ENVIRONMENTAL IMPACT ASSESSMENT (EIA) OF ARAIHAZAR (JAPANESE) ECONOMIC ZONE LIMITED AT ARAIHAZAR, NARAYANGANJ

MAY 2018

Prepared For

Bangladesh Economic Zones Authority

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ABBREVIATION

%	Percentage
°C	Degree Celsius
µg/m^3	microgram per cubic meter
AEZ	Agro Economic Zone
AEZ	Araihazar Economic Zone
As	Arsenic
AIDS	Acquired Immune Deficiency Syndrome
ANSI	American National Standard Institute
ASME	American Society of Mechanical Engineers
BBS	Bangladesh Bureau of Statistics
BDT	Bangladesh Taka
BEPZA	Bangladesh Economic Processing Zone Authority
BEZA	Bangladesh Economic Zone Authority
BMD	Bangladesh Meteorological Department
BOD	Biochemical Oxygen Demand
BS	British Standard
BWDB	Bangladesh Water Development Board
CaCOs	Calcium Carbonate
Ca	Calcium
CCL	Cash Compensation under Law
CDSP	Char Development and Settlement Project
CETP	Common Effluent Treatment Plant
cm	Centimetre
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
Cr	Chromium
CSR	Corporate Social Responsibility
Cum	Cubic meter
DC	Deputy Commissioner
DDM	Department of Disaster Management
DG	Diesel Generator
DMB	Disaster Management Bureau
DO	Dissolve Oxygen
DoEB	Department of Environment Bangladesh
DPHE	Department of Public Health and Engineering
DTA	Domestic Tariff Area
EC	Electrical Conductivity

ECA	Environment Conservation Act
ECC	Environment Clearance Certificate
ECR	Environment Conservation Rules
EIA	Environment Impact Assessment
ESIA	Environment & Social Impact Assessment
EMF	Environmental Management Framework
EMP	Environmental Management Plan
ESMP	Environmental & Social Management Plan
EPZ	Economic Processing Zone
ERP	Emergency Response Plan
ETP	Effluent Treatment Plant
EZ	Economic Zone
FAO	Food & Agriculture Organization
FDI	Foreign Direct Investment
FDIPP	Foreign Direct Investment Promotion Project
FGDs	Focus Group Discussions
Ft.	Feet
g	Gram
GDP	Gross Domestic Product
GHGs	Green House Gases
GIS	Geographic Information System
gm/cc	gram per cubic centimetre
GoB	Government of Bangladesh
GSB	Geological Survey of Bangladesh
Ha	Hectares
HHs	Households
HIV	Human immunodeficiency virus
HSMP	Health and Safety Management Plan
HYV	High Yielding Variety
ICT	Inland Container Terminal
IEE	Initial Environment Examination
IFC	International Finance Corporation
IRRI	International Rice Research Institute
IUCN	International Union for Conservation of Nature
JDI	Japan Development Institute Ltd.
JICA	Japan International Cooperation Agency
JST	JICA Survey Team
Kg	Kilogram
Kg/day	Kilogram Per Day

KLD	Kilo Litres Per Day
Km	Kilometer
Km/h	Kilometer per Hour
KV	Kilo Volts
LAP	Land Acquisition Plan
LAO	Land Acquisition Officer
Leq	Equivalent Noise Level
LPG	Liquefied Petroleum Gas
LRP	Land Resettlement Plan
M	Meter
m/s	meter / second
m/yr	meter / year
max.	Maximum
mg/l	microgram per litre
min.	Minimum
mm	Millimetre
Mm/day	Millimetre per Day
Mm/hr	Millimetre per hour
MOL	Ministry of Lands
msl	Mean Sea Level
Mn	Manganese
MT	Million Tonnes
MVA	MVA
MW	Mega Watt
NAAQS	National Ambient Air Quality Standard
NaCl	Sodium Chloride
NEMAP	National Environmental Management Action Plan
NGO	Non-governmental organization
NOC	No Objection Certificate
NOx	Oxides of Nitrogen
No.	Number
O.P.	Operational Policy
OHS	Occupational Health and Safety
OSS	One-stop-services
PA	Protected area
PAHs	Project Affected Households
PAPs	Project Affected Persons
PBS	Polli Bidyut Shamity
PCMs	Public Consultation Meetings

PDMs	Public Disclosure Meetings
PF	Protected Forest
PH	Power House
PM2.5	Particulate matter less than 2.5 micron size
PMC	Project Management Consultant
PPE	Personal Protective Equipment
PPP	Public Private Partnership
PVC	Polyvinyl chloride
RAP	Resettlement Action Plan
RC	Retention Canal
RP	Retention Pond
RMG	Readymade garments
ROW	Right of Way
RV	Replacement Value
SE	Socio Economic
SES	Socio Economic Survey
SEP	Stakeholder Engagement Plan
STI	Sexually transmitted infections
SIA	Social Impact Assessment
SO2	Sulphur Dioxide
SPC	Special Purpose Company
SRDI	Soil Resource Development Institute
Sq Ft	Square Feet
sq.km	Square kilometre
sq.m.	Square Meter
SQ	Soil Quality
SW	Surface Water
TDS	Total Dissolve Solid
ToR	Terms of Reference
TSS	Total Suspended Solids
UNDP	United Nations Development Programme
US$	United States Dollars
WS	Wildlife Sanctuary
WTP	Water Treatment Plant
NGO	Non Government Organization

TOR COMPLIANCE

S. No.	ToR Point	Compliance
I.	The project authority shall conduct a comprehensive Environmental Impact Assessment (EIA) study considering the overall activity of the said project in accordance with this ToR and following additional suggestions	The EIA study for the development of proposed AEZ has been carried out as per the ToR issued by DoE as well as JICA guidelines.
II.	The EIA Report should be prepared in accordance with following indicative outlines:	Agreed
	EXECUTIVE SUMMARY	Refer E-1 to E-12
1.	INTRODUCTION (Background, brief description, rationale of the project, scope of study, methodology, limitation, EIA team, references)	Refer Chapter 1
2.	LEGISLATIVE, REGULATION AND POLICY CONSIDERATION (covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared)	Refer Chapter 2
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iii.	Project options	Section 3.2
iv.	Interventions under selected options and project activities	Section 3.4
v.	Project Activities (A list of the main project activities to be undertaken during site clearing, construction as well as operation)	Section 3.5
vi.	Project Schedule (The phase and timing for development of the project)	Section 3.6
vii.	Resources and Utility Demand (Resources required to develop the project, such as soil and construction material and demand for utilities (water, electricity, sewerage, waste disposal and others), as well as infrastructure (road, drains, and others) to support the project)	Section 3.9
viii.	Map and Survey Information (Location map, cadastral map showing land plots (project and adjacent area), geological map showing geological units, fault zone, and other natural features)	Section 3.11
ix.	Project plan, Design, Standard, Specification, Quantification, etc.	Section 3.8
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11	CONCLUTION AND RECOMMENDATIONS	Refer Chapter 11
III.	Without obtaining approval of EIA report by the Department of Environment, the Project authority Shall not be allowed to conduct earth filling or any kind of physical intervention in the proposed project site and also not be able to start the physical activity of the project.	Agreed
IV.	This approval of the Terms of Reference (ToR) would not mean any acceptance or site clearance of the Project.	Agreed
V.	The proposed EIA study would not establish any claim, right in favour of the proponent for getting site clearance or environmental clearance.	Agreed
VI.	Without obtaining Environmental Clearance, the project authority shall not be able to start the operation of the project.	Agreed
VII.	The project authority shall submit the EIA along with the No Objection Certificate (NOC) from the local authority, NOC from Forest Department (if it is required in case of cutting any forested plant, private	Agreed

EXECUTIVE SUMMARY

E-1 Introduction

Bangladesh has been averaging relatively high annual GDP growth rate at 5 to 6 % over the past 10 years. However in order to achieve a transition to a middle-income nation by 2021 as the country envisions as its national goal, the country needs to accelerate its GDP growth rate to about 8%. To realize this goal, the country needs to break away from the existing economic structure that is heavily relying on garment exports and remittance from overseas workers. Moreover, it is essential that the country should seek diversification of the national industries and exports, and promote investment and strengthen industries with a focus on manufacturing industries that have competitiveness in export. Therefore, it is necessary for the country to improve the system, the administration and the implementation capacity of the pertinent government agencies responsible for the promotion of investment and industrial development.

The government of Bangladesh has announced that no new EPZ is needed, but instead, it has launched a new policy to establish "Economic Zones (EZs)" to reinforce enter-industrial relationship of export industry and domestic industry, and to optimize the domestic market.

Investment by Japanese companies in Bangladesh first began in Chittagong EPZ, which was established in 1983, and the investment from Japan continued in other new EPZs during 1990s. In recent years, the increasing number of Japanese companies started to recognize Bangladesh as "China plus 1" or their next investment destination due to its abundant labour force and the competitive labour cost as well as its huge domestic market of over 150 million people, and 240 Japanese companies, as of October 2016, have started their operation in Bangladesh. However, the existing EPZs are facing a shortage of available land for Japanese companies that are currently interested in investing in Bangladesh. In addition, a certain number of Japanese companies are hesitant to invest in Bangladesh due to the lack of stable power, gas and road infrastructure, and uncertainties towards the investment promotion policies and the implementation capability of the Bangladesh government.

Under these circumstances, the government of Bangladesh has requested the government of Japan to provide Yen loan for "the Foreign Direct Investment Promotion Project (hereinafter FDIPP)" in order to establish a new EZ mainly targeting Japanese companies and to further facilitate investments from Japan. The loan agreement for FDIPP was already signed in December 2015. The loan is expected to provide both short term and mid to long term low-interest financing for operation and capital investment of the EZ. Additionally, a part of the loan will contribute to the development of infrastructure such as roads, power and gas, as well as to assure the involvement of the government of Bangladesh to resolve and simplify the complicated system and procedures so that Japanese companies can be more confident and comfortable about their investment decision.

Previously, in connection with FDIPP, JICA implemented "Project for Development Study and Capacity Enhancement of Bangladesh Economic Zone Development Plan Authority" from February 2015 thru March 2017. Within the above project, analysis and site comparisons of the candidate EZ locations were conducted Araihazar and Nayanpur were

selected as prominent locations for EZ development. The project also undertook pre-feasibility studies for these two locations, and as of July 2017.

Taking into consideration the site location, available infrastructure, existing industries, investors interest and infrastructure and logistic requirement of the proposed industries, Araihazar Economic Zone is more like to be selected for EZ development through FDIPP.

