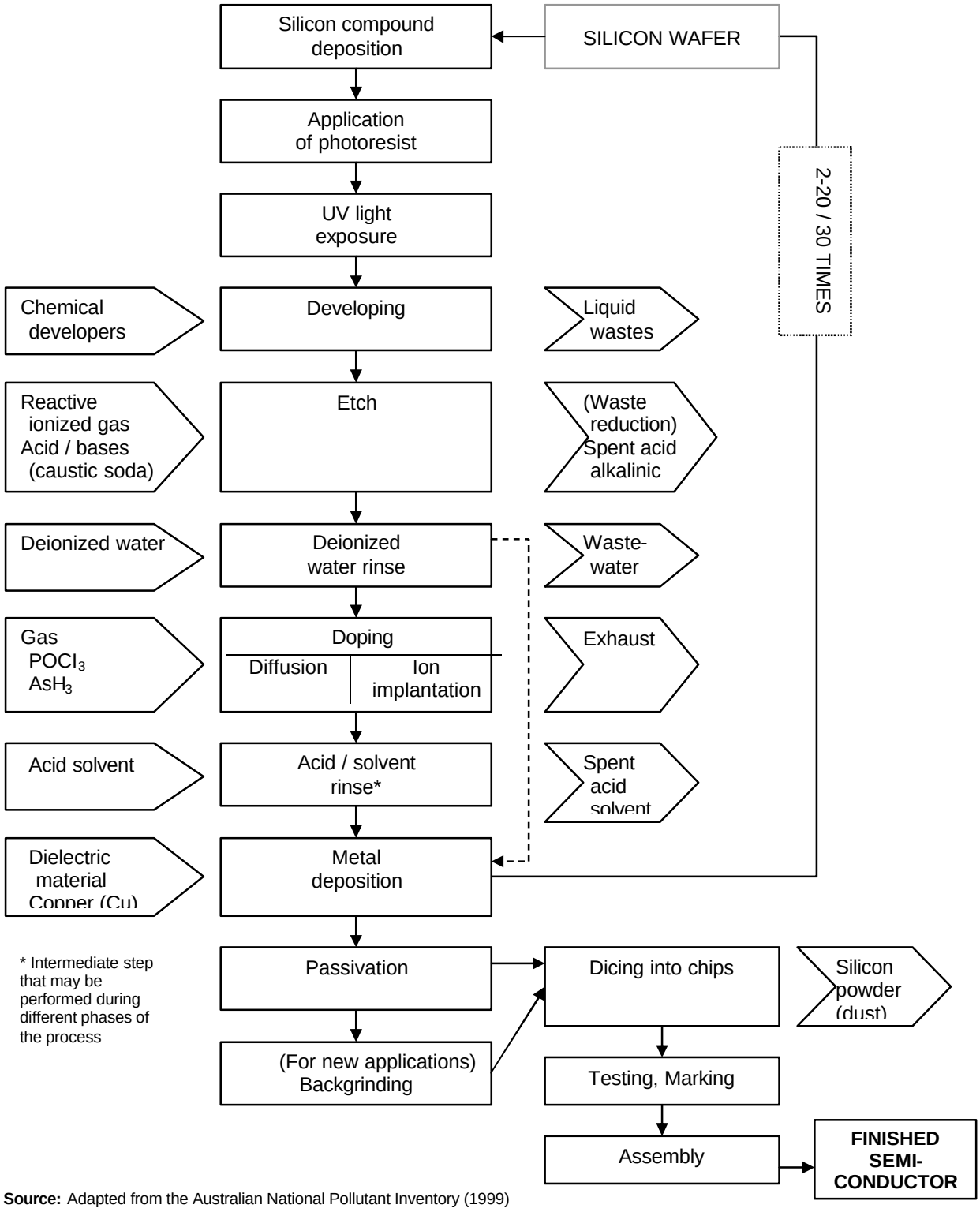
For high power substrates, AlSiC or CuSiC are used to obtain an improved thermal conductivity, compared with the standard Al_2O_3. Mixing additives to a carbon or SiC base, resistors of any dimension and ohmic value are produced. Piezoelectric characteristics are mainly used in all fields of pressure sensors

(automotive), stress sensors, and ultrasound cleaners in the industry, or to emit ultrasounds for echography. Special zinc oxide (ZnO) ceramics are used for spike voltage suppressors (varistors).

Magnetic Devices Manufacturing

The magnetic devices manufacturing processes are based on mixing magnetic powders (iron or rare earth elements) to obtain magnetic films or tapes for data storage in the informatics industry, and ceramic or sintered metal with enhanced magnetic characteristics, used for manufacturing the core of small pulse transformer or special extra powerful magnets for motor industry or for static magnetic resonance equipments.

Figure A.1: Schematic View of Semiconductors Manufacturing Process



Source: Adapted from the Australian National Pollutant Inventory (1999)

ANNEXE-XVII: ENVIRONMENTAL AND SOCIAL MANAGEMENT SYSTEM (ESMS) OF FIBER @HOME

ENVIRONMENTAL AND SOCIAL MANAGEMENT SYSTEM (ESMS) OF FIBER@HOME

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1. INTRODUCTION

Fiber@Home Limited has been incorporated with Registrar of Joint Stock Companies [RJSC], Dhaka on March 19, 2008 having their registered office at House: 7/B, Road: 13, Gulshan-1, Dhaka-1212. Authorized capital of the company is Tk. 5000.00 million and paid up capital is Tk. 810.00 million. Fiber@Home is the first ever carrier service provider incorporated in Bangladesh to infrastructural network services for the mobile operators as well as other Access Network Service (ANS) operators and service provider.

Its incorporation took place in synchronization with the policy prescription as well as thought process of the Bangladesh Telecommunication Regulatory Commission (BTRC) to separate the ANS providers (Mobile Operators, BWA Operators & ISPs) from the Transmission Network Service (TNS) with a view to developing a more secured, structured, cost effective and commonly sharable network infrastructure and related services in the country.

Fiber @ Home applied for the National Telecommunication Transmission Network (NTTN) license in response to the invitation of BTRC and Fiber@Home was duly awarded the NTTN License on January 7, 2009. From then it has started its journey to develop a comprehensive infrastructure based network and so far discharged the entire roll out obligation for the 3rd year under the NTTN License with full satisfaction of BTRC.

Vision:
To Build, Develop, Operate and Maintain a Nationwide Optical Fiber based Transmission Backbone to enable a common connectivity platform for a Digital Bangladesh. This common infrastructure will use national resources optimally in the growing need of information technology and telecommunication sector.

Mission:
Building a neutral network allowing all Access Network Service (ANS) operators to provide their services through the network:

- to enable Nationwide affordable Value Added Services (VAS) platform for the end users.
- to reach all the Upazila headquarters of Bangladesh with a Robust, Secured and Faster Transmission backbone Network to enable connectivity to multiple Government and Non-Government entities.

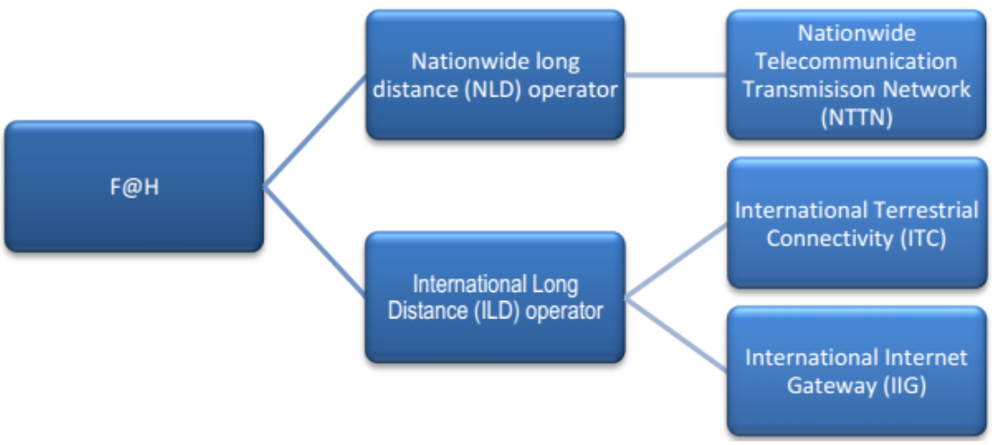


Figure-1 Fiber@Home: Holder of 3 Major Licenses

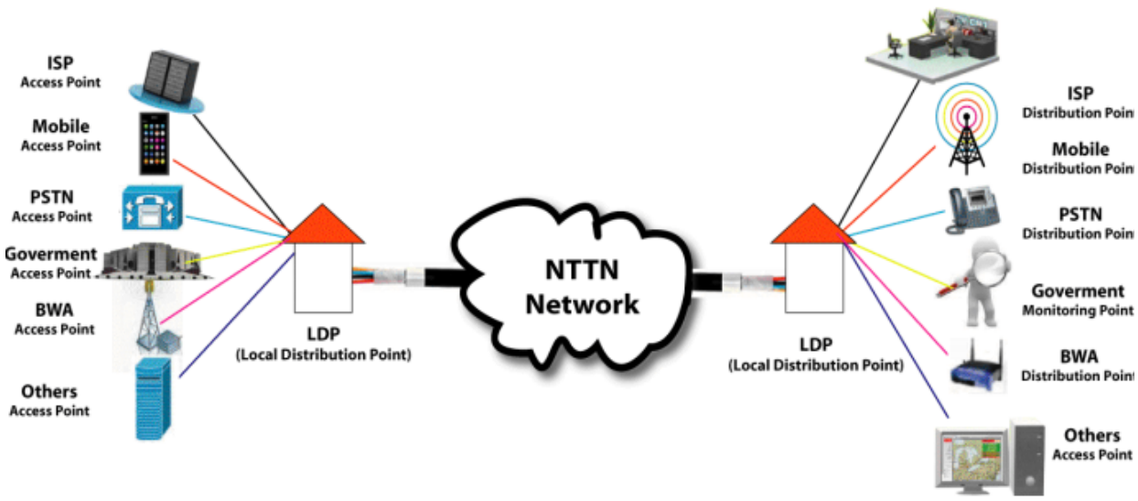


Figure 2: Business of NTTN License

2. PROJECT ACTIVITIES OF FIBER@HOME AND IFC PERFORMANCE STANDARD (PS)

The project activities of fiber@home are mainly divided into three phases:

- Pre-construction Phase
- Construction Phase and
- Operation Phase

2.1 Pre-construction Phase

Fiber@home does Plan & Design activities and negotiation with Government entities to take Road/Trench cutting & Pit cutting permission before the construction phases. Fiber@Home Ltd own team responsible for planning, Design etc. It has strong visionary planning and design team to foresee the future demand. Fiber@Home Ltd has own team to perform Plan, Design activities. A well-organized field execution team is dedicated for the field works.

Roles and Responsibilities of the Planning & Design Team:

-

2.2 Construction Phase

⇒ Excavation of a trench approximately 300 mm wide and 1 m deep along the proposed route of fiber optic line in Dhaka, Chittagong and Sylhet metropolitan areas, laying of cable conduits and construction of ancillary facilities (underground vaults or “hand holes” for cable splicing).

⇒ Pulling and splicing of the communications cable through the conduit and any necessary final restoration and cleanup operations.

⇒ Application of horizontal directional boring where presence of water or other obstacles inhibit trenching operation.

⇒ Deploy overhead fiber optic cable lines using existing power line poles owned by BREB

⇒ If necessary construction of intermediate poles to deploy overhead fiber optic cable lines

⇒ Mobilization of construction equipment and manpower.

The current Project activities of Fiber@Home are listed in Table-1:

Sl. No.	Project Name	Year of Starting	Year of Completion	Remarks
1.				
2.				

Fiber@home does underground and overhead fiber optic cabling. The details of the cabling activities are listed below:

a. Underground Fiber Optic Cabling

Underground fiber optic cable deployment is completed mainly by two methods.

⇒ Trenching, and
⇒ Horizontal Directional Drilling (HDD).

Other construction activities involve bridge crossing operation, hand hole construction, cable handling, blowing and splicing. These two methods along with other supplementary construction actions are described briefly in the following sections.

Trenching

Before trench cutting, survey is done to ascertain soil type/ underground utilities/ trees & their roots/ road crossings/ bridges, culverts etc. A realistic work program is prepared before commencing trenching. A detailed BOQ is made so that continuous supply and availability of all the materials & accessories like duct, de-coiler, warning tape, sand, and bricks etc. are available on site.

Trenching physically removes the soil from the trench slot and requires restoration of the soil, since it needs to be backfilled using sand and native soil, packed in lifts. In the component A of the project trenching operations will be conducted along the roadway only, hence there will not be any impact on the vegetation due to trenching operation.

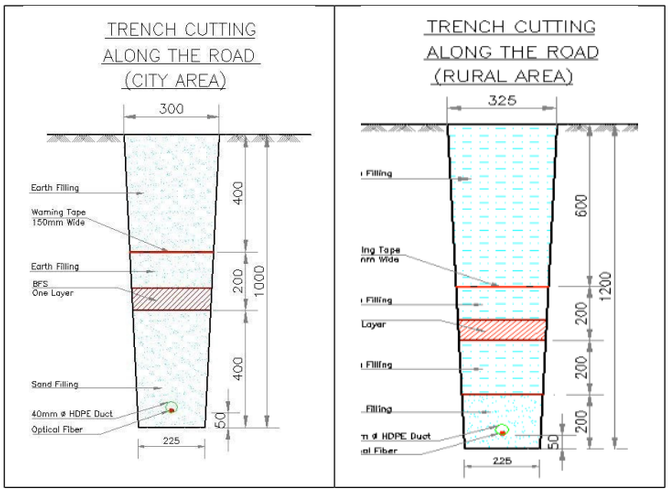


Figure-2.1 Trench Cutting Details along the Road

Trench cutting is done by labor using spade, gaite, and hammer. After Cutting the trench duct is laid as per drawing. Trenching is followed mainly to cross roads of city and rural area. Deployment speed depends on the manpower employed. However, Fiber@Home Limited can deploy 1 to 1.5km cable a day through trenching. For this deployment, it employs one engineer from its part and 100 labors from contractor's part. In city areas trench depth is usually 1.0 m, whereas for the rural areas trench depth is usually 1.2 m and backfilling is done using 100% sand.

After installing the duct in place, the trench is refilled and compacted with sand and soil. After that required hand holes are installed and the actual fiber optic cable is blown into the duct.