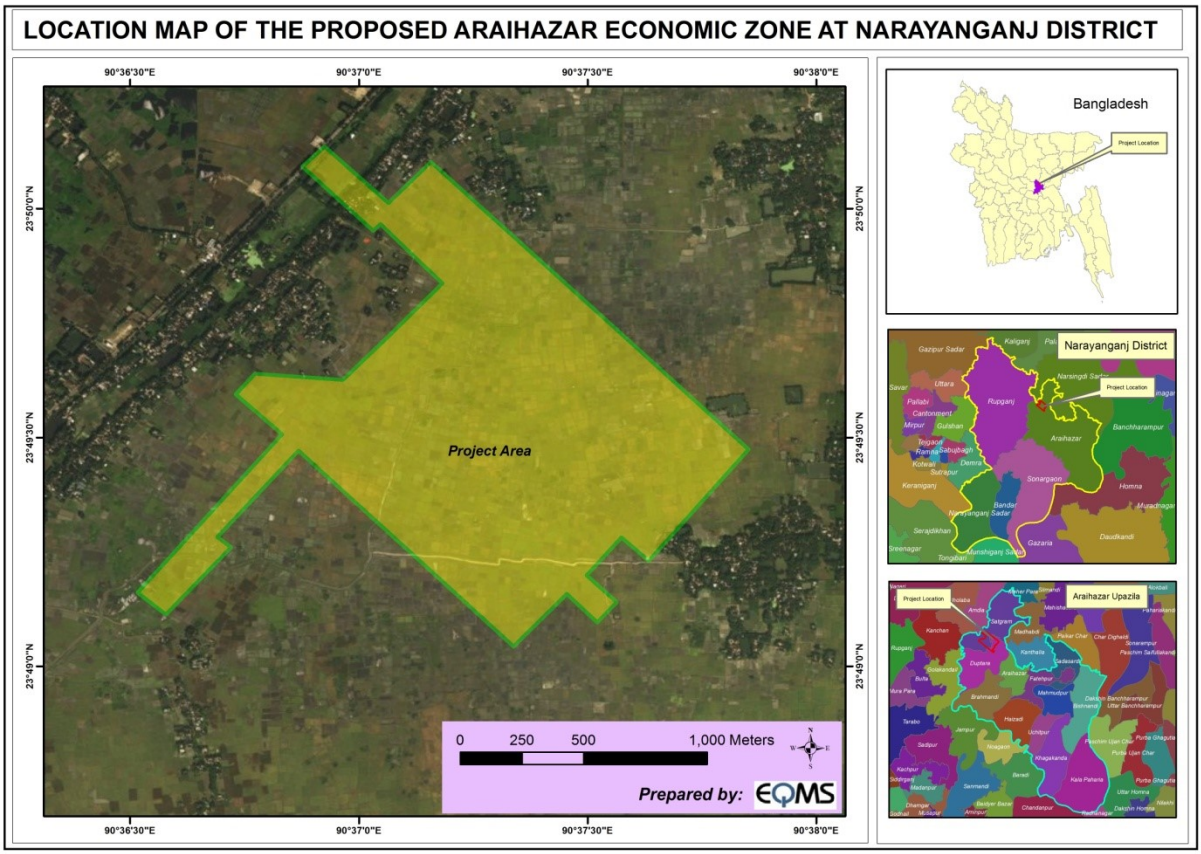
The proposed Araihazar Economic Zone (AEZ) site is located at Mouza: Panchrukhi, Panchgaog, Union: Satgram & Duptara, under Araihazar Upazila, which is adjacent to the Dhaka–Sylhet highway. The total land of Araihazar Economic Zone (AEZ) is approximately 218.84 ha or 540.77 acres for 1st phase. Upon completion, AEZ is envisaged to create approximately 10,000 jobs when fully occupied by investors.

Prospective private developers will plan onsite facilities and industrial area development on later stage. JICA has appointed Japan Development Institute Ltd. (JDI) as consultant for doing the Environment Impact Assessment (EIA) study of the Araihazar Economic Zone.

This EIA will examine the aspects of the project activities, which are likely to interact with and affect the surrounding environment and the community. The EIA report provides an Environmental Management Plan (EMP) and Social Screening issues along with specific mitigation measures with a view to reduce and/or control the level of adverse impacts upon the environment as well as to enhance measures for positive impacts resulting from the proposed project activities.

E-2 Project Description

The proposed Araihazar Economic Zone (AEZ) site is located at Satgram & Duptara Union, under Araihazar upazila. The total land of the project area is 218.84 ha or 540.77 acres. The project site is near to Dhaka-Sylhet Highway in the north-west direction, Shitalakhya River in west direction whereas settlement, water body and agricultural land in the East, west & south side of the project area. A canal pass through the proposed project boundary and a brance of Meghna River named Brahmaputra river pass through south direction to northwestern direction. The project area is mainly covers agricultural low land.



Source: Google Earth

Figure 1: Location Map of Araihazar Economic Zone

E-2.1 Project Components

Table 1: Summary of Project Components

Araihazar Economic Zone	
Location and district	Union: Satgram & Duptara, Upazila: Araihazar, District: Narayanganj
Mouza	Panchrukhi, Panchgaog
Development area	Phase-1 development: 218.84ha or 540.77 acres
Land use	Farmland, double cropping
Site preparation	Embankment: 0.6-2.6m (Avg.1.6m),Land elevation: Approx.6-m above MSL, Flood water level due to rivers of Shitalakhya and Meghna: Approx.7.52m (1/100),Elevation of land preparation: 8.6m
Environmental and social conditions	Need resettlement of houses and peoples; No precious ecology and cultural heritages sites exist
Road	**Access road** The access road is planned directly connecting from the national highway No.2 (Dhaka-Sylhet Expressway) to the Araihazar EZ with approximate length of 400 m. Access roads are designed with two lanes on each side including a median strip, sidewalks and space for utilities (gas transmission, telecommunication, etc.).

	Internal roads The center of EZ will be the internal main road and will have four lanes. Moreover, the internal roads from the main road to each block will have 2 lanes.
Canal	Rainwater drainage ditches will be located on both sides of internal roads and will drain rainwater to the canal located along the 60m main road. The flow capacity of the planned canal is, assuming the roughness coefficient is 0.035 and the water surface gradient is 0.02%, about 33.3m^3/s when the water depth is 3.6m (if the canal bottom elevation is considered to be 2.5m, water surface elevation of 6.1m), and it can carry the planned flow rate.
Retention Pond	In the land use plan, the retention pond use land is planned as 18.55 ha. It will be located at the terminal of the canal, and it will have storage functions enabling it to perform the function, preventing the impact of the change of the runoff rate accompanying land preparation, and part of the pump drainage functions during flooding. The study of pump capacity assumed the scale able to withstand 115mm/3hours of the largest past rainfall of July 18, 2005.
Utilities	**Power distribution line:** On-site developer will prepare on-site power distribution plan. Interface between On-site and Off-site is external cable terminals at 11kV Switchgears in Substation in Off-site because jointing of 11kV cables in On-site area is not recommendable from electrical safety/maintenance point of view. **Water/Sewage Pipe:** Araihazar water supply facility data is given below PVC Water-supply Pipes – 200 mm dia - 2,300 m PVC Water-supply Pipes – 150 mm dia - 9,400 m PVC Water-supply Pipes – 100 mm dia - 2,400 m High pressure PVC Pipes, for hydrant – 100 mm dia - 12,500 m **Gas Supply Plan:** In addition, use in the EZ is predicted to be general use rather than industrial use orpower generation use, so gas will be supplied in 75mm diameter pipes. **Telecommunication services:** At Araihazar EZ, communication services will be provided by installing wire (optical fiber etc.) feed cables to provide services under contracts completed by each attracted enterprise with local service providers. The wires will be installed on electric power supply poles or in underground communication line use conduits following consultations with EZ management.
Water supply	**Quantity of Water Supplied** The predicted attracted industries are assumed to be mainly manufacturing industries that use relatively little water, assembling and sewing for example, and the basic unit of the quantity of water

	used is considered 35m^3/day/ha for the total development area. In addition, the total quantity is 7,000m^3/day for the initial 189.52 ha development. In fact, the area of factory use land will be about 145 ha, so it is about 45.74 m^3/ day/ha. **Water supply facility** The water storage tank scale will be equivalent to one day's requirement of 7,000 m^3. An elevated water tank will ensure capacity for about 1 hour.
Sewage Treatment Plant(On site infrastructure)	Living wastewater of each tenant factory (kitchen and toilet wastewater) is treated by the central processing facility in the EZ candidate site. Industry wastewater from each tenant factory should be processed to an acceptable drainage level at each plant.
Industrial Waste Treatment	Processing by contract with the outsourcing of waste disposal company with improvement of local government policies

E-2.2 Connectivity

The project site is near to Dhaka-Sylhet Highway in the north-west direction, Shitalakhya River in west direction and Meghna River is in southeast direction. In addition, this location is suitable to access not only for roadway but also river way. **Airport Access:** 30.2 km from Hazrat Shahjalal International Airport (Dhaka), 265 km from Shah Aman at International Airport (Chittagong) & 221 km from Osmani International Airport (Sylhet), **Seaport Access:**258 km from Chittagong Sea Port, 248 km from Mongla Sea Port & 314 km from Payra Sea Port, **Road Access:** Adjacent Dhaka-Sylhet Highway, **River Access:** 31.5 km from Narayanganj River Port & 115 km from Chadpur River Port and **Railway station:** 30.3 km from Kamalapur Railway Station, Dhaka.

E-3 Rationale of the Project

In the past, the Government of Bangladesh has successfully provided tailored infrastructure services and business environment conditions through EPZs. EPZs were used as a strategic instrument for attracting Foreign Direct Investment (FDI) and dealing with the shortcomings of the overall investment climate, business registration, licensing, etc. that were restricting investments in the Domestic Tariff Area (DTA).

To overcome the limitations of EZ model, new Economic Zone regime has been adopted by the Government of Bangladesh so as more spill-over can be harnessed by local firms from FDI, additional investments can be encouraged within value chains, more local produce can be procured and better linkages can be established between manufacturing firms and educational institutions.

The AEZ development, a zoned industrialization, is required in Bangladesh to maximize the growth benefits of agglomeration and ease the increasing urban congestion. More importantly, the project will enable new sources of growth, where investor will show their interest.

E-4 Limitation

The present EIA Report has been prepared based on the Primary field investigations/ assessment, and secondary data from data collected from Department of Public Health and Engineering (DPHE), Bangladesh Meteorological Department (BMD), Department of Environment, Bangladesh (DoEB) and published journals, and books, public consultation and site observations. The environmental and social assessment is based on the information collected from the various agencies, community consultations and observations. Professional judgment and subjective interpretation of facts and observations has been applied for the preparation of the EIA Report.

Additionally on site facilities, sources and alignments are not fixed till date, thus assessment is made on the basis of preliminary information available from JICA and for all the options which could be explored. The onsite (industrial area detailed planning will be carried out by prospective private developer) information are available limited to feasibility assessment.

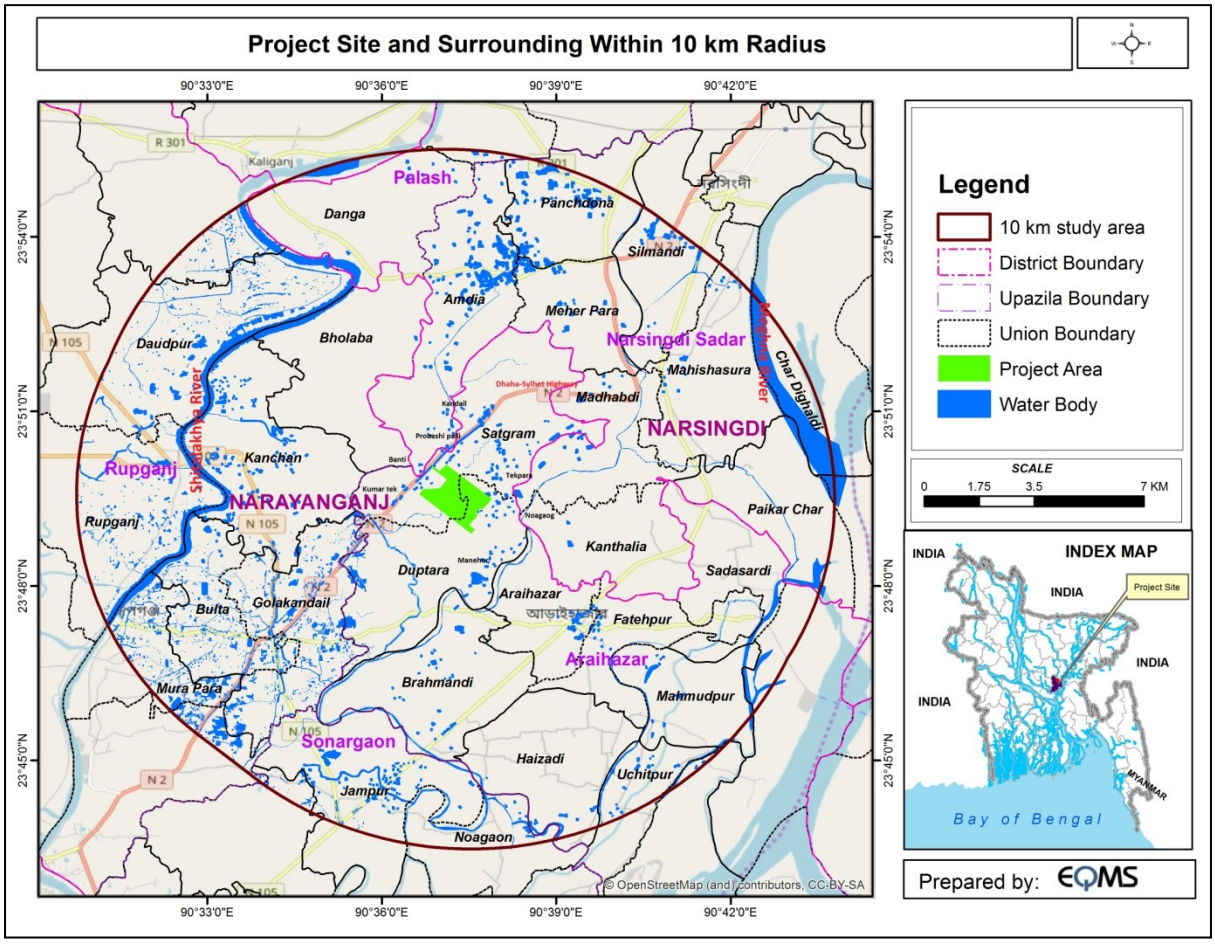
E-5 Environmental & Social Baseline

The site and surrounding detail shave already been presented under ***chapter 3***. The study area considered major settings in around the AEZ site. The project activity areas are considered as core area and remaining study area as buffer zone. Environment setting around AEZ site and surroundings of access road are given in ***Table-2***below.

Table 2: Environmental Setting

Particulars	Details
Location	Site is located at Union: Satgram & Duptara, Upazila: Araihajar, District: Narayanganj
Mouza	Panchrukhi & Panchgaon
Nearby Villages	West- Banti, Kumartek North- Kandail, Prabashi palli South-Manehor East- Tekpara, Noagaon
Project Area	Existing area approximately 198.7ha or 540.77 acres
Road Access	Adjacent Dhaka-Sylhet Highway
Weather Station	Dhaka Weather Station
Climatic conditions	Avg. Monthly wind speed– 2-5 m/s; Avg. Monthly Min. Temp. – 19.0°C January 1991; Avg. Monthly Max. Temp. – 40.2°C in April 2014; Annual Avg. Rainfall – 1994.6 mm; Average maximum humidity ranges – 94% to 97%; Average minimum average ranges – 31% to 64%;
Seismic Zone	Zone II
Forests / National Parks	None within 10 km
Archaeologically important places/monuments	No Archaeologically important places/monuments near to the site

Source: Google Earth & Site Visits



Source: Open Street Map (and) Contributors, CC-BY-SA

Figure 2: Project site and surrounding within 10 km radius

E-5.1 Temperature

The data analysis of the last 30 years (1986-2016) indicates that monthly maximum temperature varies from 30.0°C to 40.2°C whereas monthly minimum temperature varies from 13.4°C to 26.6°C.

E-5.2 Humidity

The average maximum humidity ranges from 94% to 97%, whereas the minimum average ranges from 31% to 64%.

E-5.3 Rainfall

The annual average of total rainfall recorded as 1,994.6 mm/year. According to the analysis of the historical data, the monthly average of total rainfall occurs in July at 1,049 mm whereas monthly minimum rainfall is recorded during the winter season.

E-5.4 Evaporation

In Dhaka, evapo-transpiration varies from 60 to 147 mm/day and yearly evapo-transpiration in Dhaka is 1245 mm/day.

E-5.5 Wind Speed & Direction

As per BMD, windiest month is May with average wind speed of 2.6 knot and least windy month is October with average wind speed of 0.6 knot.

E-5.6 Sun-shine Hours

The monthly average sunshine hour in Dhaka varies from 3.7 to 8.3 hour/day in a year. Highest average sunshine hours recorded in month of March.

E-5.7 Ambient Air Quality

The existing ambient air quality of the study area monitored at Four (4) locations during the monitoring period (September& October 2017). All the monitoring locations result was within the National Ambient Air Quality Standard (NAAQS) in Bangladesh.

E-5.8 Ambient Noise Level

Noise levels were recorded at ten (10) locations in the study area during the monitoring period. The noise level at some locations within the study area was well within the standard limit of ECR'97 (subsequent amendment in 2006) except NL3, NL6 & NL7.

E-5.9 Surface Water Quality

Two (2) samples of surface water were collected from the canal. The concentration level of BOD, COD and TSS are above the Bangladesh Standard for both SW1 & SW2. In addition, the concentration level of chloride and hard particles in the water is shown below to be clearly published Bangladesh Standard.

E-5.10 Ground Water Quality

A total three (3) ground water samples were collected from different locations of study area. The concentration levels of EC and Manganese (Mn) of tube well found above the standard set by the DOE, GoB for drinking water. But the levels of pH, TDS, As, Ca, COD, Chloride, Fluoride, Fe, Pb, Phosphate, Sulphate, TSS and turbidity were found to be within the limit set by the DOE, GoB for drinking water.

E-5.11 Soil Quality

Two soil samples were collected from the study area. As per laboratory analysis, SQ1 is moderately acidic and SQ2 is slightly acidic. Iron, Copper, Zinc, Lead and Manganese has detected in the soil sample.

E-5.12 Land Use

The evaluation of the existing environmental status of the study area has considered 0-10 km. This revealed that the land use/land cover consists mainly of Agricultural land, residential area, settlements with homestead vegetation and water bodies. Recommended land zoning of this area is agriculture increasing industrial and commercial zone.

E-5.13 Bio-ecological zone

IUCN has classified Bangladesh into 25 Bio-ecological Zones in the context of physiographic and biological diversity. The Project site falls under Brahmaputra-Jamuna Floodplain (Bio-Ecological Zone 4c) Zone.

E-5.13.1 Aquatic flora

The plant species usually submerged or partially submerged/floating in the water recorded from the study area are mosquito ferns (*Azollasp*), kachuripana (*Eichornia crassipes)*, tropical white morning-glory (*Ipomea alba)*, esthwaite waterweed (*Hydrilla verticillata)*, taro (*Calocasia esculenta),* globe yellow cress *(Rorippa indica)*, procumbent yellow-sorrel (*Oxalis corniculata)*, four-leaf clover (*Marselia sp*), lamb's quarters *(Chenopodiumalbum)*, goose weed (*Sphenoclea zeylanica)* and hornworts (*Ceratophyllumsp*),white water-lily (*Nymphaea nouchali)* , red water-lily*(Nymphaea rubra).*

E-5.13.2 Terrestrial flora

Grassland

A total 17 species belonging to 14 genera of 10 families were recorded from the study area. Four (4) species of grasses were identified among them Barajavani (*Fimbristylis milliacea)* and Mutha (*Fuirena ciliaris)* were found most commonly occurring. Herbs were represented by 5 species dominated by Kapalphutki (*Cardiospermum halicacabum*), Jhaljamani *(Cocculus hirsutus),* Marmarialata *(Cissus repens)* and Banorkalai (*Atylosia scrabaeoides*) list of grassland flora of the study area.

Common Plant

A total of 53 species, 48 genera belongs to 31 families were represented by terrestrial flora. Mahogani (*Swietenia mahagoni)* tree species is endangered as per classification. Coconut (*Cocos nucifera),* Eucalyptus *(Eucalyptus citriodora),* Mango *(Mangifera indica),* Guava *(Psidium guajava),* Litchi (*Lichi chinensis),*Kul-boroi *(Ziziphus mauritiana),* Pepe *(Carica papaya),* Sajna*(Moringa oleifera),* Jambura*(Citrus aurantifolia),* Mahogani *(Sweitenia mahagoni),* Banana (*Musa sapientum),* Kachkola (*Musa paradisiac),* Kathal *(Atrocarpus heterophyllus)* and Acasia *(Acacia nilotica)* were recorded most commonly occurring trees.

Agricultural Land

Mono-cropping agricultural pattern of paddy is pre dominant in the area. IRRI and Agrani are cultivated in the agricultural lands. IRRI is cultivated in the late of December whereas Agrani is cultivated in the late of March. Rabi crops cultivated are those: mustard, chilly, onion, vegetables, ladies-finger, long yard bean, tomato etc.