Horizontal Directional Drilling (HDD)

Horizontal Directional Drilling (HDD) can be used in cases where the track- crossing length is more than 20m and in places where hydraulic boring is not possible due to soil condition or underground utilities. HDD machine (Figure 2.2) is used mainly to cross Railroad and Hilly area. In case of Bridge crossing if HDD does not work then Clamping method is followed to cross a bridge. HDD enables faster deployment of cables.

Figure-2.2 Horizontal Directional Drilling (HDD) Machine

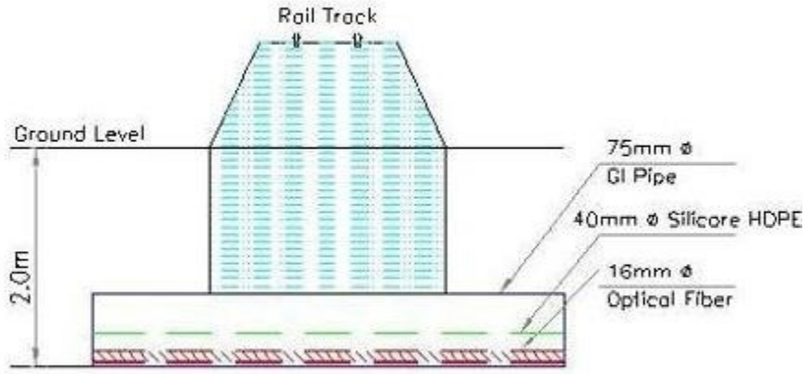


Figure-2.3 Details of a railway/roadway crossing using horizontal directional drilling (HDD) method

Bridge Crossing Operation

HDD is permitted in areas where presence of water or other obstacles inhibit trenching operation. HDD machine is set at one end of the bridge and a continuous GI pipe (by jointing one piece with another, each 3.0m length) is drilled through the soil up to the other end. Water or bentonite slurry is used during drilling. There is a pilot containing a sensor at the head of the GI pipe. The direction is maintained through another sensor from top. When the pilot comes up at other end, duct is set with the pilot using pulling grip and it is pulled to the machine end.

Bridge crossing operation by HDD method involves the following steps:

- ⇒ Pulling of one/two nos. 50/43mm HDPE (Tornado) duct by HDD method under 5 meters of river-bed. Diameter of hole will be 125mm.
- ⇒ HDD work will be within the range of 50 meter to 200 meter. If the length is higher, consent of Fiber@Home Limited Engineers will have to be taken to determine the crossing method.
- ⇒ Necessary back filling by excavated materials.

The details of the cable lying by HDD method are given in Figure 2.4.

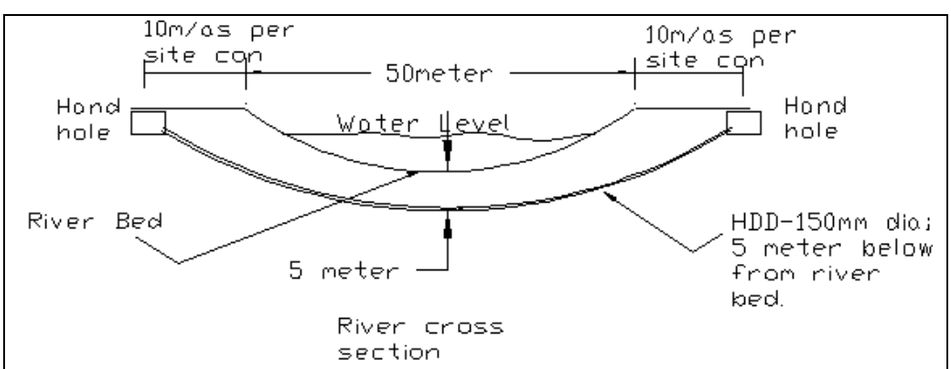


Figure2.4 Bridge crossing of fiber optic cable using HDD method.

Double walled corrugated (DWC) pipe is used with clamping or by encasing in RCC for bridge crossing of the fiber optic cable when all other options become unsuccessful. A continuous path is created while hanging DWC pipe with clamps along the bridge girder as per bellow process.

- ✓ The layout of the bridge-crossing pipe is set as per design drawings.
- ✓ A 100 mm diameter DWC pipe is used and fixed as shown in the inset of Figure 2.5.
- ✓ Clamping with bridge girder is done at every 1.5 meter (Figure 2.5).
- ✓ When the pipe is aligned on top of the bridge, it is encased by RCC (1:1.5:3) using local cement, Sylhet sand & stone chips as per attached drawing and 7 days curing must be done (Figure 2.6). (Reinforcement details: 8mm Iron bar 4 nos. and 8mm @150mm c/c tie bar)
- ✓ After fixing the DWC pipes with the bridge, 50/43mm HDPE (Tornado) duct and one copper cable (10 pair) is pushed/pulled in the DWC pipeline.

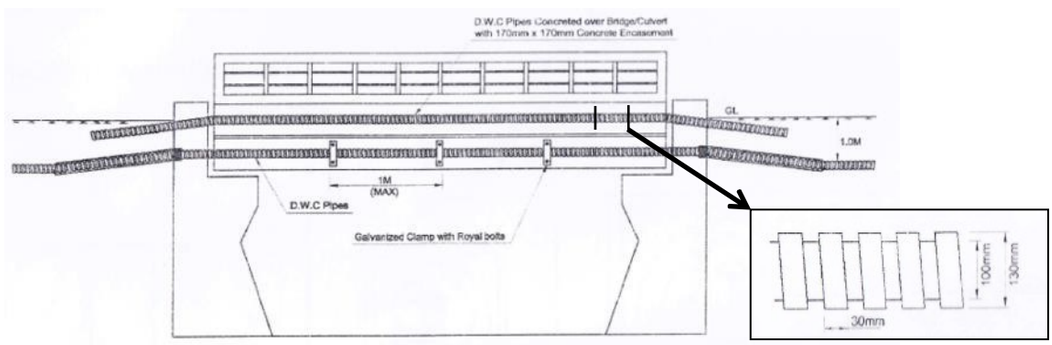


Figure2.5 Details of bridge crossing of fiber optic cable using DWC pipe with clamping

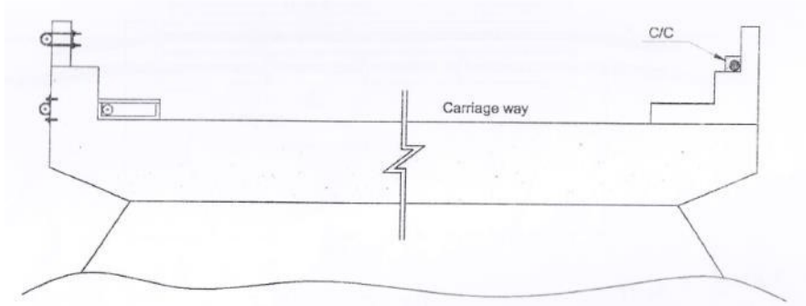


Figure-2.6 Details of bridge crossing of fiber optic cable using DWC Pipe with RCC encasing

Hand Hole Construction

Hand holes are constructed to accommodate underground connection between fiber optic cables. Figure 2.7 shows a hand hole constructed in the ground with fiber optic cables arriving from two separate directions. Generally, laborers use gaite, spread shable, hammer, cheni etc. (all are construction related tools) to construct a hand hole. The worker fabricates the reinforcement before excavating the hand hole. At site, they make the rod binding. They make an appropriately sized excavation on the ground based on the requirement and size of the prefabricated reinforcement casing. Laborers mix the cement, sand and stone chips as per 1:1.5:3 concreting ratio. After mixing they put it to the hand hole base and sidewalls gradually. Formworks are made for casting the concrete in the sidewalls. Vibrator is used to reduce honeycomb in the freshly poured concrete. A light-duty traffic-bearing lid (a concrete slab made separately with the ratio of 1: 1.5: 3) is placed over the hand hole for covering the underground fiber optic cable connection. The hand hole unit would be completely buried to restrict access, but the hand hole locations would be marked for maintenance, repairs, and expansion needs. Maintenance and repairs at these hand holes will be limited to foot traffic only.

Figure-2.7 Hand hole layout

Cable Handling, Blowing and Splicing

After trenching or HDD, DIT (duct integrity test) test is performed through the HDPE duct. It includes shuttle test, pressure test & sponge test. After assessing integrity of the duct, it is connected to the air compressor into Super Jet Machine. After this, optical fiber cable is inserted into Super Jet Machine. When the cable floats inside the HDPE duct, super jet is started and cable goes through the HDPE duct. The cable is fed from a reel drum, which is brought to the site using a truck. The cable handling process is shown in Figure 2.8.

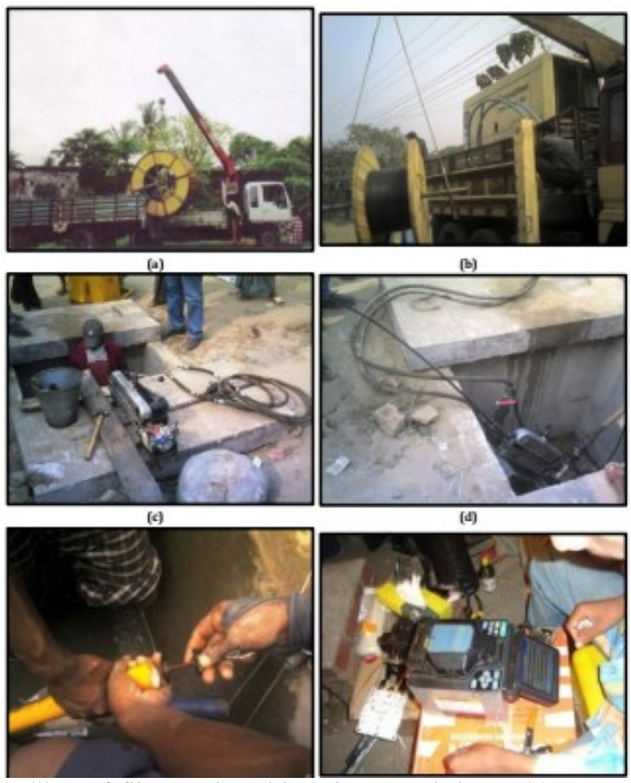


Figure 2.8: (a), (b) Handling of fiber optic cable using a reel drum, (c) Super Jet Machine for cable blowing, (d) Cable blowing through high density polyethylene (HDPE) duct, (e) Duct integrity test: Sponge test of HDPE Duct, (f) Outdoor splicing of fiber optic cable.

At the end of the cable, splicing work is done. To splice an optical fiber cable, splicing enclosure, cable dressing tools, splicing machine, splice protector, hit gun are required (Figure 2.8).

b.Deployment of overhead fiber optic cable

It is expected that overhead fiber optic cable lines will be installed on existing utility poles (owned by BREB) similar to that illustrated in Figure-2.9. This will eliminate the need of new poles. Pole replacement, if required, will be accomplished and new poles will be inserted and secured in existing utility pole holes or, if required, the new pole will be placed within 1 foot of the existing pole by auguring and inserting the pole. The area around the pole will be filled with dirt from auguring and the ground surface restored to original conditions. Pole replacements attributed to height or class issues will most often be reused elsewhere by the local utility at their discretion. Poles that are deemed unsafe or unusable will be recycled.

Steel poles will be used in case construction of new poles becomes necessary. From the experience gathered from previous fiber optic cable deployment works by Fiber@Home, steel poles are required in few locations where BREB poles are not available, or the distance between BREB poles are large to limit sagging of optical fiber cables. The steel poles are stacked along the route at designated storage areas beside the road.

The steel poles will be installed manually by digging appropriate holes on roadsides. Following erection of poles, assortments are installed for extending the fiber optic cable lines. A copper wire is passed through the poles into the ground to secure earthing. Lightening arrestor is installed at the top. From previous similar project experience the number of new poles to be installed by Fiber@Home is insignificant for a given stretch of overhead fiber optic cable line.

Figure-2.9 Installation of overhead fiber optic cable line

Designated drop points are required to lower the fiber optic from the PGCB tower network to a local overhead or underground network. From field visits it was observed that the drop points of the existing fiber optic network installed by Fiber@Home are located within the existing PGCB substations as shown in Figure-2.10.

(a)

(b)

Figure 2.10: Drop-points to lower the fiber optic cable from the PGCB tower network to a local overhead or underground network. This drop point is at the PGCB substation located in Rampura, Dhaka.

2.3 Operation Phase

Fiber@home is responsible for the operation and maintenance of the project activities. The major project activities during operation phase will be the following:

- ⇒ Day-to-day regular operation and maintenance of optic fiber lines through the hand holes or overhead connection box.
- ⇒ Regular monitoring of devices located at the control stations to ensure regular connectivity and network security.
- ⇒ The main job of the maintenance team is regular patrolling along the fiber optic cable lines to identify the need for regular and immediate maintenance operation. During the process of patrolling care is taken to trim the overgrown trees falling on to the distribution cables and/or extending into the danger zone (regarded as “danger tree”). It is also imperative to clear the fallen trees following storm or heavy rainfall events. In the urban areas of Bangladesh the residential building have been constructed without leaving any clearance for fiber optic cables, virtually erected from the edge of the footpath. Therefore, it is likely that sometimes kites, birds or clothes left for drying may get entangled with the cable system.

2.4 Fiber@Home and Performance Standards (PS)

Fiber@Home has 150 Central Offices (COs) where almost 450 staffs are working. It has three corporate offices building in the Gulshan-1 area from where all the activities of the fiber@home are controlled and managed. IFC has established eight Performance Standards (PSs) that the Fiber@Home is to meet throughout the life of the projects. The PSs triggered for the activities of the Fiber@Home are listed below.

Sl. No.	Performance Standards	Triggered for Fiber@Home		Remarks
		Yes	No	
1.	PS-1 Assessment and Management of Environmental and Social Risks and Impacts	√		
2.	PS-2 Labor and Working Conditions	√		
3.	PS-3 Resource Efficiency and Pollution Prevention	√		
4.	PS-4 Community Health, Safety, and Security	√		
5.	PS-5 Land Acquisition and Involuntary Resettlement		√	Fiber@home does not need to do any kind of land acquisition for their projects.
6.	PS-6 Biodiversity Conservation and Sustainable Management of Living Natural Resources		√	Actually all the works of fiber@home do on the existing development activities where the biodiversity Conservation and Sustainable Management of Living Natural Resources are avoided.
7.	PS-7 Indigenous Peoples		√	Actually all the works fiber@home do on the existing development activities where the indigenous peoples avoidance were made.
8.	PS-8 Cultural Heritage		√	Actually all the works fiber@home do on the existing development activities where the indigenous peoples avoidance were made.