E-5.13.3 Aquatic fauna

Macro-invertebrate Fauna

Macro-invertebrate surveys were conducted in 22-23 October2017 survey. Macro invertebrate species such as water spiders (*Argyroneta aquatic*), Common Apple snail (*Pila globosa*), Disk Snail (*Macrochlamys sequax*), River Snail (*Bellamya begalensis*), Brotia Snail (*Brotia costula*), Lymneid Snail (*Lymnaea luteola*), Fresh water Mussels species such as (*Lamellidens corrianus*), (*Lamellidens marginalis*), (*Lamellidens jenkinsianus*) were observed in the study area. None of the species observed are of conservational significance.

Fish

The Sonakahli and Dhawrakhali canal interconnected with each other while they are connected to Old-Brahmaputra River. 31 species of 25 genera belonging to 17 families are

reported from the canal and river. Among of them 4 species are in endangered and 2 species are vulnerable and 3 are near threatened according to the Red list of IUCN (2015, Vol.3).

E-5.13.4 Terrestrial fauna

Mammals

Nine species of terrestrial mammals belonging to the 8 genera of 6 families were recorded to occur in wild in the Project. Golden Jackal (*Canis aureus*), Bengal Fox (*Vulpes bengalensis*) and Indian Gray Mongoose (*Herpestes edwardsii*) were seen visiting canal area, Sonpara during the field survey by the ecology team. Jungle Cat (*Felis chaus*) was reported to be seen by locals during field consultations in agricultural and homestead plantation areas. None of the species is reported to be listed in RED category of IUCN 2015 v2. However, Indian Gray Mongoose (*Herpestes edwardsii*), Jungle Cat (*Felis chaus*) and Asian House Shrew (*Suncus murinus*) are reported to be listed in Bangladesh Wildlife Prevention Order, 1973 as Sch-III which protects them from hunting, killing and capturing.

Avifauna

A total of 45 species belonging to 37 genera of 27 families were observed to be in the study area during field survey by ecology team in 22-23 October, 2017. These species are present in variety of habitats from Grassland, homestead plantation, agriculture plantation and aquatic habitat.Out of these 45 species, Red Vented Bulbul (*Pycnonotus cafer*), Black Drongo (*Dicrurus macrocercus*), Oriental Magpie Robin (*Copsychus saularis*), Spotted Dove (*Streptopelia chinensis*), Black Kite (*Milvus migrans*), Large Billed Crow (*Corvus macrorhynchos*), Rufous Treepie (*Dendrocitta vagabunda*), Indian Roller (*Coracias benghalensis*), Common Hoopee (*Upupa epops*), Black Rumped Flameback (*Dinopium benghalense*), White Throated Kingfisher (*Halcyon smyrnensis*), Pied Kingfisher (*Ceryle rudis*), Fulvus breasted Woodpecker (*Dendrocopos macei*), Shikra (*Accipiter badius*), White Wagtail *(Motacilla flava*), Red Wattled Lapwing (*Vanellus indicus*), Asian Koel (*Eudynamys scolopacea*), Rock Pigeon (*Columbam livia*), Common Myna (*Acridotheres tristis*), Jungle Myna (*Acridotheres grandis*) and Green Bee eater (*Merops orientalis*) are reported to be listed in Bangladesh Wildlife Prevention Order,1973 as Sch-III which protects them from hunting, killing and capture.

The proposed project site has many harbors species such as Red vented bulbul, Red Watted Lapwing, Black Kite, Black Drongo, Rock Pigeon, Long–tailed Shrike and Common Myna. These species are common in the area and sufficient habitats are available within area once the construction and operation activities are commenced. None of the species were listed as threatened as per IUCN classification.

Herpeto-fauna

Nineteen (19) species belonging to 17 genera of 14 families are reported from the area. Out of these House Lizard (*Hemidactylus flaviviridis),* Indian Rat Snake (*Ptyas mucosa*) and Checkered Keelback (*Xenochropis piscator*) were observed by ecology team during field survey in October 2017. Rests of the reptilian fauna were reported to be observed by locals during field consultations in the villages of project area. Among the 9, Bengal Monitor (*Varanus benghalensis*) and Spotted Flapshell Turtle (*Lissemys punctata*) are reported to be

listed in Bangladesh Wildlife Prevention Order,1973 as Sch-III which protects them from hunting, killing and capturing.

E-5.13.5 Protected Area (PA)

No PA exists at or near the project site.

E-5.13.6 Wildlife Sanctuary (WS)

No WS exists at or near the study areas.

E-5.13.7 Ecologically Critical Area (ECA)

In 2009, the Bangladesh Government declared the four rivers, such as Buriganga, Sitalakhaya, Turag and Balu around Dhaka city as ECAs. However, no ECA falls within 5 km study area.

E-5.13.8 Cultural Heritage

Nothing found in the development area would be affected by the development.

E-5.14 Socio-economic Condition

E-5.14.1 Population and Demography

In the 5-kilometer study area, there are 159,785 households (HHs) including squatters with a total population of 534,281 that will be somehow affected (directly or indirectly) by the implementation of the project. Population density per square km of the study area is 2,973, which is very much higher than the national figure of 976 per square km. The average sex ratio is 107 against the national figure of 100, which depicts a higher male population than the female population. Moreover, where national household size is 4.44, the average household size of the study area is slightly higher(4.7)

Demographic Profile of Affected Population

100% census and socio-economic survey was carried out in the project surroundings area. A total of 1714 households with a Project Affected Persons (PAPs) of 6,343 were identified and surveyed in phase-1 including retention pond/canal area of Araihazar Economic Zone project.

E-5.14.2 Ethnic Composition

According to population and housing census (2011), only 10 ethnic households consisting31 populations are found in the Union lied within the 2km radius boundary from the project site.These ethnic groups are Marma, Chakma and Others.

According census and SES in 2017 conducted by EQMS consulting Ltd, no indigenous or ethnic minority populations were identified in the project phase-1 area.

E-5.14.3 Religion

As per BBS, Population and Census (2011), the population of the project study area primarily consists of Muslims constituting almost 94.4% of the total population. The remaining 5.6% is primarily comprised of Hindus with Christians, Buddhists, and others comprising far lesser percentages.

E-5.14.4 Education

The population and housing census (2011) shows that concentration of literate people in underlying unions of selected Upazilas is 49% which is lower than the national average of 51.8%.

E-5.14.5 Settlement & Housing

Predominant structure of this study area is kutcha (71.7%) followed by Semi-pucka (21.1%), Pucka (6.7%) and Jhupri (0.5%). Housing tenancy of the study area is owned by (49.6%), rented (46.6 %) and Rent free (3.8%).

E-5.14.6 Water Supply

At the project study area, the major source of drinking water is tube-well where about 93.8% population use tube-wells water. About 3.2% people have access to tap water. Other3.0% people have access neither tube-well nor tap water.

According to census and SES findings, it was learned that 100% affected households have access to safe water for drinking, cooking and other regular household's uses.

E-5.14.7 Electricity

In the project study area, 91.8% of the households have grid electricity connection.

E-5.14.8 Sanitation

In the Project area, only about 11.1% and 44.7% of households use respectively water sealed andnon water-sealed sanitary latrine facility, which represents the 55.8% households of the study area. 36.7% households use non-sanitary facilities.

Survey results shows that only 0.29% (5 nos.) affected households are using kutcha i.e. unhygienic latrine. Apart from this almost 99.71%, affected households have sanitary latrine i.e. hygienic sanitation facilities.

E-5.14.9 Economy & Employment

About 45.0% of total population followed by 79.9% of male and 10.1% of female population of selected Unions are engaged in economic activities. 36% of total population is engaged in domestic work where majority female of total female population (71.6%) are doing domestic work. All over 18.6% population, do not work whereas only .3% population is looking for work.

According to the census and SES findings, most of the affected household head (66.45%) are engaged with agricultural activities. About 248 including five women household head are doing business for their livelihood.

E-6 Alternative Analysis

In order to consider the project area and the shape of the Economic Zone, two alternatives were compared comprehensively from the viewpoint of technical aspect, economical aspect, safety and social and environmental consideration.

Compared with Nayanpur EZ, Araihazar EZ has advantages from the viewpoint of technical aspect economical aspect, safety aspect, and environmental/social consideration. Therefore, Araihazar EZ is chosen as the preferred option.

E-7 Scoping & Terms of Reference

E-7.1 Scoping & Terms of Reference

Scoping was conducted toward the development project of Araihazar Economic Zone. These impacts were evaluated in each of the three phases separately, namely: pre-construction, construction phase and operation phase. Scoping Matrix of the Proposed project is given in Chapter 6.

In order to fulfill the requirements of the JICA Environmental Guidelines and advisory instructions given by JICA Environmental and Social Consideration Advisory Committee, the JICA Survey Team prepared a term of reference (TOR) for identified uncertain impacts summarized for the JICA EIA study and RAP study.

E-8 Environmental & Social Impacts

On these 30 items, baseline survey, project impact prediction and, if impact is considered either negligible or severe, environmental management planning including monitoring plan was established as bellow.

Environmental Pollution

1. Air Pollution
2. Water Pollution
3. Waste
4. Soil Pollution
5. Noise & Vibration
6. Ground Subsidence
7. Offensive odors
8. Sediment Quality

Natural Environment

9. Protected areas
10. Ecosystems
11. Hydrology
12. Topography and Geology

Social Environment

13. Involuntary Resettlement
14. Vulnerable Group
15. Indigenous and ethnic people
16. Local Economics, Such as Employment, Livelihood
17. Land Use and Utilization of local resources
18. Water Usage
19. Existing Social Infrastructures and Services
20. Social Institutions Such as Social Infrastructure and Local Decision making institutions
21. Misdistribution of Benefits and Damages

22. Local Conflict of Interest
23. Cultural Heritage
24. Landscape
25. Gender
26. Children's Right
27. Infectious Diseases
28. Occupational Health and Safety

Others

29. Accidents
30. Transboundary impact and climate change

E-9 Environmental Management Plan

A summary of mitigation measures identified for the pre-construction, construction& operation phases of the project is presented in below. This also identifies lead responsibility for implementing the mitigation measures and sources of funds for such implementation.

Table 3: Environmental& Social Mitigation and Management Plan (Pre-construction, Construction & Operation Phase)

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
Pre-construction Phase						
Environmental Pollution	Air Pollution	• Site clearance, leveling & filling activities for development of EZ which generate air pollution as well as dust generation	• To minimize the dust generation, water should be sprinkled regularly at the site and low sulphur diesel should be used in land leveling equipments to control the SO_2 emissions	Appointed Contactor	BEZA	Contractor Cost
	Water Pollution	• May muddy water flowing to the river due to land reclamation work is expected • Dredged soil may compound with the canal water due land filling period	• Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Avoid excavation activities during rain; • Minimize run-off by using sprays for curing; • Maintaining proper management plan should take in the land filling period.	Appointed Contactor	BEZA	Contractor Cost
	Soil Pollution	• Development of the structures and construction of the access road • Land filling activities • Land will be filled and compacted	• Raw material will be stored under covered sheds and paved surface; • Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Fuel storage area should be proper containment; • Adoption of best management practices to prevent any spillage of raw materials; • Food waste/wet waste should be composted in pits within the camp site;	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
			• Recyclable waste should be sold to the authorized dealers.			
	Noise& Vibration	• Operation of different machineries • Running of heavy load traffic for material transportation	• Vehicles and machinery should be regularly serviced and check for pollution control • Machinery to be used should comply with the noise standards prescribed by DoE. • No activities to be undertaken during night hours.	Appointed Contactor	BEZA	Contractor Cost
	Sediment Quality	• During the land development, earth-filling material may washout to canal and increase the sediment concentration.	• Earth filling material should be in proper containment; • Proper monitoring should be taken at land development • Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management;	Appointed Contactor	BEZA	Contractor Cost
Natural Environment	Ecosystems	• Land filling • Extensive use of vehicle horns • Disrupting feeding or nesting behavior • A total 1,055 trees will be affected by the project where 349 fruits trees, 127 timbers, 253 bananas and 326 Bamboos are identify;	• No solid or liquid waste shall bedischarged in water bodies; • Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Septic tanks/soak pit should be provided to treat sewage to be generated from labour camps; • Toilets should be provided at site to prevent contamination of water; • Vehicle washing/equipment cleaning should not be allowed near canal/drains in EZ site; • Temporary storm water drainage system	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
			should be developed at site; • All the raw material and debris should be stored in covered sheds on paved surfaces; • Diesel, paints, cements etc should not be stored near the water bodies; • If any kind of trees cut down because of the project, in that case the project proponent should take NOC from Forest Department (FD).			
	Hydrology	• Impact on drainage pattern &hydrology is temporarily expected caused by land modification • The adjacent land may inundate by high precipitation and over flow of canal/river water	• It was confirmed that the path and the direction of Dhawrakhali Canal would be kept intact during all phases of the project • In general, the difference in elevation between adjacent points might change but their order would be almost kept unchanged; • Surface water flow would not change significantly and would keep its current water flow.	Appointed Contactor	BEZA	Contractor Cost
Social Environment	Involuntary Resettlement	• Total 540.77 acres of land will be acquired for Economic Zone (1st phase) • Approximately 1,714 no of HHs and 6,343 of populations will lose their land; • Total of 11 affected households will lose	• Proper resettlement action Plan (RAP); • Provide adequate compensation in time to PAPs; • The authority should be careful and take necessary measures that every displaced people can be resettled as per Bangladesh law of the land;	Appointed Contactor	DC office/ BEZA	DC office

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		their structures;				
	Vulnerable Group	• In Araihazar Economic Zone project, out 1,714HHs a total of 150 (8.75%) households were identified as vulnerable. Among them 25 are female headed having no male income earner, 58 are elderly headed and 67 were identified as extreme poor.	• Promoting payment of compensation in joint name of husband and wife; • Provide soft skill jobs (physically benign) and employment opportunities for vulnerable Group • Organising women in self-help group to operate canteens in the EZ; • Ensure non-exploitation of women in terms of equal wage, opportunity, participation indecision making etc. • Implementation of social welfare programs targeted at vulnerable groups including old aged, physically handicapped etc. under CSR programsand activities	Appointed Contactor	DC office/ BEZA	DC office
	Local Economic, such as employment, livelihood	• Total 1,714 HH's will be affected by the project where 66.45%are engaged with agricultural activities. About 248 including five women household head are doing business for their livelihood. • Only 23 persons were identified as sharecroppers in the	• Income loss can be mitigated by providing alternative job opportunities for PAPs; • Give proper compensation to farmers and sharecroppers as per LAP • All direct income loss must be adequately compensated within the RAP; • A major segment of the population on the area is unemployed. Construction activity will provide employment to huge nos. of people including skilled, unskilled and non-skilled workers. This will improve the quality of life of people; • Provision of proper training to all workers for	Appointed Contactor	DC office/ BEZA	DC office