3. MANAGEMENT SYSTEM

A management system is a set of processes and practices to consistently implement a company's policies to meet the business objectives. The goal of this ESMS is to make sure that the fiber@Home has the appropriate policies and procedures in place and that people will consistently follow.

The management system helps to assess and control the risks and is the key to lasting improvement. A key feature is the idea of continual improvement an ongoing process of reviewing, correcting and improving the system of the fiber@Home. The most common method is the Plan-Do-Check-Act cycle (PDCA), described below.

Identifying and analyzing the risks and objectives

Implementing the improved solution

Developing and implementing a potential solution

Measuring how effective the solution was, and analyzing whether it could be improved

4. ELEMENTS OF ENVIRONMENTAL AND SOCIAL MANAGEMENT SYSTEM (ESMS)

A solid, functioning environmental and social management system (ESMS) is made up of interrelated parts. There are nine elements of this ESMS. Each of these elements is important, because these are helpful to assess, control and continually improve the environmental and social performance, as part of the Plan-Do-Check-Act cycle. The following section presents ESMS of the fiber@Home. The content of the ESMS of fiber@Home are:

- ✓ Environmental and Social Policy
- ✓ Identification of risks and impacts
- ✓ Management programs
- ✓ Organizational capacity and competency

- ✓ Emergency preparedness and Responses
- ✓ Stakeholder engagement
- ✓ External communication and Grievance Mechanisms
- ✓ Ongoing reporting to affected communities
- ✓ Monitoring and review

5. ENVIRONMENTAL AND SOCIAL POLICY

Fiber@Home recognizes the need to operate the business in a manner which reflects good environmental and social management. Fiber@Home is aware of the environmental impacts of its construction, operations and will balance its business with the need to protect the local and global environment.

Environmental and Social Policy of Fiber@Home will earn the confidence of employees, shareholders, customers and the general public by demonstrating our commitment to comply with all relevant environmental legislation and minimize pollution, resource use and waste, where feasible, through the continual improvement of performance in all areas of the Company.

The Company has demonstrated a commitment to identify all activities that have the potential to cause an environmental and social impact, as well as providing adequate resources to help minimize or prevent any negative impact.

In order to achieve this commitment, Fiber@Home will:

- ✓ Identify all environmental and social risks and impacts of its business activities or projects that it undertakes, well in advance of any site activities and, prepare adequate mitigation measures commensurate to the risk and impacts; and implement the mitigation measures to ensure compliance with all applicable laws, license conditions, legal agreements and IFC Performance Standards.
- ✓ ensure similar compliance of applicable laws and Performance Standards by all its sub-contractors and vendors.
- ✓ Exercise adequate supervision on the business activities, make improvements and undertake corrective actions to ensure adherence to this policy.Make provisions for adequate financial and manpower resources to ensure adherence to this policy.
- ✓ Consistently increase the awareness and provide necessary training to all the employees of Fiber@Home and customers to ensure environmentally responsible concepts are integrated into their normal working practices.
- ✓ Identify and mitigate against potential accidents that could result in an environmental and social impact, so that if an accident did occur the consequences would be minimized.
- ✓ Use products that have a negligible environmental impact, where appropriate options exist.

- ✓ Minimize the storage and use of all articles and substances, where appropriate.
- ✓ Reduce the consumption of resources (energy, materials, packaging), where feasible.
- ✓ Minimize waste through to reuse, recover or recycle, where feasible.

It is the duty of Fiber@Home to ensure that good environmental and social management is practiced in all contracts and projects that Fiber@Home is involved in, and will seek to influence customers to demonstrate a positive environmental and social commitment.

Regulatory Policies in Bangladesh:

National ICT Policy 2009:

ICT policy in Bangladesh was first formulated in 2002. Since then a number of reforms have taken place in both the telecommunications and the ICT sectors. A new ICT Policy was adopted in 2009. This policy forms the basis for the "Digital Bangladesh" agenda of the current government, which envisages taking Bangladesh to the status of a middle income country by 2021.

ILDTS Policy:

Technological advancement in the field of telecommunication has brought in new generation technologies in the International Long Distance Telecommunication Services (ILDTS). Voice over Internet Protocol (VoIP) is one of such very popular technologies which is being used universally for inexpensive voice communications through Internet all over the world. The VoIP technology succeeded in proliferating popularity due to its low cost and compatibility with a host of different Internet Protocol (IP) based networks. This policy is formulated to facilitate, liberalize and legitimize ILDTS including VoIP. The policy is primarily focused on providing affordable communication means to the people at home and abroad, encouraging local entrepreneurs, new technologies to grow and ensuring due earning of revenues for the government.

Broad Band Policy 2008

The broad band policy 2008 aims at facilitating the growth of high speed internet services at affordable price.

BTA

In 2001, Bangladesh Telecommunications Act (BTA) was passed replacing both the Telegraph Act, 1885 and the Wireless Act, 1933. It details the conditions and provisions of getting licenses. It also explains spectrum management, charges and tariff.

In absence of any separate transmission service providers / licensees the Telco's and Internet Service Providers [ISP] were providing transmission services either through their own transmission network or through leasing from some other transmission lines. These transmission lines were being developed by different entities keeping their business interest and do not necessarily cater for overall national benefits.

At present the metropolitan cities and towns are cluttered with hazardous overhead optical fiber/cables and there are access optical fibre / wired networks in the same area by the multiple ANS operators abusing drainage to the national resources. Therefore, de-cluttering the city areas and towns, minimizing the wastage of national resources are also the objectives to create NTTN.

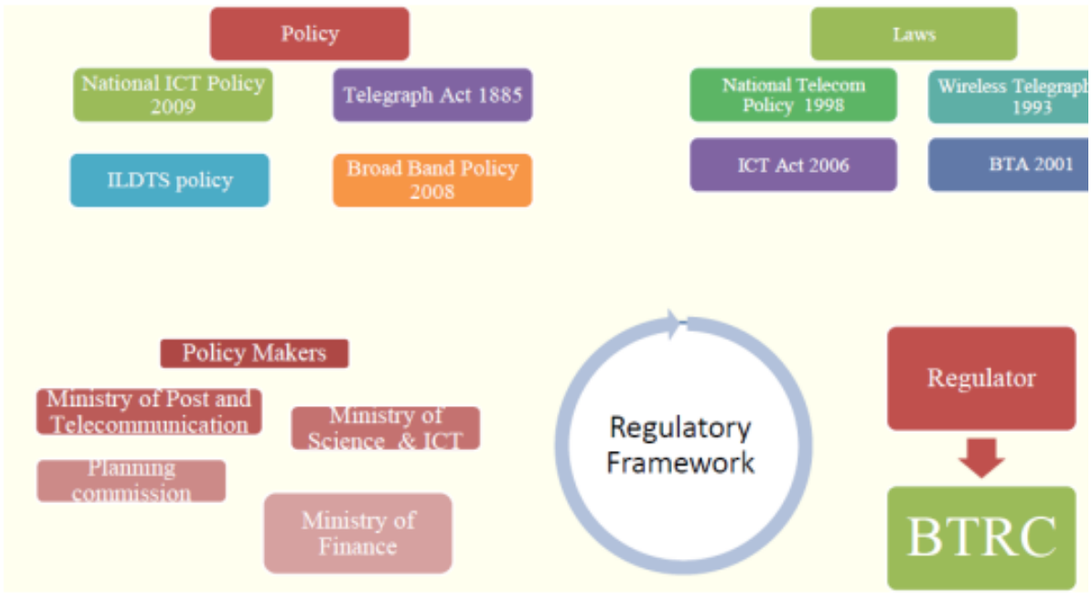


Figure-5.1 Regulatory Environment of NTTN Business

It is clearly vivid from the Nationwide Telecommunication Transmission Network (NTTN) license that BTRC intended to issue NTTN license with clear objective of separating transmission services from ANS operators. Fiber@home has the NTTN license for their permission of performing the project activities.

Important Features of Fiber@home NTTN license are listed below:

- Fiber@home can develop, build, operate and maintain its NTTN system anywhere in the entire country.
- Fiber@home can lease out/rent out its NTTN resources to the ANS operators, licensed telecommunication operators and to other authorized users for a specified lease term/rental term not exceeding NTTN's license duration.
- Fiber@home can obtain permission from the commission before making any lease agreement. The licensee will entitle the lessee for sharing or sub-leasing of any of its leased systems or any apparatus or facility to others without any discrimination. The licensee shall file all concluded lease agreements with the commission.
- The licensee shall keep provisions in the lease agreement so that (a) the lessee has an obligation to connect the NTTN to the systems of any other operator licensed by the commission and the lessee will ensure compatibility; (b) the lessee complies with the requirements and approval of tariff by the commission.
- NTTN would be given preference over others to develop network where there is no existing network.
- Foreign shareholding is limited to 60%. But for Non Resident Bangladeshi, shareholding may go up to 70%
- As per the BTRC guideline the mobile operators (CDMA/GSM) and broadband wireless access (BWA) operators having license from the commission and any of its existing shareholders (foreign/Bangladeshi) and any other company whose shareholders hold shares of any cellular mobile phone operator company and BWA operators holding license from the commission and any other person who is partner/ director/shareholder of licensed mobile operators and BWA operators in Bangladesh shall not be eligible to apply for this license.
- The licensee shall have to file for IPO within 5 years of the issuance of the license. The licensee shall not be allowed to transfer any shares before issuance of IPO and without prior written permission from the BTRC. The company has extended the IPO filing time for 2 (two) years with proper approval from BTRC, the regulator, up to 2016.
- Revenue sharing with BTRC: the terms of revenue share with BTRC is as per following table:

Year	1st	2nd & 3rd	4th & 5th	Subsequent year
Revenue Sharing	0%	1%	2%	3%

- Performance Bank Guarantee: the licensee had to furnish bank guarantee of BDT Tk. 100 (one hundred) million with a 10 years validity in favor of BTRC which has been reduced by BTRC to BDT 30 million based on 7 year's performance.
- The licensee shall have the obligation to develop NTTN services minimum up to Upazila Head quarters. Network must have nodal points for connection up to Upazila Head Quarters.
- Rollout obligation period shall be counted from 180 days after the issuance of license i.e. From January 7, 2009, licensees shall have to provide NTTN connectivity as per following table :

Year	1st	2nd	3rd	4th	5th	6th to 10th
Upazila Coverage	5%	10%	20%	30%	40%	100%

- It is to mention here that rollout obligation means that F@H has to make it services available in all sub districts. To this end F@H may deploy FOC or ride on other's FOC to make its services available.
- NTTN licensee will not provide telecommunications services directly to the end users. ANS operators and licensed telecommunications operators can use the NTTN resources to provide telecommunication services to the end users.
- The licensee shall take prior written permission of the commission to take any loan. The license shall not be assigned or pledged as security.
- The licensee shall seek written approval of the commission before making any changes in its ownership or shareholding.
- The licensee shall neither transfer any shares nor issue new shares without prior written permission of the commission

Institutional Arrangement for Implementation of ESMS:

Fiber@Home has a strong Management Team. There are five boards of directors and a Managing Director in a Board of director's panel. Under a managing director five management members are working.

Under the chief technical officer an Environmental and Social Management Unit (ESMU) headed by the General Manager (Operations) of Fiber@Home Ltd. will be formed who will oversee the project activities and the in houses personnel's HES compliances.

The "Environmental and Social Management Unit" should be manned by personnel competent in undertaking environmental and social screening and monitoring and will report directly to the General Manager (Operations) of Fiber@Home Ltd.

The "Environmental and Social Management Unit" with support from relevant local communities (if necessary) will carry out "Environmental/Social Screening" and "Analysis of Alternatives" of sub-projects, following the guidelines contained in the Environmental and Social Management System (ESMS). If required, Fiber@Home may consider hiring consultants (environmental and social specialists) for carrying out these screening activities.

Guidelines for analysis of Alternatives:

The site selection analysis of the project should follow the selection and recommendation of the most preferable site for the new project among different options. Technical, environmental and economic aspects has to be considered for the best site selection. Factors which should be taken into account includes:

- Minimal hindrance to habitation;
- Avoidance of forest area;
- Avoidance of homestead, schools, graveyard, mosque, church/ temple, cremation yards etc.;
- Avoidance of environmental sensitive areas, historic and archaeological sites as much as possible; and
- Avoidance of areas with high geo-hazard risk.

Apart from the above factors, the following considerations should be made during the site selection process:

The critical and attentive issues for selection of site would be:

- Selection of sites avoiding the following Ecologically Critical Areas:
  Human Settlements, Forest Sanctuaries, National Parks, Game Reserves, Mangroves, Forest Areas, Wetlands, Wildlife Habitats, Archaeological Sites, Ancient Monument Sites, Biodiversity Areas and Similar Other Areas.
- Considering and weighing up these issues, the preferred sites out of the selected different options should be finalized.

The 'Environment and Social Management Unit', as required, will carry out further EHS issues of the fiber@home and keep the record of compliances reports for future record. To carry out all sort of environmental and social issues required in any project construction and operation as well the EHS of Fiber@Home based on the compliance of any project's EMP and preparation of quarterly reports will need a well composed environmental and social experts. In the ESMU the following experts will be working for carry out the ESMS of the Fiber@Home Ltd.