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		project area;	handling the construction equipment;			
	Land use and utilization of local resources	• The crop production will be obstructed in storage and stockyard areas;	• Plantation area which will be tentatively occupied during pre-construction, will be restored to original state and returned to the land owner after construction.	Appointed Contactor	BEZA	Contractor Cost
	Misdistribution of Benefits and Damages	• Only landowner and property owners and affected labours will be eligible for the compensation and rehabilitation.	• Prepare RAP involving the followingmeasures - Assessed compensation will base on the market price - Payment will be carried out before resettlement • Establish external monitoring committee consists of the third party	Appointed Contactor	BEZA	Contractor Cost
	Children's Right	• Impact on educational opportunity on school children in PAHs of the project as well as community • Impact of the Project on increase of child labor;	• Support of sending children to school; • Helping the parents with hunting for a job, including the one at the construction site; • Mediation for micro credit loan; • Introducing them to assistance organizations such as NGO and so forth	Appointed Contactor	BEZA	Contractor Cost
Construction Phase						
Environmental Pollution	Air Pollution	• Earthworks construction, site clearing, small structures demolition, civil construction will generate dust	• Sprinkling of water at construction site and haul roads • Trucks transporting fine materials, soil and waste to and from the Project site will be covered to reduce the release of dust; • Debris should be stored under covered sheds	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		• Construction of access roads and its dust • Carbon dioxide and nitrogen oxides may be emitted from vehicles, machinery and generators etc. • Excavation of retention pond • Access road construction	• Generators, compressors, and other equipment to be shut down when not in use; • Provision of face mask to workers to minimize inhalation of dust particles • Construction vehicles and machinery should be regularly serviced and check; • Air emission monitoring programme to be undertaken quarterly by the contractor; • Green buffer should be developed			
	Water Pollution	**Surface Water Quality** • Run-off from the construction site may carry sediments and oil which may pollute the surface water • Excavation of retention pond • Access road construction **Ground Water Quality** • It was learned that 100% affected households have access to safe water for	**Surface Water Quality** • Avoid excavation activities during rains; • Prevent piling up of excavated soil, raw material and construction debris at site by proper management and disposal; • Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Minimize run-off by using sprays for curing; • Maintaining appropriate flow of water sprinklers at site; • Collection & Reusing of curing over flow, tire wash water etc within the site; • Construction of adequate nos. of toilets and proper sanitation system to prevent open defecation along the canals/river banks/water supply lines; • Construction of soak pits/septic tanks to	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		drinking, cooking and other regular household's uses.	dispose-off the domestic waste to prevent disposal of sewage in surface water bodies; **Ground Water Quality** • No sewage or waste water should be accumulated in any unlined structure; • Timely disposal of the construction/chemical/hazardous waste so as to prevent leaching of any pollutant to ground;			
	Waste	• Construction sludge by boring from underground and domestic waste from base camp is generated during construction. • Excavation of retention pond • Access road construction	• Minimize volume to use silt basin before disposing; • Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Segregate waste to minimize waste material • Disposed in designated dumping site instructed by the section handling waste • Recycled as possible with consideration of soil property;	Appointed Contactor	BEZA	Contractor Cost
	Soil Pollution	• Development of the structures and construction of the access road may disturb the soil profile of the area. • Fuel and construction debris may contaminate the soil	• Raw material will be stored under covered sheds and paved surface; • Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Fuel storage area should be proper containment; • Adoption of best management practices to prevent any spillage of raw materials;	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		• Excavation of retention pond	• Construction debris should be stored under covered sheds and paved surface; • Food waste/wet waste should be composted in pits within the camp site; • Recyclable waste should be sold to the authorized dealers;			
	Noise & Vibration	• Operation of different machineries and equipments for construction activities, running of heavy load traffic, materials transportation may generate noise • Continuous exposure of neighbors to noise nuisance; • Exposure of employees to high noise level (above 85dB) continuous for 8hoursper day may result in noise induced haring lose; • Excavation of retention pond • Access road construction might generate noise	• Machinery to be used should comply with the noise standards prescribed by DoE; • Vehicles and machinery should be regularly serviced and check for pollution control; • All employees likely to be exposed to ear noise to be provide with ear protectors; • No noise generating activity shall be carried out in the night; • No construction activities to be undertaken during night hours; • Fitting noise machines with noise reduction devices; • Temporary noise barriers should be provided near the high noise generating areas; • Any employee who may complain about ear related pain and or complication while at work to access medical attention at the expense of the contractor;	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
	Sediment Quality	• Development of the structures and construction of the access road may disturb the bottom sediment profile of the water bodies. • Storage of raw material, fuel and construction debris may contaminate the bottom sediment; • Excavation of retention pond might pollute sediment quality.	• Raw material will be stored under covered sheds and paved surface; • Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Fuel storage area should be proper containment; • Adoption of best management practices to prevent any spillage of raw materials; • Construction debris should be stored under covered sheds and paved surface; • Food waste/wet waste should be composted in pits within the camp site; • Recyclable waste should be sold to the authorized dealers;	Appointed Contactor	BEZA	Contractor Cost
Natural Environment	Ecosystems	• Removal of vegetation& agricultural crop • Overlap between the project activity and their breeding period will produce much greater impact • Disturbance due to increased noise level and human activities • Medium and small mammals will avoid	• No solid or liquid waste shall be discharged in water bodies; • Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Septic tanks/soak pit should be provided to treat sewage to be generated from labour camps and prevent its disposal in water body; • Toilets should be provided at site to prevent contamination of water due to open defecation in nearby areas; • Vehicle washing/equipment cleaning should not be allowed near canal/drains in EZ site;	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		the locations due to increased human presence • Resident birds in the homestead vegetation will be disturbed • During construction many seasonal and perennial water bodies will lose their characteristics • Run-off from construction site which may pollute water quality of canals and adjacent river	• Wastewater from the washing area should be collected and should be used for curing purpose or wheel washing purpose; • Excavation and filling should be carried out in phased manner to minimize exposure of loose earth for longer duration; • Temporary storm water drainage system should be developed at site to channelize the storm water away from excavation/filling area, debris storage area and raw material storage area; • All the raw material and debris should be stored in covered sheds on paved surfaces to minimize the contamination of rainfall run-off; • Diesel, paints, cements etc should not be stored near the water bodies;			
	Hydrology	• Impact on hydrology is temporarily expected caused by land modification	• The path and the direction of Dhawrakhali Canal would be keeping intact; • The difference in elevation between adjacent points might change but their order would be almost kept unchanged; • The excavation work would be designed to minimize the excavation volume as much as possible; • Water consumed for the construction work and related activities during the construction phase would include water for washing vehicles and equipment, sprinkling water and domestic water.	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
	Topography & Geology	• The topography of the area is likely to be changed due to filling with dredged soil; • Due to the significant sand reclamation from the surrounding river beds, erosion of the river bank could occur;	• Save topsoil removed at the start of the project and use it to reclaim disturbed areas upon completion of construction activities. • Apply protective covering on disturbed soils as quickly as possible. • Clean and maintain catch basins and drainage ditches regularly. • Re-establish the original grade and drainage pattern to the extent practicable. • Obtain borrow material from authorized and permitted sites.			
Social Environment	Involuntary Resettlement	• Total 540.77 acres of land will be acquired for Economic Zone (1st phase) • Approximately 1,714 no of HHs and 6,343 of populations will lose their land; • Total of 11 affected households will lose their structures;	• Proper resettlement action Plan (RAP); • Provide adequate compensation in time to PAPs; • The authority should be careful and take necessary measures that every displaced people can be resettled as per law of the land;	Appointed Contactor	DC office/ BEZA	DC office
	Vulnerable Group	• The vulnerable groups identified for the Project are those old and aged, physically handicapped and destitute individuals that are potentially	• Promoting payment of compensation in joint name of husband and wife; • Provide soft skill jobs (physically benign) and employment opportunities for vulnerable; • Giving preference in physically less demanding jobs in the EZ such as cleaning, office assistant, computer operator etc;	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		affected by the project activities • In Araihazar Economic Zone project, out 1,714HHs a total of 150 (8.75%) households were identified as vulnerable.	• Ensure non-exploitation of women in terms of equal wage, opportunity, participation in decision-making etc. • Create awareness about sexually transmitted disease, HIV/AIDS, exploitation etc; and • Implementation of social welfare programs targeted at vulnerable groups including old aged, physically handicapped etc. under CSR programs and activities			
	Local Economics, such as employment, livelihood	• PAPs who earn income from paddy fields and/or vegetable fields might lose their income source. • Total 1,714 HH's will be affected by the project where 66.45% are engaged with agricultural activities. • Only 23 persons were identified as sharecroppers in the project area;	• Income loss can be mitigated by providing alternative job opportunities for PAPs; • Give proper compensation to farmers and sharecroppers as per LAP • All direct income loss must be adequately compensated within the RAP; • A major segment of the population on the area is unemployed. Construction activity will provide employment to huge nos. of people including skilled, unskilled and non-skilled workers. This will improve the quality of life of people; • Provision of proper training to all workers for handling the construction equipment;	Appointed Contactor	DC office/ BEZA	DC office
	Land Use and Utilization of local resources	• The agricultural crop production will be obstructed due to storage and stockyard;	• Plantation area which will be tentatively occupied during construction, will be restored to original state and returned to the land owner after construction.	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		• Crops will also be damaged due to equipments and heavy vehicles movement;				
	Water Usage	• Araihazar EZ sites do not have existing public water supply facilities; • Utilize the nearby rivers or wells as water sources. • Excessive withdrawal of ground water may lead to depletion of aquifers.	• Regular inspections at site to monitor leakages in water storage tanks; • Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Creating awareness among construction workers about the importance of water conservation; • Adoption of the advance technologies and machinery which helps in minimizing water requirement for construction; • Temporary rain water harvesting ponds should be constructed so as to store rain water for construction activities;	Appointed Contactor	BEZA	Contractor Cost
	Misdistribution of Benefits and Damages	• Not everybody could benefit from the construction work due to limited requirements and preferences of the contractors.	• Prepare RAP involving the following measures - Assessed compensation will base on the market price - Payment will be carried out before resettlement • Establish external monitoring committee consists of the third party	Appointed Contactor	BEZA	Contractor Cost
	Local Conflict of Interest	• Due to employment, opportunity will be increasing during	• Job opportunities should be provided in fair way' • Clear information about the needs of labor	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		construction; candidates of construction workers may have some conflicts between communities.	(number and qualification) should be provided with local people' • The job skills and the priority for the affected people shall be taken into account and the workers can be chosen;			
	Children's Right	• Impact on educational opportunity on school children in PAHs as well as local community; • Impact of the Project on increase of child labor;	• Child labor at the construction site during the project implementation shall be strictly prohibited; • Guide contactors and their related firms to discourage child labor; • Support of sending children to school; • Helping the parents with hunting for a job; • Mediation for micro credit loan; • Introducing them to assistance organizations such as NGO and so forth;	Appointed Contactor	BEZA	Contractor Cost
	Infectious Diseases	• During Construction, in general, a lot of migrant workers flow into the sites, who may have the possibility with HIV/AID Sand the disease can spread among local people;	• To provide surveillance for worker's health; • Prevention of illness among workers by undertaking health awareness • To provide treatment through standard case management in on-site and community health care facilities as necessary; • Promoting collaboration with local authorities to enhance access of worker's families and the community to public health services and promote immunization as necessary; • Promoting use of repellents, clothing, netting, and other barriers to prevent insect bites;	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
	Working conditions, including occupational safety	• Occupational Health & Safety • Community Health & Safety • Risk of Fire	• To provide adequate health care facilities and first aid within construction sites; • To provide OHS training program • To provide adequate laboratory facilities for the number of people expected to work in the facility; • To provide adequate supplies and easy access of drinking water with a sanitary; • To provide temporary shelters to protect against heat stroke during working activities or for use as rest areas as needed; • To promote the use of repellents, clothing, netting, and other barriers to prevent insect bites and snake bite; • Adequate preventive measures from negative factors such as fire precautions, lighting, safe access, work environment temperature, area signage, labelling of equipment, communicate hazard codes, electrical; • To establish rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures, and control of traffic patterns or direction; • To identify and provide appropriate PPE that offers adequate protection to the worker, co-workers, and occasional visitors; • Do not smoke in the project site; • Maintain safe housekeeping practices that reduce the risk of fire danger;	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
			• Implement a program that includes preparation, prevention, and recognition of fire Risk; • Proper handling of combustible and flammable material; • Keep all fires and heaters well guarded, especially open fires; • Keep portable heaters and candles away from furniture and curtains; • Don't dry or air clothes over or near the fire, or the cooker;			
Others	Accidents	• Construction accidents and road accidents around the project site are expected. Construction workers can have harmful and critical troubles. • Excavation of retention pond • Access road construction	• Follow Health and Safety Management Plan (HSMP) rules and regulations designated by contractors; • Provision of traffic sings, road mark, bump, zebra mark, guard rail and pole, and curb stones etc;	Appointed Contactor	BEZA	Contractor Cost
Operational Phase						
Environmental	Air Pollution	• Significant air emissions result from light-engineering industries. • These are particulate	• All industries should obtain clearance from DoE, Bangladesh; • Latest technology, methodology, and machinery involving minimal air emissions should be adopted by industries;	Tenant/Third party agency	SPC/BEZA	Tenant Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		matter, sulphur dioxide, metals and other criteria pollutants like O_3, NOx and CO, lead may be generated in some of the processes. • Air emissions from food processing industry will contain some volatile organic compounds • Malodour from these water detoriate the air quality; • Vehicles movement and its gaseous emission	• Air pollution control measures should be taken by industries as prescribed in the mitigation plan; • Periodic renewal of ECC should be obtained by all the industries; • Power Generators should be provided with stacks of adequate height (higher than nearest building) to allow enough dispersion of emission; • Process emission if any shall be control with the installation of adequate air pollution control systems; • All industries should obtain clearance from DoE, Bangladesh as applicable. • Preference of usage of clean fuel like LPG, low sulphur diesel should be explored;			
	Water Pollution	**Surface Water Quality** • Industries are likely to generate domestic and industrial effluent; • Liquid waste which can be generated from light engineeringindustries; • Domestic and cleaning waste is likely to be	**Surface Water Quality** • Each industry should obtain an ECC from the DoE Bangladesh; • Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Each industry should treat the effluent and sewage generated by them so as to achieve zero discharge and no untreated effluent should be discharged into anywater body; • Proper management of waste should be done to	Tenant/Third party agency	SPC/BEZA	Tenant Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		generated • Food processing industries similarly generate both liquid and solid waste. • Uncontrolled discharge of these effluents to canal/river **Ground Water Quality** • During the operation phase EZ of which water demand is about approximately 7,000m^3/day;	prevent any contact between thewaste and storm water; • Common waste disposal sites should also be developed within EZ site; • Storm water system should be inspected & cleaned before monsoon every year; • Peripheral drain shall also be lined and shall not be connected to internal storm water drainage system; • River water quality shall be monitored periodically; **Ground Water Quality** • Each industry should pre-treat the effluents and sewage before sending them to CETP; • No leachate, wastewater and waste material should be stored in pervious unlined area/pond. • Ground water quality shall be monitored periodically;			
	Waste	• Industrial waste is expected. Appropriate waste management by law and regulation is the responsibility of the tenant factory/ facilities, which shall be approved by DoE for their own EIAs;	• Selection of low vulnerability settings suited to the nature of the planned industrial activity; • Effective community consultation; • Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Fail-safe containment of any facilities that could put the environment at risk; • Access to or provision of services that ensure potential wastes are reduced, recycled or	Tenant/Third party agency	SPC/BEZA	Tenant Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
			adequately treated before safe disposal; • Proper Environmental Management and Monitoring systems must apply; • Environmental training and awareness programs for site employees and contractors;			
	Soil Pollution	• All waste including solid and liquid wastes may cause soil contamication • Improper disposal of waste (hazardous and non-hazardous waste) may degrade soil; • Lubricate oil/waste oil is generated from the machineries as hazardous waste.	• Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Treatment of the effluents and sewage and ensuring proper disposal; • Segregate non-hazardous solid waste from hazardous one and dispose properly; • Industrial waste generated will be stored in impervious storage tanks and will be disposed of as per guidelines of the DoE; • All factories will ensure proper storage for their chemical and hazardous materials to prevent accidental spillage; • Industrial waste generated should be stored on sealed surfaces and should be disposed off as per guidelines of DoE, Bangladesh; • Advanced wastewater treatment should be adopted by industries;	Tenant/Third party agency	SPC/BEZA	Tenant Cost
	Noise & Vibration	• Traffic in the area will increase significantly • Operation of EZ, water pumps, and light engineering	• Pumps should be fitted in acoustic enclosure to reduce the noise generation; • A noise canopy is mandatory for the power engine to operate for central power generation as well as in any factory;	Tenant/Third party agency	SPC/BEZA	Tenant Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		factories to be operated in proposed EZ may increase the noise level	• Noise barriers will be mandatory for the factories generating a lot of noise during operations; • Plantation should be developed along the roads and boundary to form continuous barrier that will reduce the noise level significantly;			
	Ground Subsidence	• Based on the deep ground water surveys, enough ground water resources were confirmed at the deep aquifer that is deeper and different from the aquifer of the residential wells;	• Need proper ground water resource management; • Groundwater management will need to keep in reasonable balance the costs and benefits of management activities; • It will be necessary to set possible management interventions in the context of the normal evolution • Prioritization of domestic water security within a strategy to implement the groundwater management program;	Tenant/Third party agency	SPC/BEZA	Tenant Cost
	Sediment Quality	• Bottom sediment of the surrounding water bodies would be deteriorated by wastewater generated from the industries. • Disposal of industrial domestic and process waste may contaminate land and	• Treatment of the effluents and sewage and ensuring proper disposal; • Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Segregate non-hazardous solid waste from hazardous one and dispose properly; • Industrial waste generated will be stored in impervious storage tanks and will be disposed of as per guidelines of the DoE;	Tenant/Third party agency	SPC/BEZA	Tenant Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		bottom sediment of the area. • Solid waste from textiles majorly composed of resins, fabric, apparel, dye, discarded machinery and fibers. • Solid waste from the food processing industries includes both organic and packaging waste.	• All factories will ensure proper storage for their chemical and hazardous materials to prevent accidental spillage; • Raw material will be stored under covered sheds and paved surface; • Fuel storage area should be proper containment; • Advanced wastewater treatment should be adopted by industries; • Adoption of best management practices to prevent any spillage of raw materials; • A site for disposal of hazardous waste can be identified within the EZ and it should be developed as per the norms of DoE and upcoming Hazardous Waste Management rules of Bangladesh.			
Naatural Environment	Ecosystems	• Post development of the economic zone & setting up of industries, there could be some impacts on the ecosystem of the area. • Generation of emissions, air emission, effluents, noise and increased vehicular movements may have overall	• Periodic monitoring shall be carried out as per the monitoring plan for air, water, noise and soil and ensure that no impact; • Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • No waste shall be discharged in water bodies, i.e. canal and agricultural land etc. • Central ETP should install to treat the effluent generated and to re-use and recycle it completely. No untreated effluent should be discharged in water bodies, i.e. canal and agricultural land;	Tenant/Third party agency	SPC/BEZA	Tenant Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		negative impact on the eco-system.	• Tree survival rate shall be monitored; • Native species should only be planted in the region;			
	Hydrology	• Impact on hydrology is expected caused by the existence of development area;	• Natural drainage pattern should be maintained. • Run-off assessment shall be made of catchment area and peripheral/garland drains shall be constructed around EZ site; • Storm water drain shall have the provision of de-siltation before discharge to river;	Tenant/Third party agency	SPC/BEZA	Tenant Cost
Social Environment	Water Usage	• Thousands of employees and workers who will use and consume water and generate wastewater from the office and the residential building; • During the operation phase a plant of which water demand is about approximately 7,000m^3/day;	• Centralized rainwater harvesting system will be implemented; • Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Water efficient technologies will be adopted in central utility service divisions and also at the factory process level; • Adoption of best management practices to prevent water wastage and minimize water loss; • Usage of water conservation fixtures to minimize water consumption; • Installation of leakage detection system to minimize the water loss; • Regular monitoring of ground water level in the area should be carried out;	Tenant/Third party agency	SPC/BEZA	Tenant Cost
	Landscape	• Although semi-	• The development will be implemented under	Tenant/Third	SPC/BEZA	Tenant