- One Environmental Specialist (ES)
- One Social Specialist (SS)
- One Coordinator

Roles & Qualifications of ES:

- Lead the whole ESMU team for the Environmental aspects of the projects
- Keep liaison with regulatory authorities
- Actively participate in planning and monitoring
- Prepare and pass monitoring budget

Roles & Qualifications of SS:

- Lead the whole ESMU team for the Social aspects of the projects
- Keep liaison with the project sites PAPs if any
- Actively participating in planning and monitoring
- Prepare and pass monitoring budget

Roles & Qualifications of Coordinator:

- Work in close coordination with AGM monitoring and reporting
- Monitoring schedule
- Mobilization of monitoring team
- Make monitoring done on schedule date
- Collect and organize monitoring results
- Prepare and submit monitoring reports

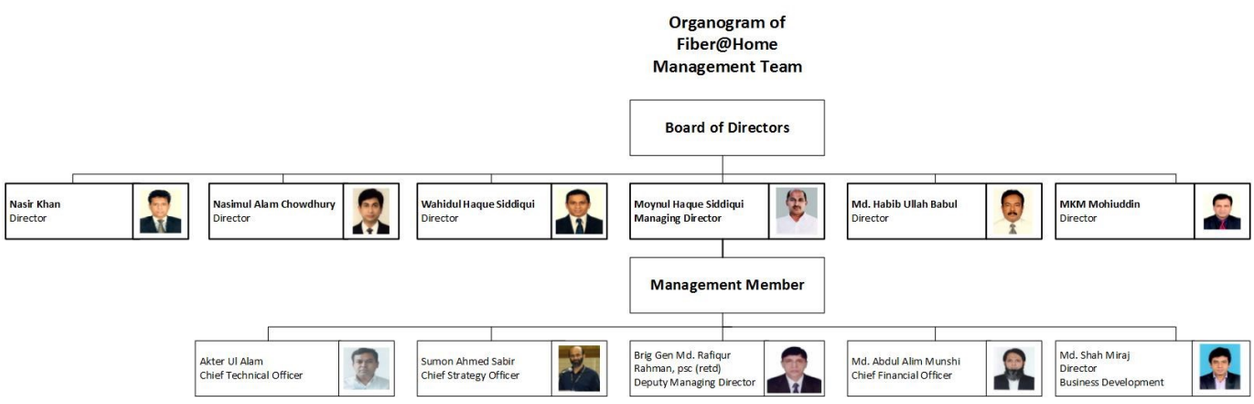
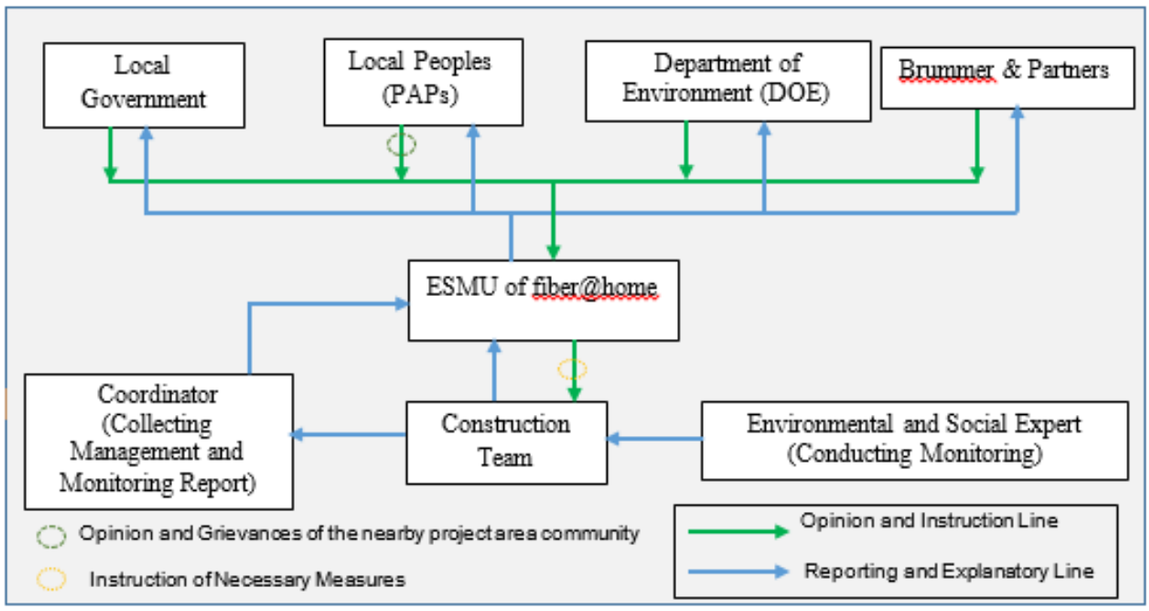


Figure-6.1 Organogram of Management Team

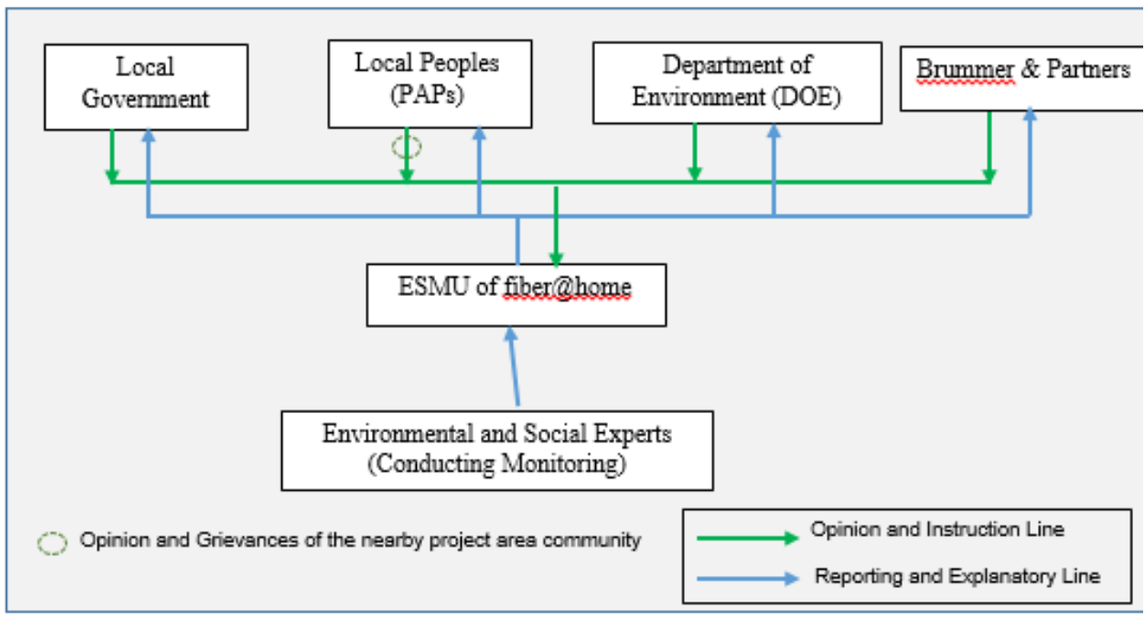
Fiber@home has a formulated the hierarchy from the senior executive to the Board for the regular monitoring of the Environmental and Social issues which are to be monitored for the compliance of its

ongoing construction and operation projects as per the prescribed EMP. The hierarchy is figured out in the Figure-6.2.

Figure-6.2 Hierarchy of E&S issues of the Fiber@home



During Construction Phase



Operation Phase

(ESMU: Environmental and Social Management Unit, ES: Environmental Specialist, SS: Social Specialist)

Figure-6.3 Organogram of the Fiber@Home

6. IDENTIFICATION OF RISKS AND IMPACTS

The primary objective of a risk assessment is to identify the potential negative environmental and social impacts so that the appropriate strategies can be taken to address them. The key risks and impacts associated with the activities of the Fiber@Home are listed below:

6.1 Construction Phase

i) Environmental: Pollution Prevention and Resource Efficiency

⇒ Inadequate disposal of construction waste leading to land/water contamination

⇒ Horizontal Directional Drilling Work
- Noise and air pollution,
- Worker health and safety,
- Disruption of local drainage
- Water pollution due to sediment suspension (increase in suspended solids) or washing away of slurry to the water bodies

⇒ Excavation and backfilling (trenching operation), concreting work, mobilization of vehicles and equipment
- Noise Pollution
- Air pollution due to fugitive construction dust
- Fossil fuel burning by construction equipment
- Increased traffic
- Traffic congestion during roadside work
- Damage/ reduction of native flora, displacement of wildlife, birds etc.
- Water pollution by suspended solids as a result of soil erosion or by accidental fuel spills
- Disruption of local drainage

⇒ Water body crossing operation of fiber optic cables by clamping to bridge
- Noise and air pollution
- Disruption of bridge traffic

⇒ Water Pollution
- Drainage congestion of the office Building/Central office etc.

⇒ Air pollution
- Poor air quality due to vehicular emission (SOX, NOX, COX, HC) of the users.

⇒ Solid waste
- Soil contamination as well as attraction of insects and bad odor due to improper handling and disposal of generated Solid Waste of the office Building/Central office etc.

⇒ Noise pollution
- Generation of high level of noise from vehicles or Generator which cause nuisance to the surroundings;

⇒ Fire Safety
- Risk of severe injuries and loss of lives Damage to property

⇒ Traffic problem
- Presence of high tech manufacturing unit/movement of officials will add traffic to burden the existing roads.

ii) Occupational Health and Safety

⇒ Failure to equip workers with PPE including head, eye, hand and foot protection, and highly visible/ reflective clothing

⇒ Installation of fiber optic cables: Various injuries related to fiber optic cable handling-
- exposure to laser
- microscopic fiber optic shards
- fire hazard

⇒ Fatalities and/or injuries related to:
- falls from heights due to improper installation and use of formwork/ scaffolding/ stairways /railings
- falling materials
- inappropriate use and maintenance of heavy construction machinery and equipment
- entering confined spaces without preparation
- carrying heavy loads

- ⇒ Lack of potable water and sanitation facilities
- ⇒ Lack of appropriate housing and cooking facilities for workers leading to overcrowding, informal cooking in rooms, etc.
- ⇒ Safety for building and equipment
- ⇒ Precautions in case of fire
- ⇒ Fencing of machinery
- ⇒ Floor, stair and passage way
- ⇒ Work on or near machinery in motion
- ⇒ Carrying of excessive weights
- ⇒ Sufficient latrines and urinals shall be provided
- ⇒ Latrines and urinals shall be maintained in clean and sanitary condition
- ⇒ Latrines and urinals shall be adequately lighted and ventilated
- ⇒ First aid arrangement shall be provided and maintained
- ⇒ One First aid arrangement for every one hundred and fifty workers
- ⇒ First aid arrangement shall be kept with a responsible trained person who shall be available during the working hours
- ⇒ In every facility where five hundred or more workers are employed, a dispensary shall be provided and maintained

iii) Labor

- ⇒ Failure to monitor contractors' and subcontractors' compliance with and enforcement of labor laws
- ⇒ Low awareness of labor laws among contractors and subcontractors as minimum working conditions are typically absent from the subcontracting process
- ⇒ Use of migrant/temporary labor subject to working conditions below minimum standard established by law
- ⇒ Labor Low wages
- ⇒ Child labor
- ⇒ Gender discrimination in terms of employment (such as remuneration)

iv) Health, Safety and Security- Community level to the Head Office

- ⇒ Accidents due to increased vehicle traffic from transport of construction materials and waste;
- ⇒ Employment of poorly trained vehicle operators who engage in inappropriate behavior (e.g. speeding, over revving, excessive brake use in heavy vehicles) potentially leading to mechanical failures and accidents
- ⇒ Failure to deploy traffic warning signs and personnel to control movement of workers, equipment and goods to and within construction site
- ⇒ Lack of proper fencing or boundary controls to prevent site access from unauthorized personnel and members of the community (especially children)
- ⇒ Exposure to dust from use of machinery or potentially containing dangerous trace components
- ⇒ Exposure to noise or vibrations from drilling, breaking or crushing
- ⇒ Spread of HIV-AIDS and other STDs due to migratory labor force
- ⇒ Increase of disease vectors - mosquitoes, black flies, rodents - from failure to manage liquid and solid wastes

6.2 Operation Phase

At the operational phase, Fiber@Home will be responsible for the operation and maintenance of the fiber optic cable network and ancillary facilities, maintenance of Head Office/Central offices/Park Complex. Operation and maintenance will be on foot traffic only and no adverse environmental impact to environmental parameters is anticipated during the operation phase. However, during the maintenance and repair of fiber optic cables, the issue of worker exposure to laser and microscopic fiber optic shards would have to be considered. The safety protocols stated in the IFC/World Bank Group EHS guidelines for fiber optic cable safety would have to be followed in order to minimize and eliminate any adverse effect on worker health and safety.

- ⇒ Fire Safety: Risk of severe injuries and loss of lives Damage to property;
- ⇒ Solid Waste management of the Head Office/Central offices/Park Complex;
- ⇒ Visual survey of the Head Office/Central offices/Park Complex during operation. Road traffic management, management of flammable materials (if any), use of Personal Protective Equipment during monitoring of the network, the central offices and head office operations by officials.

7. MANAGEMENT PROGRAMS

The major activities in the construction phase include Excavation of a trench approximately 300 mm wide and 1 m deep of fiber optic line, laying of cable conduits and construction of ancillary facilities, pulling and splicing of the communications cable through the conduit and final restoration and cleanup operations, mobilization of equipment and manpower and application of horizontal directional boring where presence of water or other obstacles inhibit trenching operation.

At the operational phase, Fiber@Home is responsible for the operation and maintenance of the fiber optic cable network and ancillary facilities. Operation and maintenance will be on foot traffic only and no adverse environmental impact to environmental parameters is anticipated during this phase.

Project activities in Construction Phase:

- Excavation and backfilling (trenching operation), concreting work, mobilization of vehicles and equipment
- Installation of fiber optic cables
- Horizontal Directional Drilling Work
- Water body crossing operation of fiber optic cables by attachment to bridge

Project Activities in Operation Phase:

During the maintenance and repair of fiber optic cables, the issue of worker exposure to laser and microscopic fiber optic shards are considered.

Action Plan:

Action Plan against Air Pollution:

- Ensure that all project vehicles are in good operating condition;
- Spray water on dry surfaces/ unpaved roads/ vulnerable areas regularly to reduce dust generation;
- Maintain adequate moisture content of soil during transportation, compaction and handling;
- Sprinkle and cover stockpiles of loose materials (e.g., fine aggregates for concreting work);
- Securing and covering material in open trucks while hauling excavated material, construction materials (for concreting work);
- For concreting work, not using equipment such as stone crushers at site, which produce significant amount of particulate matter;
- Establishment of minimally intrusive and well-designed traffic patterns for onsite construction activities;
- Limiting GHG emission by using modern construction equipment and by prohibiting excessive idling of equipment when not in use;
- Apply relevant Standard Operating Practices for excavation and preventing air pollution from construction activities.

Action plan for protection of Flora and Fauna:

- Plantation/afforestation program for tree replacement (plantation of at least two trees of similar species for each cut tree);
- Provide proper compensation if there is any destruction of trees outside RoW;
- Not removing undergrowth fully where possible, so that they may re-grow naturally after the project activity;
- Control intensive movement of heavy construction vehicles;
- Temporary stockpiling of materials should be done on non-vegetative surfaces;
- Avoid removing mature riparian vegetation;
- Revegetation should be done using native, non-invasive species and by preventing the introduction of noxious weeds;
- Keep noise level (e.g., from equipment) to a minimum level, as certain fauna may be very sensitive to loud noise;
- Apply relevant Standard Operating Practices for disturbance to fauna and faunal habitat.

Action Plan for against Water Pollution:

- Remove from site excess subsoil, substrate, and/or large rock materials that cannot be buried in the excavated trench;
- Install sediment basins to trap sediments in storm water prior to discharge to surface water;
- Replant vegetation when soils have been exposed or disturbed;

- No in-stream river or water body crossing will be allowed;
- Work would be halted when wet conditions would lead to excessive damage to soils and vegetation in work areas;
- Employ typical spill prevention guidelines as outlined in the SOP;
- Hazardous materials (fuel) will not be drained into the ground or allowed to drain into the nearest drainage canals;
- A spill prevention, containment, and countermeasure plan would be prepared. This plan would detail the measures required of all construction, operation, and maintenance personnel for transport, storage, use, spill response/ containment, and disposal of hazardous materials, waste, and debris.

Action Plan against Noise Pollution:

- Use of noise suppressors and mufflers in heavy construction equipment;
- Avoid using of construction equipment producing excessive noise during school hours and also at night;
- Avoid prolonged exposure to noise (produced by equipment) by workers/ give protective gears;
- Regulate use of horns and avoiding use of hydraulic horns in project vehicles.

Action Plan against Disruption of local drainage:

- Provide adequate diversion channel, if required ;
- Provide facilities for pumping of congested water, if needed;
- Ensure adequate monitoring of drainage effects, especially if construction works are carried out during the wet season.

Action Plan against Traffic congestion during roadside work:

- Schedule deliveries of material/ equipment during non-school hours and after regular working hours;
- Employ a minimally intrusive and well designed traffic patterns for onsite activities;
- Depute flagman for traffic control;
- Arrange for signal light at night.

Action Plan against direct or indirect impact to natural, manmade or buried physical cultural resources:

- Excavation activities through places of archaeological and historical importance should be avoided at all costs;
- Place fences at the boundaries of these places so that construction activities or equipment movement do not harmfully affect them;
- Limiting noise-generating activities near such sites which can interfere with the use and enjoyment of PCR such as tourist destinations, historic buildings, religious establishments and cemeteries;
- During excavation activities, if any buried PCR items are found, the Chance Find Procedures should be followed.

Action plan against Health and safety of workers, risk to pedestrian movement:

- Clean bill of health a condition for employment;
- Provide the workers with personal protective equipment for protection against dust and noise
- Contractors and workers should wear high visibility safety apparel while working in public right of way;
- Signposts and directional signs should be provided at appropriate locations for pedestrians and traffic at construction site;
- Contractor should develop and occupational health and safety plan.

Action Plan against Obstruction or interference with other utility infrastructures and Unforeseen Loss/damage of public Infrastructure (electric water supply, sewerage & telephone lines, gas lines):

- During design and permitting process of the project, efforts should be made to coordinate and minimize disruptions;
- In case of unforeseen loss or damage, compensation in cash at replacement cost to respective agencies or restoration of affected assets.

Action Plan again Visual impact of construction work in the locality, inconvenience in performing economic activities of local vendors and shopkeepers:

- Perform the excavation and backfilling work in the quickest possible time;
- Post notices in the locality (local shops, public places, schools and mosques) at least two weeks ahead of the commencement of construction work. These notices should also be available at the webpage of Fiber@Home;
- Small adjustments to the alignment of the fiber optic cable installations to be made negotiating the locations of the immovable vendors and small business establishments to avoid disruption of their economic activity;
- Encourage the movable vendors to position themselves over the handholes. There has been evidence that this provides added security to the handholes.

Action plan against loss of business /income or employment due to temporary closure of shop during construction activities:

- In case of temporary loss of business incomes, compensation to the affected persons will be wages equivalent to closure period OR Alternative business site (usually within a few feet) for continued income stream.

Action Plan against various injuries related to fiber optic cable handling (exposure to laser, microscopic fiber optic shards), fire hazard:

- Follow the fiber optic cable safety protocols as stated in IFC guidelines for environmental, health and safety for telecommunications.

Action Plan against Noise and air pollution, worker health and safety, disruption of local drainage:

- As applicable, adopt similar noise and air pollution mitigation measures, measures to prevent drainage congestion and ensuring worker health and safety stated above for trenching operation, concreting work, mobilization of vehicles and equipment.

Action Plan Water pollution due to sediment suspension (increase in suspended solids) or washing away of slurry to the water bodies:

- The directional drilling equipment should be placed away from stream shore (at least 20 feet away from stream shore according to SOP;
- Ensuring that no seepage occurs through the borehole. In case of seepage, the procedures outlined in the SOP should be followed;
- In water body crossing, it has to be ensured that the borehole remains at a sufficient depth below the lowest bed level of the water body;
- The accurate bed level of water bodies needs to be determined through morphological surveys;
- After completion of the borehole, all slurry should be removed from the construction site and disposed in an approved site.

Action Plan against Disruption of bridge traffic

- Employ a minimally intrusive and well-designed traffic patterns for onsite activities;
- Depute flagman for traffic control;
- Arrange for signal light at night.

Action Plan for Health and safety of workers:

- Provide the workers with personal protective equipment for protection against noise.
- Provide the workers with life jackets with high visibility while working on the bridge.
- Signposts and directional signs should be provided at appropriate locations for diverting pedestrians and traffic on the bridge.
- Contractors should comply with the relevant IFC guidelines of occupational health and safety

The Management Programs are centered on Action Plans and improved procedures to avoid, minimize or compensate for the risks and impacts that were identified. Fiber@Home will always emphasize for preventive and proactive actions:

1) try to avoid causing social or environmental damage;
2) if not possible, then minimize the impact;
3) if not possible, then compensate or offset the damage.

Mitigation and enhancement measures of the potential impacts of the aspects of the Fiber@Home are listed below:

- Ensure that all project vehicles are in good operating condition
- Spray water on dry surfaces/ unpaved roads/ vulnerable areas regularly to reduce dust generation
- Maintain adequate moisture content of soil during transportation, compaction and handling
- Sprinkle and cover stockpiles of loose materials (e.g., fine aggregates for concreting work).
- Securing and covering material in open trucks while hauling excavated material, construction materials (for concreting work)
- For concreting work, not using equipment such as stone crushers at site, which produce significant amount of particulate matter
- Establishment of minimally intrusive and well-designed traffic patterns for onsite construction activities
- Limiting GHG emission by using modern construction equipment and by prohibiting excessive idling of equipment when not in use.
- Apply relevant Best Management Practices for excavation and preventing air pollution from construction activities (Appendix A)
- Plantation/afforestation program for tree replacement (plantation of at least two trees of similar species for each cut tree).
- Provide proper compensation if there is any destruction of trees outside RoW.
- Not removing undergrowth fully where possible, so that they may re-grow naturally after the project activity.
- Control intensive movement of heavy construction vehicles.
- Temporary stockpiling of materials should be done on non-vegetative surfaces
- Avoid removing mature riparian vegetation.
- Re-vegetation should be done using native, non-invasive species and by preventing the introduction of noxious weeds
- Keep noise level (e.g., from equipment) to a minimum level, as certain fauna may be very sensitive to loud noise.
- Apply relevant Best Management Practices (BMP) (Appendix A) for disturbance to fauna and faunal habitat.
- Remove from site excess subsoil, substrate, and/or large rock materials that cannot be buried in the excavated trench
- Install sediment basins to trap sediments in storm water prior to discharge to surface water.
- Replant vegetation when soils have been exposed or disturbed.
- No in-stream river or water body crossing will be allowed
- Work would be halted when wet conditions would lead to excessive damage to soils and vegetation in work areas.
- Employ typical spill prevention guidelines as outlined in the BMP (Appendix A).
- Hazardous materials (fuel) will not be drained into the ground or allowed to drain into the nearest drainage canals.
- A spill prevention, containment, and countermeasure plan would be prepared. This plan would detail the measures required of all construction, operation, and maintenance personnel for transport, storage, use, spill response/ containment, and disposal of hazardous materials, waste, and debris.
- Use of noise suppressors and mufflers in heavy construction equipment.
- Avoid using of construction equipment producing excessive noise during school hours and also at night
- Avoid prolonged exposure to noise (produced by equipment) by workers/give protective gears
- Regulate use of horns and avoiding use of hydraulic horns in project vehicles.
- Provide adequate diversion channel, if required
- Provide facilities for pumping of congested water, if needed
- Ensure adequate monitoring of drainage effects, especially if construction works are carried out during the wet season.

- Schedule deliveries of material/ equipment during non-school hours and after regular working hours
- Employ a minimally intrusive and well-designed traffic patterns for onsite activities
- Depute flagman for traffic control
- Arrange for signal light at night
- Excavation activities through places of archaeological and historical importance should be avoided at all costs.
- Place fences at the boundaries of these places so that construction activities or equipment movement do not harmfully affect them.
- Limiting noise-generating activities near such sites, which can interfere with the use and enjoyment of PCR such as tourist destinations, historic buildings, religious establishments and cemeteries?
- During excavation activities, if any buried PCR items are found, the Chance Find Procedures outlined in Appendix C should be followed.
- Clean bill of health a condition for employment
- Provide the workers with personal protective equipment's (PPEs) for protection against dust and noise
- Contractors and workers should wear high visibility safety apparel while working in public right of way.
- Signposts and directional signs should be provided at appropriate locations for pedestrians and traffic at construction site.
- Contractor should develop an occupational health and safety plan
- During design and permitting process of the project, efforts should be made to coordinate and minimize disruptions
- Follow the fiber optic cable safety protocols as stated in IFC guidelines for environmental, health and safety for telecommunications (Appendix B)
- As applicable, adopt similar noise and air pollution mitigation measures, measures to prevent drainage congestion and ensuring worker health and safety stated above for trenching operation, concreting work, mobilization of vehicles and equipment.
- The directional drilling equipment should be placed away from stream shore (at least 20 feet away from stream shore according to BMP in Appendix A)
- Ensuring that no seepage occurs through the borehole. In case of seepage, the procedures outlined in the BMP (Appendix A) should be followed.
- In water body crossing, it has to be ensured that the borehole remains at a sufficient depth below the lowest bed level of the water body. The accurate bed level of water bodies needs to be determined through morphological surveys.
- After completion of the borehole, all slurry should be removed from the construction site and disposed in an approved site.
- As applicable, adopt similar noise and air pollution mitigation measures stated above for trenching operation, concreting work, mobilization of vehicles and equipment.
- Employ a minimally intrusive and well-designed traffic patterns for onsite activities
- Depute flagman for traffic control
- Arrange for signal light at night
- Provide the workers with personal protective equipment for protection against noise.
- Provide the workers with life jackets with high visibility while working on the bridge.
- Signposts and directional signs should be provided at appropriate locations for diverting pedestrians and traffic on the bridge.
- Contractors should comply with the relevant IFC guidelines of occupational health and safety (Appendix B)
- During the maintenance and repair of fiber optic cables, the issue of worker exposure to laser and microscopic fiber optic shards would have to be considered. The safety protocols stated in the IFC/World Bank Group EHS guidelines for fiber optic cable safety would have to be followed in order to minimize and eliminate any adverse effect on worker health and safety.

8. ORGANIZATIONAL CAPACITY AND COMPETENCY

A well-implemented ESMS is ultimately about trained, committed people. The experts of the ESMU needs detailed training so that they can develop the necessary knowledge and skills. They will need to understand the basics of the Plan-Do-Check-Act cycle and know the nine elements of an ESMS. They have to be updated with the latest IFC Handbook and guidelines. In addition to the detailed training of the team,

everyone will need to receive awareness training so there is a shared understanding of the goals of the ESMS.

9. EMERGENCY PREPAREDNESS AND RESPONSES

The Emergency Preparedness and Response Plan include:

- Identification of potential emergencies based on hazard assessment;
- procedures to respond to the identified emergency situations;
- procedures to shut down equipment;
- procedures to contain and limit pollution;
- procedures for decontamination;
- procedures for rescue and evacuation, including a designated meeting place outside the facility;
- location of alarms and schedule of maintenance;
- list and location of equipment and facilities for employees responsible for responding to the emergency (fire-fighting equipment, spill response equipment, personal protection equipment for the emergency response teams, first aid kits and stations);
- protocols for the use of the emergency equipment and facilities;
- schedule for periodic inspection, testing and maintenance of emergency equipment;
- clear identification of evacuation routes and meeting points;
- schedule of trainings (drills), including with local emergency response services (fire fighters);
- procedures for emergency drills;
- emergency contacts and communication protocols, including with affected communities when necessary, and procedures for interaction with the government authorities;
- Procedures for periodic review and update of emergency response plans.

Suggested Safety Directives for Head Office, Central Offices (COs) and other established offices including KHT park:

Adequately equipped Emergency Response Cell (ERC) with highly trained manpower and appropriate gears is to be established within the Head office/COs or Park complex in order to effectively implement the emergency response plan.

The main functions of the emergency response cell should include the following:

- Identification of various types of emergencies;
- Identification of groups, communities, and areas those are vulnerable to different kinds of emergencies;
- Preparing service teams for various operations within the organization through extensive training;
- Establishment of early detection system for emergencies;
- Developing reliable, instant information communication system; and
- Mobilizing all units in the complex within a very short time to address any emergency

The ERC headed by a trained Manager should establish an Emergency Control Room with links to all building control rooms and all other services. The ERC shall work as a team of the following officials:

- Emergency Manager (Team Leader),
- Fire Officer,
- Safety Officer,

- Chief Security Officer,
- Chief Medical Officer,
- Rescue Officer, and
- Public Relations Officer

Suggested Safety Directives for Work Equipment

It is employer's (contractor) obligation that every possible measure is taken to ensure the safety of the work equipment made available to workers.

During the selection of the work equipment the employer shall pay attention to the specific working conditions, which exist at the workplace, especially in relation of safety and health of the workers. A brief list of work equipment safety issues is given below:

- Work equipment control devices which affect safety must be clearly visible and identifiable and appropriately marked where necessary.
- Where there is a risk of mechanical contact with moving parts of work equipment, which could lead to accidents, those parts must be provided with guards or devices to prevent access to danger zones or to halt movements of dangerous parts before the danger zones are reached.
- Work equipment may be used only for operations and under conditions for which it is appropriate.
- Work equipment must bear the warnings and markings essential to ensure the safety of workers.
- All work equipment must be appropriate for protecting workers against the risk of the work equipment catching fire or overheating, or of discharges of gas, dust, liquid, vapor or other substances produced, used or stored in the work equipment.
- Work equipment must be erected or dismantled under safe conditions, in particular observing any instructions, which may have been furnished by the manufacturer.