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		urbanization of landscape in and around Araihazar Economic Zone is inevitable;	the project proponent internal regulation, which rules to secure the environmental friendliness for users and residents, and harmonization with the surrounding area. • Greening area will be established in each plot and public space; • The landscape of the project area is expected to be well-maintained semi-urbanized area;	party agency		Cost
	Children's Right	• Children's educational opportunity will be temporarily disrupted due to the relocation • Child Labour	• Project proponents will implement "EZ neighbors students Support Program" as one of the community support programs targeting not only for children of PAH but also for surrounding communities. • According to the Labour Law of Bangladesh 2006, the minimum legal age for employment is 14. • The Project and industries keep laws in Bangladesh; illegal child labor will be preventing in employment of labors.	Tenant/Third party agency	SPC/BEZA	Tenant Cost
	Infectious Disease	• This is a possibility to increase the risks of infectious diseases due to influx of workers of the industries and the semi-urbanization of the project area and its surroundings area.	• Conduct mitigation measures stipulated in the international guidelines such as EHS Guidelines of IFC • To conduct Information, Education and Consultation Communication (IEC) campaign at least every other month to all site staff, employees, and immediate local communication concerning the risks; • To provide male or female condoms for all staff and laborers as appropriate and	Tenant/Third party agency	SPC/BEZA	Tenant Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
			• To provide for STI and HIV/AIDS screening, diagnosis, counseling and referral to dedicated national STI and HIV/AIDS program.			
	Working Conditions, including occupational Safety	• Occupational Health and Safety • Community Health and Safety • Risk of fire	• To provide adequate health care facilities and first aid within construction sites of industries or operation phase; • To provide OHS training program; • To provide adequate supplies and easy access of drinking water with a sanitary; • To provide temporary shelters to protect against heat stroke during working activities or for use as rest areas as needed; • To arrange for provision of clean eating areas where workers are not exposed; • To promote the use of repellents, clothing, netting, and other barriers to prevent insect bites and snake bite; • Adequate preventive measures from negative factors such as fire precautions, lighting, safe access, work environment temperature, area signage, labeling of equipment, communicate hazard codes, electrical; • To establish rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures, and control of traffic patterns or direction; • To identify and provide appropriate PPE that offers adequate protection to the worker, co-workers, and occasional visitors;	Tenant/Third party agency	SPC/BEZA	Tenant Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
Others	Accident	• Road accidents would be increased due to industrial vehicles, commuter buses, and motor lines.	• Follow Health and Safety Management Plan (HSMP) rules and regulations designated by contractors; • Provision of traffic sings, road mark, bump, zebra mark, guard rail and pole, and curb stones etc	Tenant/Third party agency	SPC/BEZA	Tenant Cost
	Transboundary impact and climate change	• Emission of Carbon Dioxides (CO_2) • The utilization of commuter bus for workers to reduce traffic GHG emission will be initiated by the tenants;	• Control of GHGs emission by energy use efficiency, process modification, selection of fuels or other materials, the processing of which may result in less emission, application of emission control techniques, if possible; • Provision of commuter bus;	Tenant/Third party agency	SPC/BEZA	Tenant Cost

E-9.1 Environmental Management & Monitoring Budget:

Table 4: Environmental Management Cost (A) in BDT

No.	Description of Item	Unit	Quantity	Unit Rate	Item Total
Pre-construction/Construction Stage					
01	Dust management by water sprayer	LS	-	-	1,000,000
02	Maintenance and protection of traffic including construction of diversion road, warning signs, and posting of signboard detaining project activities	LS	-	-	200,000
03	Campsite waste disposal facilities	Nos.	-	-	1,000,000
04	First aid box for treatment of injuries in emergency situations	Nos.	-	-	200,000
05	Water Supply	Nos.	-	-	500,000
06	Sanitary facilities	Nos.	-	-	200,000
07	Tree plantation and green area development plan	LS	-	-	5,000,000
08	Water quality protection measures: soil erosion and sedimentation control at the construction site and prevention of spillages, leakages of polluting materials, etc. to be at the satisfaction of the engineer.	LS	-	-	100,000
09	Stripping topsoil from borrowed agricultural lands, stockpiling and replacing the same to rehabilitate the land to the entire satisfaction of the owner and the engineer	LS	-	-	Included in the construction cost
10	Rehabilitation of ancillary sites including stockpile sites, brick crushing sites, borrow areas, work force camps/site office etc and leaving to the entire satisfaction of the engineer.	Sq.m	-	-	200,000
11	Orientation to the technical personnel/ Construction worker associated with the Economic Zone about the key issues of EMP	LS	-	-	Included in the construction cost
Total Environmental Management Cost (A)					**8,400,000**

Table 5: Environmental Management Cost (B) in BDT

No.	Description of Item	Unit	Quantity	Unit Rate	Item Total
Operation Stage (Yearly)					
01	Maintenance and protection of traffic including construction of diversion road, warning signs, and posting of signboard detaining project activities	LS	-	-	100,000
02	Campsite waste disposal facilities	Nos.	-	-	100,000
03	First aid box for treatment of injuries in emergency situations	Nos.	-	-	50,000
04	Water Supply	Nos.	-	-	Included in Operation & Maintenance Cost
05	Sanitary facilities	Nos.	-	-	Included in Operation & Maintenance Cost
06	Tree plantation and green area development plan	LS	-	-	300,000
07	Orientation to the technical personnel/ Construction worker associated with the Economic Zone about the key issues of EMP	LS	-	-	Included in the Operation & Maintenance Cost
Total Environmental Management Cost (B)					**550,000**

Table 6: Environmental Monitoring Cost (C) in BDT

Component	Stage	Item	Unit Cost	Quantity	Total Costs
Involuntary Resettlement	Pre-Construction &During Construction	Monitoring of Compensation for impact	-	-	Included in RAP Cost
Accident	During Construction	Ensuring that HSMP works right on the road track	-	-	Included in Construction Cost
	During Operation	Installing traffic signs, road mark, bump, zebra mark, guard rail and pole, and curb stones etc	-	-	Included in Construction Cost
HIV/ AIDs	During Construction	Ensuring that contractor's personnel	-	-	Included in EMP Cost

Component	Stage	Item	Unit Cost	Quantity	Total Costs
		and local community understand HIV-AIDS awareness campaign			
	During Operation	HIV-AIDS awareness campaign	-	-	Included in EMP Cost
Air pollution	During Construction	Measurement of SPM, PM 2.5, PM10, CO, SOx, NOx	50,000	48	2,400,000
	During Operation	Measurement ofPM10, PM2.5, SOx,NOx, CO	50,000	16	800,000
Water pollution (Surface & Ground Water)	During Construction	***Surface Water*** Turbidity, pH, DO, Total dissolved solids, oil & grease, total coliform, heavy metals ***Ground Water*** Drinking water quality parameters as per Schedule 3 of ECR 1997	30,000	48	1,440,000
	During Operation	***Surface Water*** Turbidity, pH, DO, Total dissolved solids, oil & grease, total coliform, heavy metals ***Ground Water*** Drinking water quality parameters as per Schedule 3 of ECR 1997	30,000	16	480,000
Waste	During Operation	Turbidity, pH, DO, Total dissolved solids, oil & grease, total coliform, heavy metals	30,000	4	120,000
Noise	During Construction	Periodical maintenance of construction vehicles and installation of sound insulation cover(Noise levels)	5,000	180	900,000
	During Operation	Securing of a buffer zone around 100m as noise decay distance (Noise levels)	5,000	60	300,000

Component	Stage	Item	Unit Cost	Quantity	Total Costs
Soil	During Pre/ Construction	pH, salinity, NH4+, total- P, heavy metals, oil & grease	-	LS	240,000
Offensive odor	During Construction	Odor inspection to ensure harmful odor is not released from equipment and waste	-	-	Included in Construction Cost
Occupational Health & Safety and Community Health & Safety	During Construction	Accident or incidents due to construction activities, dangerous occurrences	-	-	Included in EMP Cost
	During Operation	Hazard due to road traffic	-	-	Included in EMP Cost
Ecology	Aquatic and Terrestrial Ecology	Visible flora and fauna monitoring	-	-	Included in EMP Cost
Total Environmental Monitoring Cost (C)					**6,680,000**
Environmental Training	During Operation	Orientation Workshop and follow up training program for capacity building/ institutional development program	-	LS	2,000,000
Environmental Training Costs (D)					**2,000,000**
Grand Total (A+B+C+D)					**17,630,000**

E-10 Emergency Response Plan (ERP)

An Emergency Response Plan (ERP) is a written document, which is required for an organization according to occupational health safety standards and must be displayed at every job site with a certain number of employees (usually five to ten). It is a detail step-by-step procedure to follow in emergency such as fire, chemical spill or a major accident. An emergency response plan also includes information such as whom to notify, who should do what, and location of emergency stock. The Emergency Response Plan includes any measures that should be in place at all facilities to combat an accident resulting from fire, explosion or due to any natural calamities (e.g. Earthquake, cyclones, and flood).