Safety Directives for Protective Gears

Personal protective equipment is suggested for use when the risks cannot be avoided or sufficiently limited by technical means. All personal protective equipment must:

- be appropriate for the risks involved, without itself leading to any increased risk
- correspond to existing conditions at the workplace
- fit the wearer correctly after any necessary adjustment.

The Contractor shall organize orientation to use of personal protective equipment. Workers shall be informed of all measures to be taken. Consultation and participation shall take place on the matters related to the use of the protective equipment. A partial list of protective gears to be worn by the workers at designated work areas is given below; Table 9.1 presents the list in tabular form.

Works/ Equipment Use	Safety Measures for Workers and/or Work Areas
Common Construction Works	HH, STB, HG
Earth-works	HH, STB, HG
Cables and Wires	HG, EG, HH
Auger Drill	HH, STB, HG, WB
Concrete Mixer	HH, STB, HG, WB
Fork Lift	HH, HG, STB, WB
Elbow Jack	HH, STB, HG
Sledge/Pick Hammer	HH, STB, HG, WB
Vibrator	HH, STB, HG, WB
Pick Axe	HH, STB, HG, WB
Electric Saw	HG, EG, EM
Working on Poles, Towers	HH, STB, HG, WB

Note: HH = Hard Hat, STB = Steel-tipped Boot, HG = Hand Gloves, BH = Body Harness, WB = Waist Belt, EM = Ear Muff, EP = Ear Plug, WV = Welding Visor, FM = Face Mask, BP = Body Protective Apron, IB = Insulating Boots, EG = Eye protection Glasses

Head Protection: Protective helmets will be put on at all times mainly at the control center construction sites, under scaffolds, erection and stripping of formworks, etc., where there are possibilities of head injuries from falling/flying objects. Eye and Face Protection: Spectacles, Goggles, Face Shield or Arc-welding Mask with Hand Masks, whichever is appropriate.

Safety and Health Signs

Safety signs, health signs, prohibition sign, warning sign, mandatory sign, emergency escape sign, first-aid sign, information sign, signboard, supplementary signboard, safety color, symbol, pictogram, illuminated sign, acoustic signal, verbal communication and hand signal are essential tools for preventing accidents by providing information in advance.

When working on or with overhead lines the provisions of the paragraphs shall be complied with:

- Prior to climbing poles, ladders, scaffolds, or other elevated structures, an inspection shall be made to determine that the structures are capable of sustaining the additional or unbalanced stresses to which they will be subjected.
- Where poles or structures may be unsafe for climbing, they shall not be climbed until made safe by guying, bracing, or other adequate means.
- Before installing or removing fiber optic cable, strains to which poles and structures will be subjected shall be considered and necessary action taken to prevent failure of supporting structures.
- Pole holes shall not be left unattended or unguarded in areas where employees are currently working.

The erecting of poles, hoisting machinery, site preparation machinery, and other types of construction machinery shall conform to following applicable requirements:

- No one shall be permitted under a tower, which is in the process of erection or assembly, except as may be required to guide and secure the section being set.
- Equipment and rigging shall be regularly inspected and maintained in safe operating condition.
- Adequate traffic control shall be maintained when crossing highways and railways with equipment as required.

The Contractor will provide or ensure that appropriate safety and/or health signs are in place at their work sites where hazards cannot be avoided or reduced. The Contractor should comply with the relevant IFC guidelines of occupational health and safety (Appendix B) Workers and their representatives must be informed of all the measures taken concerning health and safety signs at work and must be given suitable instruction about these signs.

10. STAKEHOLDER ENGAGEMENT

A stakeholder is defined as “a person, group, or organization that has direct or indirect stake in a project/organization because it can affect or be affected by the Project or its Proponent’s actions, objectives, and policies”. Stakeholders vary in terms of degree of interest, influence and control they have over the Project or the proponent. In the present study, all the stakeholders have been primarily categorized into two categories that have been identified as:

- Primary Stakeholders: include people, groups, institutions that either have a direct influence on the project or are directly impacted (positively or adversely) by the project and its activities; and
- Secondary stakeholders: are those that have a bearing on the project and its activities by the virtue of their being closely linked or associated with the primary stakeholders and due to the influence they have on the primary stakeholder groups.
- Apart from categorization, the stakeholders have also been classified in accordance with the level of influence they have over the project as well as their priority to the project proponent in terms of importance.
- The influence and priority have both been primarily rates as:
  - ✓ High Influence/Priority: This implies a high degree of influence of the stakeholder on the project in terms of participation and decision making or high priority for project proponent to engage that stakeholder.
  - ✓ Medium Influence/Priority: This implies a moderate level of influence and participation of the stakeholder in the project as well as a priority level for project proponent to engage the stakeholder who are neither highly critical nor are insignificant in terms of influence.
  - ✓ Low Influence/Priority: This implies a low degree of influence of the stakeholder on the project in terms of participation and decision making or low priority for project proponent to engage that stakeholder.

Based on the above attributes, the following Table 10.1 delineates the stakeholders identified for the project and their analysis.

Table 10.1: Stakeholder Mapping for the Project

Stakeholders	Category of stakeholder	Brief profile	Overall influence on the project	Basis of Influence Rating
Project Management				
Fiber@home Ltd.	Primary	Fiber@home Ltd. is the primary project proponent own a controlling stake of 100% in the project	Highest	• Are the primary project proponents • Responsible for operation of this project • Primary financial beneficiaries • Responsible for all the project related risks and impact liabilities
Community				
Land Losers	Primary	Land owners impacted with respect to loss of land and potential livelihood impact.	Medium	• Lack of information during land acquisition process • Support to land losers in terms to temporary sustenance and employment opportunities • Preference for Employment opportunities
Local Community	Primary	• Primarily includes adjacent community to the project	Medium	• No major restrictions around the project site especially with respect to grazing land • Project bring development to the area • Increase in employment opportunities and preference in job • Minimize impact
Regulatory/Administrative Authorities & Agencies				
Dept. of Environment, Bangladesh	Primary	The Department of Environment is the primary government regulatory authority for Environmental protection in Bangladesh.	High	• Responsible for monitoring project's Environmental compliance throughout the project lifecycle
Other Regulatory & Permitting Authorities	Primary		High	• Agencies required for obtaining permits and licenses for operation of the project • Primary involvement during operation phases
Political Administration				
Upazilla (sub District Level) Political Administration	Secondary	Elected representative of people at sub-district level for a fixed tenure	Medium	• Key linkage between the community and the project proponent
Union leaders & local representatives	Secondary	Elected representative at union level i.e. village level for a fixed tenure	Medium	• Plays important role in providing public opinion and sentiment on the project • Empowered to provide consent and authorization for establishment of project on behalf of the community

11. EXTERNAL COMMUNICATION AND GRIEVANCE MECHANISMS

A. Background and Purpose

The proposed nationwide fiber optic network project of the Fiber@Home may cause temporary displacement of people from their businesses, cause temporary loss of income, cause temporary change in land use and construction activities may induce environmental concerns. Installation activity of underground fiber optic cable in any sub-project may have a complicated situation due to the density of settlement in some areas. It is very likely that communities will have questions and complaints and in some cases suggestions on alternative options for routes and locations. The likely affected persons may temporarily have to close down their businesses and may have to sustain income loss due to occupation of land areas during construction phase for project purpose. Such affected persons may have issues of recognition of losses and the compensation process applied for them. There is no need to do the acquisition of land. Because fiber@home just digging on the government roads & doing HDD under the river etc. for trenching & ducting. In this case, fiber@home provide the compensation & took approval from the government entities for cutting roads. Before completion of works government entity has taken compensation to repair the roads. If any damage occurs during installation or trenching/HDD on others entity utilities, for that reason fiber@home has to give compensation directly to impacted entities. Considering the context, the project will establish a Grievance Response Mechanism (GRM) to answer to queries, receive suggestions and address complaints and grievances about any irregularities in application of the guidelines adopted in this framework for project design, and assessment and mitigation of social and environmental impacts. Based on consensus, the procedure will help to resolve issues/conflicts amicably and quickly, saving the aggrieved persons from having to resort to expensive, time-consuming legal action. The procedures will however not pre-empt a person's right to go to the courts of law.

B. Grievance Focal Points

Grievance response focal points will be available at the local and project level within Fiber@Home. The Fiber@Home representatives at the union/town/ward level will be the first focal point on project GRM and the Grievance Redress Committee (GRC) at the Fiber@Home level will be authorized to deal with all suggestions and complaints at the subproject level. Fiber@Home will ensure that communities are fully informed about the GRM and their rights to offer suggestions and make complaints, and the different mechanisms through which they can do so, including grievances related to physical displacement. The Secretariat for each GRC will be at the local project site office.

The membership of the GRCs will ensure proper presentation of complaints and grievances as well as impartial hearings and investigations, and transparent resolutions. Where tribal peoples are among the beneficiaries or affected persons, the membership composition of the GRCs will take into account any traditional conflict resolution arrangements that tribal communities may practice. The GRC Chairman will call the concerned representative from the local community from which the complaint was received for hearing. If the aggrieved person is a female, Fiber@Home will ask the concerned female representative of the local community to participate in the hearings.

To ensure that grievance redress decisions are made in formal hearings and in a transparent manner, the GRC Chairman will apply the following guidelines:

- Reject a grievance redress application with any recommendations written on it by a GRC member or others such as politicians and other influential persons.
- Remove a recommendation by any person that may separately accompany the grievance redress application.
- Disqualify a GRC member who has made a recommendation on the application or separately before the formal hearing:
- Where a GRC member is removed, appoint another person in consultation with the Project Director.

The GRC Chairmen will also ensure strict adherence to the guidelines of social management and impact mitigation policies adopted in this framework and the mitigation standards, such as compensation rates established through market price surveys.

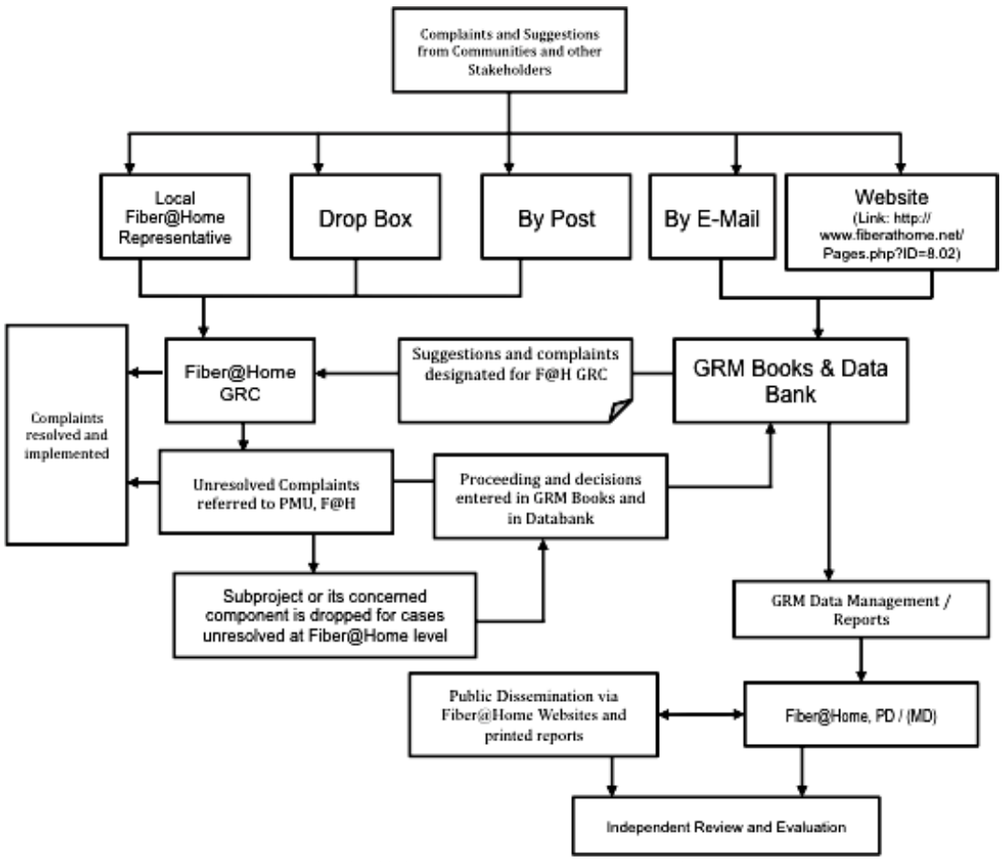


Figure 10.1: GRM Institution and Focal Points

C. GRM Policy Guidelines

The GRM focal points at the local Fiber@Home level will be established before approval of the sub-projects at the Central Fiber@Home level for financing. GRC at the field Fiber@Home level will meet at least once before commencement of a project and have an orientation on their mandate, functions and working procedures. Within the context of this proposed project, for the proposed GRM to work effectively, the following issues will be taken into account.

1. Sensitization and Dissemination of GRM: The Fiber@Home will disclose project related information including subproject interventions with location, provision of GRM with scope and procedures, and rights of the communities of accessing the GRM with limitations through their website (link: http://www.fiberathome.net/Pages.php ID=13). Before commencement of the sub-project, a session with GRC, Fiber@Home office bearers and administrative and engineering staff is to be organized on the GRM provision including functions of GRC, and rights and responsibility of the communities. Exact addresses for lodging complaining and providing suggestions to the project team will be disclosed in the meeting and subsequently published in the Fiber@Home company website and in leaflets to be disseminated among the beneficiaries.

2. Social Inclusion and Safeguards: Fiber@Home must ensure effective implementation of OP 4.10 and 4.12 of WB. Fiber@Home will appoint designated Social Management Specialists and project level personnel helping the Fiber@Home in social management. Specifically, Fiber@Home will ensure implementation of project specific EMF and SMF in their full meaning and requirements.

3. Setting up GRM Data Bank: Fiber@Home will set up a central Data Bank on all complaints received and handled segregated by types of complaints. The database should be accessible by all key project staff with the PMU, Fiber@Home. They will send quarterly GRM report to the World Bank. This report will provide detailed information on number and types of complaints received by districts followed by status of resolutions. The World Bank will have access to the GRM Data Bank, if required. Fiber@Home will be able to access their data in the GRM Databank. The project Design, Supervision and Management Consultant will help the project to set up and maintain such databank. Setting up this databank will include developing and administering necessary computer software and

networking with the project supported by Fiber@Home.

4. Independent M&E of GRM Implementation: An independent Monitoring and Evaluation (M&E) and associated sanction measures will ensure check and balance of the GRM of the project. The M&E report on GRM will be prepared against a set of indicators developed at the time of implementation and included in the SMP.

D. Scope of GRM

Suggestions and complaints to be addressed through GRM include, but not limited to the following:

- Location/alignment of subproject interventions
- Temporary and permanent displacement of people
- Compensation and assistance issues against temporary displacement of people
- Environmental concerns and construction safety
- Gender and vulnerability based discriminations
- Quality of works

All other complaints will be first dealt at the local Fiber@Home representative level. If the local Fiber@Home representatives cannot resolve a specific complaint, they will be referred to the GRCs. There will be two primary channels for an aggrieved person for lodging a complaint or sending a suggestion related to a subproject.

a) **Electronic submission:** Fiber@Home has already developed (i) a user-friendly complaint mechanism in the Fiber@Home website (link:http://www.fiberathome.net/Pages.php?ID=8.02) and (ii) a valid email address @fiberathome.net) of the Fiber@Home to follow up complaints lodged. In the website, there will be designated feedback window to launch a complaint. A complainant will receive a unique Case Number via email from Fiber@Home for future tracking.

b) **Paper-based submission:** This mechanism will provide a Drop Box, accept Postal mail and walk in submission to GRC secretariat or to the local Fiber@Home representatives. Each complaint received will be assigned a unique Case Number so that the status of cases can be tracked. Fiber@Home will initiate the GRM channels and the local Fiber@Home will establish GRM focal points, GRC and channels for accepting suggestions and complaints at least 30 days before bidding process.

E. Grievance Petition and Resolution Process

A GRM information leaflet will be developed in local Bangla language and distributed among the communities in the subproject beneficiary areas. The portable document format (pdf) version of the information leaflet will be uploaded online in the Fiber@Home company website. Fiber@Home consultants will assist in preparation, printing and online publishing of this leaflet for the participating local Fiber@Home. The steps for submission of complaints and suggestions and their resolution at GRCs will be the following:

Step One: All complaints will first be received with the local Fiber@Home representatives through the complainant. The local Fiber@Home representatives will review and sort the cases in terms of nature of grievance and urgency of resolution. If the complaints are about any misconception or wrong understanding on policy and measures, the local Fiber@Home representatives will clarify and if the aggrieved person is satisfied, will close the case at the entry level keeping a case record. The complaints and suggestions designated after scrutiny will be forwarded to the GRC at local Fiber@Home.

Step Two: The aggrieved persons may also lodge the complaints and send suggestions directly through postal mail, e-mail, websites or drop the written complaint in the Fiber@Home drop box. The Fiber@Home will disclose the addresses of these portals to the communities before submission of their subprojects for approval and financing.

Step Three: The complaints and suggestions received through various designated channels will be documented through paper-based registers and in computerized Data Bank with unique Case Numbers. The Member Secretary of the GRC will scrutinize the merits and produce the cases to the GRC's Monthly Sessions. Attendants, minutes of the meeting, and the decisions will be instantly noted in the resolution book and entered into the GRM Databank with a resolution ID number. All complaints will be resolved in a maximum of 4 weeks after receiving the cases.

Step Four: If the resolution attempt at the local level fails, the GRC will refer the complaint with the minutes of the hearings to the PMU, Fiber@Home, as the case may be, for further review. With active assistance from the Social Management Specialist, the Project Directors will make a decision and communicate it to the concerned GRC. The decisions on unresolved cases at this stage will be communicated to the GRC within one week of the complaint receipt. If a decision at this level is again found unacceptable by the aggrieved person(s), the Fiber@Home will advise the concerned local Fiber@Home to drop the subproject or the concerned component from the investment.

A decision, agreed by the complainant at any stage of the GRM process, will be binding upon the Fiber@Home concerned.

F. GRM **Documentation**

To ensure impartiality and transparency, hearings on complaints at the GRC level will remain open to the public. The GRCs will record the details of the complaints and their resolution in a register, including intake details, resolution process and the closing procedures. Fiber@Home will maintain the following three GRM Books:

Registration Book: (1) Serial no., (2) Date of receipt, (3) Name of complainant, (4) Gender, (5) Father or husband, (6) Complete address, (7) Main objection (loss of income/business), (8) Complainants' story and expectation with evidence, and (8) Previous records of similar grievances.

Resolution Book: (1) Serial no., (2) Case no.,(3) Name of complainant, (4) Complainant's story and expectation, (5) Date of hearing, (6) Date of field investigation (if any), (7) Results of hearing and field investigation, (8) Decision of GRC, (9) Progress (pending, solved), and (10) Agreements or commitments.

Closing Book: (1) Serial no., (2) Case no., (3) Name of complainant, (4) Decisions and response to complainants, (5) Mode and medium of communication, (6) Date of closing, (7) Confirmation of complainants' satisfaction, and (8) Management actions to avoid recurrence.

Grievance resolution will be a continuous process during subproject implementation. The Fiber@Home will keep records of all resolved and unresolved complaints and grievances and make them available for review as and when asked for by WB and any other interested persons/entities. The Fiber@Home will also prepare periodic reports on the grievance resolution process and publish these on their websites. Fiber@Home will consolidate reports from the local Fiber@Home on GRM and post those reports on their websites.

12. MONITORING AND REVIEW

The primary objective of the environmental monitoring is to record environmental impacts resulting from the sub-project activities and to ensure implementation of the "mitigation measures" identified earlier in order to reduce adverse impacts and enhance positive impacts from project activities.

Fiber@Home will be responsible to monitor and make sure that the environmental mitigation/enhancement measures (including health and safety measures) outlined in the ESMS are being implemented.

Apart from general monitoring of mitigation/enhancement measures, important environmental parameters to be monitored during the construction phase of the sub- projects include noise level, water quality, drainage congestion etc. Table 12.1 presents guidelines for monitoring of specific environmental parameters during construction phase of fiber@home projects.

Table 12.1: Guidelines for monitoring of environmental parameters during construction phase

Monitoring	Period/Location	Parameters to be monitored	Monitoring Frequency and responsibilities	Resources Required
Noise Level	Baseline One set of measurements at property boundaries of selected critical locations (schools, residential areas, hospitals etc.) prior to commencing cable laying activities	Equivalent Noise level (L_{eq}) with GPS location, wind speed and	Spot checking in a monthly basis;	Noise level

Monitoring	Period/Location	Parameters to be monitored	Monitoring Frequency and responsibilities	Resources Required
	Three set of measurements at the same locations during cable laying process (trenching) Three set of measurements at the same locations during cable laying process (HDD operation)	direction	Contractor's Responsibility	meter, GPS;
Air Quality (dust particles/ particulate matter)	Baseline Only at selected critical locations downwind of site activities (prior to commencement of work) and in close proximity to human receptors Only at selected critical locations downwind of site activities (during trenching and cable laying work) and in close proximity to human receptors	SPM, PM_{10} with GPS location, wind speed and direction	Spot checking on a Monthly basis; Contractor's Responsibility	Particulate matter sampling device, GPS Wind speed/direction data to be collected from local BMD station
Water Quality	Baseline: One measurement from the nearest surface water body[a] One measurement from the nearest surface water body during cable laying operation by trenching One measurement from the nearest surface water body during cable laying operation by HDD	Turbidity, Total Suspended Solids, Total Solids, Dissolved Oxygen	Monthly and as directed by the Project team leader; Contractor's Responsibility[a]	Laboratory facilities for water/ wastewater analysis
General site condition	Baseline: Visual survey (once) of proposed cable laying site before prior to cable laying operation Visual survey of cable laying site during the entire period of cable laying operation	General site condition, traffic condition, pedestrian movement, vegetation clearance etc. by visual survey (photographs)	Weekly and as directed by the Project team leader; Contractor's Responsibility	Digital camera
House-keeping activities, Safety measures during construction	Visual survey of cable laying site during the entire period of cable laying operation	Construction debris management, traffic management, management of flammable materials (if any), use of Personal Protective Equipment by workers etc.	Weekly and as directed by the Project team leader; Contractor's Responsibility	Digital camera
Occupational Health and safety Compliance	During the period of cable lay for workers engaged in optical fiber connection	Routine eye examination	For each worker exposed to laser light during cable installation	Eye specialist

Fiber@Home anticipates no adverse environmental or social impacts during the operation phase of the proposed fiber optic cable installation project. An ESMS Heatmap (Annex-C) has been prepared based on the preconstruction, construction and operation stage of its projects works as well as the activities of Central Offices, Operation Data Center, Head Office, High Tech Park etc. This ESMS Heatmap shall be regularly updated at least every six months. However, the following issues need to be addressed during the operation phase:

- The trenches should be monitored over a three-year period for settling and possible cracks showing evidence of disturbance from proposed activities. Visual observation with photograph documentation in this case would be sufficient. This is the responsibility of Fiber@Home.
- The project-affected area should be monitored over a period of one year to ensure reseeding does not appear unnatural (i.e. presence of non-native or invasive species). Visual observation with photograph documentation in this case would be sufficient. This is the responsibility of Fiber@Home.
- For personnel engaged in fiber optic repair and maintenance, if they are exposed to laser during such operation, they should have their eyes examined regularly by a medical professional. This would be the responsibility of Fiber@Home and the actual frequency of monitoring would have to be determined by Fiber@Home as well.

APPENDIX A STANDARD OPERATING PRACTICES (SOP) FOR FIBER OPTIC CABLE INSTALLATION

The Standard Operating Practices (SOPs) are guidelines to reduce or eliminate environment risk due to various activities associated with the construction and installation of Fiber Optic Cable Lines of Fiber@Home.

A. Protection of Flora and Fauna

(a) Construction Phases:

i) Where stream crossings would include excavation or other activities that would result in suspended sediment, disturbance or modification of stream banks and beds, and/or removal of native riparian vegetation, measures will be employed to avoid or reduce the effect of these impacts.

ii) Where the potential for suspended solids re-suspension exists, monitoring for elevated turbidity levels will be planned, with contingencies in place to avoid elevated levels of suspended sediment that could result in adverse effect to sensitive aquatic species and other fish-bearing streams.

iii) Removal of mature native riparian vegetation will be avoided, where avoidance is not possible, as few trees as possible will be removed to support the construction.

iv) Where placement of cable or other infrastructure would result in removal of tree nests for migratory birds, surveys for all species of concern will be performed, and survey findings will be applied to include protective timing measures or other protections that ensure compliance with related local laws and guidelines.

v) Removal of trees needs to be avoided where such activities would result in mortality of eggs or nestlings or the abandonment of eggs and nestlings of birds

vi) If sensitive plant species are found in the planning area while project activities are occurring, an ecologist would be consulted as to measures required to protect the species and its essential habitat. In addition, restrictions should be imposed on noise-generating activities and application of artificial lighting that disturbs sensitive species. If threatened or endangered species are affected due to project activities, appropriate measures should be taken for their rescue and relocation.

vii) Tree felling, if unavoidable, shall be done only after compensatory plantation of at least three saplings for every tree cut is done.

viii) The species shall be identified in consultation with officials of forest department/local community, giving due importance to local flora. It is recommended to plant mixed species in case of both avenue or cluster plantation.

ix) The plantation strategy shall suggest the planting of fruit bearing trees and other suitable trees.

(b) Operation Phase:

i) During the operational phase regular trimming of trees along the route of aerial installation of fiber optic cable line may become essential to prevent accidents due to over- growth onto the power lines. However, his activity should be conducted with minimal damage to the existing vegetation.

ii) The project proponents would take up the planting of fruit bearing and other suitable trees, on both sides of the roads or other infrastructure development projects location from their own funds.

B. Excavation, Backfilling and Topsoil Restoration and re-Vegetation

(a) Construction Phase:

i) Topsoil lift material would be replaced as the surface soil layer during backfilling. Excess subsoil, substrate, and/or large rock materials that cannot be buried in the excavated trench (trenching method) would be removed from the site.

ii) Some compacting of backfill soil materials would be required while when closing trenched portions of the fiber optic line so as to eliminate excess soil settling. Backfilled sites should be mounded slightly at the completion of backfilling to accommodate for a reasonable amount of settling. Backfilling and compaction must be complete in all areas within 50 yards of road drainage culverts or natural channels before crews leave the job site for an extended period (weekend, holiday, etc.).

iii)Drainage congestion may result from possible obstruction to natural flow of drainage water due to the storage of materials, digging/back-filling of water fiber optic line trenches. Therefore, care should be taken to avoid any drainage congestion during these activities.

(b) Operation Phase:

i) Restoration of topsoil will be required where soil is disturbed by project activities. The goal is to provide long-term soil cover and reduce the risk of weed infestation. Native plant materials are the first choice in re-vegetation, but non-native, non-invasive plant species may also be used. Prompt re-vegetation is critical to restoration of backfilled areas. Installation of native rather than imported plants will increase vegetation viability, avoid immediate- or long-term irrigation needs, and promote rapid ground cover. Plant diversity also will create useful wildlife habitat and more opportunities for future activities or site reuse.

ii) If grass seed is not established within two years of initial seeding then reseed as necessary.

iii) The topsoil salvaging provision applies to all areas along the proposed fiber line installation route where one or more of the following conditions exist:

- o trenching would be used for cable installation;
- o the fiber optic line would be buried in a borrow ditch or along other drainage features;
- o any areas where the fiber optic line passes through mature stands of conifers or deciduous trees, i.e.: areas obviously lacking previous disturbance.

Topsoil salvaging would not be required in any areas where the soil surface is characterized as rubbly, extremely stony, or extremely boulder based on the size and amount of rock fragments on the surface. Topsoil salvaging would also not be required in areas that are severely infested by noxious weeds or cheat grass.

C. Reuse of Excavated Soil

(a) Construction Phase:

i) Reusing excavated soil can be done from construction activities, where appropriate, to support similar construction development activities. This limits the need to import soil from natural or virgin sources. It also reduces the environmental impacts and costs associated with taking excess soils to commercial fill or landfill sites. All soils imported to a site for reuse should be of a quality appropriate for anticipated future land uses and to prevent adverse effects. Municipalities are encouraged to consider these soil reuse options in their procurement practices, and when issuing approvals or permits that include soil management and importation.

D. Protection of Sensitive Locations

(a) Construction Phase:

i) At boundaries of sensitive areas (places of historical or archaeological importance), their buffers, and other areas stake or wire fences may be used to protect them from any harmful effects due to project activities. The fences will also assist in controlling vehicle access to and on these areas.

E. HDD Operation

(a) Construction Phase:

i) Directional Drilling equipment will be located outside of stream buffers - typically 20 feet or more from stream shore.

ii) During directional boring operations the following mitigation measures may be adopted if seeping occurs:

(A) Containment and cleanup equipment will be present for use at the site, as needed;

(B) If boring under stream crossings, a qualified hydrological monitor will be present at all bore sites to monitor construction activities for prompt detection of any releases;

(C) Releases will be immediately controlled and the drilling fluid will be contained and removed;

(D) A remediation plan will be developed based on the site-specific conditions.

iii) Upon completion of a directional bore, all slurry will be removed from the construction site and deposited at an approved site.

F. Cable Lying by Bridge-crossing

(a) Construction Phase:

i) Safety netting will be installed under aerial and bridge attachment installations over water bodies to avoid equipment, tools, or workers from falling into the water body.

G. Pole Construction (Aerial installation of fiber optic cable line)

(a) Preconstruction Phase:

i) All regulatory clearances shall be obtained before actual start of work. River Crossing Towers are very high electric towers specially designed to cross large rivers.

(b) Construction Phase:

i) Erection of poles/towers for installation aerial fiber optic cable lines of the Fiber@Home involves:

- Informing the local community about the installation schedule;
- Marking and clearance of the designated locations for installation/replacement of poles.
- Pole Erection Activities by Fiber@Home

- Informing the community and local city/village councils about the likely schedule of erection;
- After obtaining the consent of the community Fiber@Home shall be responsible to stake out the designated locations.

ii) Pole Erection Activities by the Contractor

- The contractor shall submit the schedules and methods of operations for various items during the Pole erection operations to the Fiber@Home for approval.
- The clearance of sites shall involve the removal of all materials such as trees, bushes, shrubs, stumps, roots, grass, weeds, part of topsoil and rubbish. Towards this end, the Contractor shall adopt the following measures:
  - To minimize the adverse impact on flora and vegetation, only ground cover/shrubs that impinge directly on the permanent works shall be removed.
  - In locations where erosion or sedimentation is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion and sedimentation control features can follow immediately, if the project conditions permit.
  - The disposal of wastes shall be in accordance with the provisions of BMPs related to Waste Management.
- Tower construction for river crossing will require proper protective measures against bank collapse. Sheet-Piling or Shore protection measures should be ensured while laying the foundation of the tower near the river bank or in the river bed. Pre-cast piles should be driven in with extreme care so as to expose the workers to the least possible danger.
- Foundation should be checked for damages or uneven settlement following construction.
- Proper safety measures should be ensured prior to River crossing jobs.
- The work plans should be submitted by the contractor/engineer prior to commencement of the erection work. The work plan should provide detailed steps of foundation works in the river. River traffic movement should not be obstructed t any stage.
- Proper protective measures should be adopted to prevent or minimize river water pollution.

H. Installation of control station for fiber optic line

(a) Preconstruction Phase:

i) All regulatory clearances shall be obtained before actual start of work.

(b) Construction Phase:

i) The clearance of site shall involve the removal of all materials such as trees, bushes, shrubs, stumps, roots, grass, weeds, part of topsoil and rubbish. Towards this end, the Contractor shall adopt the following measures:

- To minimize the adverse impact on flora and vegetation, only ground cover/shrubs that impinge directly on the permanent works shall be removed;
- In locations where erosion or sedimentation is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion and sedimentation control features can follow immediately, if the project conditions permit;

- The disposal of wastes shall be in accordance with the provisions of SOPs related to Waste Management.

I. Waste Management

(a) Post-construction Phase:

- In case of disposal of wastes on private land, certificate of Completion of Reclamation is to be obtained by the Contractor from the landowner that "the land is restored to his satisfaction".

(b) Construction Phase:

- The contractor shall either re-use or dispose the waste generated during construction depending upon the nature of waste.
- The contractor shall dispose of wastes that could not be re-used safely.
- Fiber@Home shall review the waste management practices adopted by the Contractor during the progress of construction.

J. Public Health and Safety

(a) Pre-construction Phase

- In order to incorporate public health and safety concerns, Fiber@Home and the Contractor shall disseminate the following information to the community:
  i. Location of project activities,
  ii. Borrow areas,
  iii. Extent of work
  iv. Time of construction
  v. Involvement of local labors in the road construction
  vi. Health issues - exposure to dust, communicable diseases etc.

(b) Construction Phase

- The Contractor shall schedule the construction activities taking into consideration factors such as:
  i. Sowing of crops
  ii. Harvesting
  iii. Local hindrances such as festivals, etc.
  iv. Availability of labor during particular periods
- Proper safety/warning signs are to be installed by the contractor to inform the public of potential health and safety hazard situations during the construction phase in the vicinity of the project.
- Fiber@Home shall carry out periodic inspections in order to ensure that all the measures are being undertaken as per this SOP.

(c) Operation Phase:

During operation phase (especially during regular maintenance) following issues should be addressed for overhead fiber optic cable lines:

- Regular patrolling along the overhead fiber optic cable lines to identify the need for regular and immediate maintenance operation.
- Inspection immediately after a major storm/rainfall event
- Regular cutting and trimming of trees around fiber optic cable lines.

K. Natural Habitats

(a) General

- This code of practice envisages measures to be undertaken during implementation of the said projects by the Fiber@Home near natural habitats. These measures shall be undertaken in addition to the measures laid down in the other BMPs.
- As per the World Bank OP 4.04, the conservation of natural habitats, like other measures that

protect and enhance the environment, is essential for long-term sustainable development. A precautionary approach to natural resource management to ensure opportunities for environmentally sustainable development has been adopted for the project.

(b) Pre-construction Phase

Contractor in consultation with forest ranger or any other concerned authority shall prepare a schedule of construction within the natural habitat. Due consideration shall be given to the time of migration, time of crossing, breeding habits and any other special phenomena taking place in the area for the concerned flora or fauna.

- The infrastructure development projects near the natural habitat shall be declared as a silence zone;
- Compensatory tree plantation within the project area shall be done.

(c) Construction Phase

- Collection of any kind of construction material from within the natural habitat shall be strictly prohibited;
- Disposal of construction waste within the natural habitat shall be strictly prohibited.

L. Air Pollution Control

i) Construction Phase:

(i) Field generation of contaminated or uncontaminated dust and mobilization of volatile organic compounds can be reduced by new and traditional SOPs such as:

- Covering excavated areas with biodegradable fabric that also can control erosion and serve as a substrate for favorable ecosystems, or with synthetic material that can be reused for other onsite or offsite purposes
- Spraying water in vulnerable areas, in conjunction with water conservation and runoff management techniques
- Securing and covering material in open trucks while hauling excavated material, and reusing the covers
- Re-vegetating excavated areas as quickly as possible
- Limiting onsite vehicle speeds to 10 miles per hour SOPs related to safety during fueling operations and cleaning of spills

(ii) Fueling of equipment is not to be done in close proximity to sensitive aquifers designated wetlands, wetland buffers, or other waters of the State.

(iii) The presence and constant observation/monitoring of the driver/operator at the fuel transfer location at all times will be implemented. Fueling will be located at least 25 feet from the nearest storm drain or covering the storm drain to ensure no inflow of spilled or leaked fuel.

(iv) The local fire department contact names and numbers will be on-site in case of any spill entering the surface or ground waters or in the event of fire.

(v) Petroleum products will be stored in tightly sealed containers which are clearly marked.

(vi) All onsite vehicles will be checked for leaks and receive regular preventive maintenance to reduce the chance of leakage.

(vii) Manufacturer-recommended methods, materials, and equipment for spill cleanup will be available on site, and personnel will be made aware of the procedures and the location of the information and cleanup supplies.

(viii) All spills will be cleaned up immediately after discovery. Personnel will wear appropriate protective clothing to prevent contact with hazardous substances.

M. General maintenance and erosion control

(a) Construction and Operation (Maintenance) Phase:

i) When water or sediments are removed from vaults, inspect for the presence of oil or sheen. If oil or sheen is present, the liquid will be pumped out and disposed of properly via the sanitary sewer or directly at a wastewater plant.

ii) Storm drain inlets will be protected to prevent coarse sediment from entering drainage systems prior to permanent stabilization of the disturbed areas. It may be necessary to build a temporary dike, use a block and gravel filter around the inlet using standard concrete blocks and gravel. Other methods recommended are gravel and wire mesh filters, catch basin filters, curb inlet protection with wooden

weir, block and gravel curb inlet protection, or curb and gutter sediment barrier.

iii) All construction and maintenance activities would be conducted in a manner that would minimize disturbance to drainage channels, and stream banks.

APPENDIX-B IFC/WORLD BANK GROUP OCCUPATIONAL HEALTH AND SAFETY GUIDELINES FOR FIBER OPTIC CABLE INSTALLATION

Workers involved in fiber optic cable installation or repair may be at risk of permanent eye damage due to exposure to laser light during cable connection and inspection activities. When extending a cable or mounting a cable connector, a microscope is typically attached to the end of the fiber optic cable allowing the worker to inspect the cable end and prepare the thin glass fibers for extension or connection assembly. Workers may also be exposed to minute or microscopic glass fiber shards that can penetrate human tissue through skin or eyes, or by ingestion or inhalation. Optical fiber installation activities may also pose a risk of fire due to the presence of flammable materials in high-powered laser installation areas. Recommendations to prevent, minimize, and control injuries related to fiber optic cables installation and maintenance include:

- Worker training on specific hazards associated with laser lights, including the various classes of low and high power laser lights, and fiber management;
- Preparation and implementation of laser light safety and fiber management procedures which include:
  - Switching off laser lights prior to work initiation, when feasible
  - Use of laser safety glasses during live optical fiber systems installation
  - Prohibition of intentionally looking into the laser of fiber end or pointing it at another person
  - Restricting access to the work area, placing warning signs and labeling of areas with potential for exposure to laser radiation, and providing adequate background
  - Lighting to account for loss of visibility with the use of protective eyewear
  - Inspecting the work area for the presence of flammable materials prior to the installation of high-powered laser lights
- Implementation of a medical surveillance program with initial and periodic eye examinations;
- Avoiding exposure to fibers through use of protective clothing and separation of work and eating areas.

Reference: *IFC and World Bank Group (2007) Environmental, Health and Safety Guidelines for Telecommunications. Available at the following link:*

http://www.ifc.org/wps/wcm/connect/0985310048855454b254f26a6515bb18/Final%2B-%2BTelecommunications.pdf?MOD=AJPERES&id=1323152343828

ANNEX-C SUMMARY OF ESMS OF FIBER@HOME

ENVIRONMENTAL AND SOCIAL MANAGEMENT SYSTEM OF FIBER@HOME

FIBER@HOME POLICIES AND PLANS

Legal Register EHS / Labour / Social	WiP
EHS Policy	FR
Social Policy (+)	**WiP**
Recruitment Policy	FR
Overtime Policy	FR
LeavePolicy	FR
Wages & Other Facility Policy	FR
Working Hour Policy	FR
Women Right	FR
Child Labour/ Adolescent Remediation Policy	FR
Forced Labour Policy	FR
Child Care Policy	EaS
Grievance Handling Policy	FR
Discrimination prevention Policy	FR
Disciplinary Action Policy	FR
Basic Right of Worker Policy	FR
Attendance Bonus Policy	FR
Harassment Policy	FR
Sexual Harressment Policy	FR
Medical Teatment Policy	FR
Worker - Staff Encourage & Award Policy	FR
Annual Leave Policy	FR
Insurance Policy	FR
Gender Policy	FR
Workers Participation Committee Policy	FR
Maternity Benefit Policy	FR
Policy Change Policy	FR
External Grievance Mechanism	EaS
Security Management Plan	WiP
Contractor Management Plan	EaS
Life and Fire Safety Management Plan	EaS
Supplier Policy (Out of the scope - To be explored in due course)	N/A

PRE-CONSTRCUTION

E&S Procedures for new projects / expansions

Status		
	EaS	To be commenced / early stage
	WiP	Work in Progress
	FR	Close to finalisation / Final review
	C	Completed

CONSTRUCTION

	EHS CONSTRUCTION MANAGEMENT PLAN	
	Health and Safety Management Plan	WiP
	Risk Assessment table	C
	PPE procedure	C
	Excavation Management procedure	C
	Electrical Safety procedure	C
	Material handling procedure	C
	Hot work procedure	C
	Health check procedure	FR
	Accident Investigation	FR
	Cross-reference to MPs below)	
	Air emission Management Plan	EaS
	Noise Management Plan	EaS
	Soild waste Management Plan	FR
	Waste water Management Plan	FR
	CHEMICAL MANAGEMENT PLAN	N/A
	TRAFFIC MANAGEMENT PLAN (internal)	FR
	TRAFFIC MAANGEMENT PLAN (external)	EaS
	SCAFFOLDING MANAGEMENT PLAN	C
DRAFT	EMERGENCY PREPAREDNESS AND RESPONSE PLAN	WiP
	CONTRACTOR MANAGEMENT PLAN	EaS

OPERATIONS (Facility-1: COs/Operation Data Center/ Head Office etc.)

Framework	EHS OPERATIONS MANAGEMENT PLAN	
	Health and Safety Management Plan	Status
	Risk Assessment table	C
	PPE procedure	FR
	Electrical Safety procedure	FR
	Material handling procedure	FR
	Health check procedure	EaS
	Accident Investigation	FR
	Cross-reference to MPs below)	
	Air emission Management Plan	N/A
	Noise Management Plan	WiP
	Soild waste Management Plan	WiP
	Waste water Management Plan	WiP
	CHEMICAL MANAGEMENT PLAN	N/A
	TRAFFIC MANAGEMENT PLAN (internal)	EaS
	TRAFFIC MAANGEMENT PLAN (external)	EaS
DRAFT	EMERGENCY PREPAREDNESS AND RESPONSE PLAN	WiP

OPERATIONS (Facility 2: Network O&M)

	BASIC EHS OPERATIONS M. PLAN	
Draft / Basic	Health and Safety Management Plan	WiP
	Risk Assessment table	C
	PPE procedure	FR
	Electrical Safety procedure	FR
	Material Handling procedure	FR
	Cross-reference to MPs below)	
	Soild waste Management Plan	WiP
	CHEMICAL MANAGEMENT PLAN	N/A
Basic	EMERGENCY PREPAREDNESS AND RESPONSE PLAN	WiP