E-11 Public Consultation Meeting

A joint public consultation for the EZ EIA preparation and stakeholder meeting for the RAP preparation was held on 22th November 2017 at the union office of one of the major project impacted communities (Satgram Union Parishad, Purinda Bazar). The joint consultation/meeting was participated by roughly 95 persons (***Annex B*).**The list of participants from these groups and attendance sheet are shown in ***Annex C***.

In the consultation meeting, after the explanation on the project outline planned in Araihazar EZ, which includes the industrial area, residential and commercial areas, and the logistic area, the expected key environmental and social benefits as well as potential negative impacts were explained during the construction and in the operation stage. In addition, survey items of the baseline EIA study and future schedule for the EIA were presented to the participants. At the end, a question and answer session was organized in all the meetings. As a whole, seven questions were raised from the participants and discussed with the project proponent and coordinating organization.

Table 7: Summary of Public Consultation Meeting for EIA at the Scoping Stage

Time and Date	**1st Public Consultation Meeting:** Date: 22 November, 2017 Day: Wednesday Time: 10:00 AM to 1:00 PM **2nd Public Consultation Meeting:** Date: 22 November, 2017 Day: Wednesday Time: 1:00 AM to 2:00 PM
Venue	Satgram Union Parishad, Purinda Bazar, Araihazar, Narayanganj
Invitees	- Deputy Commisioner (DC), Narayanganj - Manager (Administration), BEZA - Police Super, Narayanganj - Upazila Nirbahi Officer, Araihazar, Narayanganj - Executive Engineer, Roads & Highway Department/ DPHE, Narayanganj - Director General, PBS, Narayanganj - Assistant Commissioner (Land), Araihazar, Narayanganj - Social Specialist, BEZA project - Chairman, Araihazar upazila parishod - Upazila Agriculture/ Fisheries/ Education Officer, Araihazar upazila - Union Chairman, Shatgram union parishod - Union Chairman, Duptara union parishod - Local residents in and around Araihazar EZ area - Other organizations and individuals who are interested in the Project
Attendee	**1st Public Consultation Meeting:** 95 people (men: 91, women: 4) Age range: 21-74 Category of participants: Project affected people, local community and relevant stakeholders including both governmental and private sector representatives irrespective of gender; Occupation: Farmer, Businessman, Service holder, Teacher, Police, Student & Unemployed Persons **2nd Public Consultation Meeting:** 11 people (men: 11, women: 0) Age range: 35-70 Category of participants: Person to be displaced

Agenda	- Brief explanation on the past EIA-related studies - Project brief in the industrial area, residential and commercial areas, and the logistic area planned in Araihazar EZ area - Major positive and negative findings on the draft scoping results - Scope of the EIA study - Further schedule of EIA
Language Used	In local language: Bangali language

E-12 Conclusion and Recommendations

Bangladesh Economic Zones Authority (BEZA) has been emerged by the Bangladesh Economic Zones Act, 2010; the Government on 9 November 2010 officially instituted The Bangladesh Economic Zones Authority (BEZA). BEZA aims to establish economic zones in all potential areas in Bangladesh including backward and underdeveloped regions with a view to encouraging rapid economic development through increase and diversification of industry, employment, production and export'.

As per the procedure, the Bangladesh Economic Zone Authority (BEZA) has gotten the approved ToR from the department of Environment. Approved ToR was granted by DoE vide Memo No. 22.02.0000.018.72.003.17/334 dated 21 June 2017. The EIA study for the development of proposed Araihazar Economic Zone has been carried out as per the ToR issued by DoE.

The proposed Araihazar Economic Zone (AEZ) site is located at Mouza: Satgram, Shatgaon, Union: Satgram & Duptara, under Araihazar Upazila, which is adjacent to the Dhaka–Sylhet highway. The total land of Araihazar Economic Zone (AEZ) is approximately 218.84ha or 540.77 acres for 1st phase.

Most of the impacts are controlled and limited in and around the project area. The key negative impacts such as emission of gas and dust, deterioration of water quality, generation of noise, soil pollution, 540.77 acres land acquisition and some scale of involuntary resettlement are expected. Impact on livelihood of the project-affected persons (PAPs) including vulnerable people and children all are expected during the pre-construction, construction and operation phase. Clearance of existing vegetation during construction phase though there is no sensitive ecological protection area. However, implementation of appropriate mitigation and management plan is given in **Chapter 8**. On the other hand, some positive impacts of the Project such as increase in job opportunity (approximately 10,000) and improvement of social infrastructure are also expected.

In consideration of the result of the EIA study for the Project, the Environmental Management Plans (EMPs) including adequate mitigation measures to reduce the negative impacts and Environmental Monitoring Plan (EMoP) are proposed for this Project: pre-construction phase, construction phase, and operation phase.

It was confirmed that the environmental, social and health impacts of the Project were assessed and the Environmental& Social Management Plan was formulated properly. In the process of EIA, opportunity of public involvement was ensured and comments from the public were reflected into the final EIA Report. The Public consultation meeting was held on

22thNovember 2017 at Satgram Union Parishad, Purinda Bazar. Affected persons, local community and relevant stakeholders including both govt. and private sector representatives irrespective of gender were participated in this Public Consultation Meeting. The proceedings commenced at 10:00 am. The meeting was attended by a total of 95 people. Thus, the EIA was completed in accordance with the requirements of the EIA Procedure properly in case that project proponent will follow EMP accordingly.

Recommendations made for the project development on the basis of EIA study are given below:

- Dhawrakhali canal should be retained in its natural position
- Proposed Environment & social management plan should be implemented strictly both during pre-construction, construction and operation phase of the project
- Suggestions & requests made by public for employment shall be taken into consideration
- Proper training of maintaining environment, health and safety should be given to Project management unit in both constructions an operation phase
- Provision of CETP, WTP, Drainage system, Retention pond and thick green belt shall be adhered.
- Rainwater harvesting should be carried out to reduce the pressure on surface and ground water resources.
- Construction activities for proposed off-site developed should only be started after obtaining environment clearance certificate from DoE, Bangladesh
- Environmental monitoring should be conducted as proposed in environment and social management plan
- Separate Environment impact assessment study is to be carried out for individual industries where applicable as per the ECR, 1997.

CHAPTER 1

1 INTRODUCTION

Bangladesh has been averaging relatively high annual GDP growth rate at 5 to 6 % over the past 10 years. However in order to achieve a transition to a middle-income nation by 2021 as the country envisions as its national goal, the country needs to accelerate its GDP growth rate to about 8%. To realize this goal, the country needs to break away from the existing economic structure that is heavily relying on garment exports and remittance from overseas workers. Moreover, it is essential that the country should seek diversification of the national industries and exports, and promote investment and strengthen industries with a focus on manufacturing industries that have competitiveness in export. Therefore, it is necessary for the country to improve the system, the administration and the implementation capacity of the pertinent government agencies responsible for the promotion of investment and industrial development.

Since 1980s, Bangladesh has made effort to promote investment and industrial diversification by establishing "Export Processing Zones (EPZs)" under Bangladesh EPZ authority (BEPZA), and currently eight (8) EPZs are operating in Dhaka, Chittagong and other locations. However, the majority of the businesses(about 70% out of 300 companies) within these EPZs are mainly labour intensive industries that rely on imported raw material and processing them with low labour cost. This kind of processing industry, however, has a limited impact on backward linkage within the country, and less likely to induce other downstream or upstream manufacturing businesses. As a result, the government of Bangladesh has announced that no new EPZ is needed, but instead, it has launched a new policy to establish "Economic Zones (EZs)" to reinforce enter-industrial relationship of export industry and domestic industry, and to optimize the domestic market.

Investment by Japanese companies in Bangladesh first began in Chittagong EPZ, which was established in 1983, and the investment from Japan continued in other new EPZs during 1990s. In recent years, the increasing number of Japanese companies started to recognize Bangladesh as "China plus 1" or their next investment destination due to its abundant labour force and the competitive labour cost as well as its huge domestic market of over 150 million people, and 240 Japanese companies, as of October 2016, have started their operation in Bangladesh. However, the existing EPZs are facing a shortage of available land for Japanese companies that are currently interested in investing in Bangladesh. In addition, a certain number of Japanese companies are hesitant to invest in Bangladesh due to the lack of stable power, gas and road infrastructure, and uncertainties towards the investment promotion policies and the implementation capability of the Bangladesh government.

Under these circumstances, the government of Bangladesh has requested the government of Japan to provide Yen loan for "the Foreign Direct Investment Promotion Project (hereinafter FDIPP)" in order to establish a new EZ mainly targeting Japanese companies and to further facilitate investments from Japan. The loan agreement for FDIPP was already signed in December 2015. The loan is expected to provide both short term and mid to long term low-interest financing for operation and capital investment of the EZ. Additionally, a part of the

loan will contribute to the development of infrastructure such as roads, power and gas, as well as to assure the involvement of the government of Bangladesh to resolve and simplify the complicated system and procedures so that Japanese companies can be more confident and comfortable about their investment decision.

Previously, in connection with FDIPP, JICA implemented "Project for Development Study and Capacity Enhancement of Bangladesh Economic Zone Development Plan Authority" from February 2015 thru March 2017. Within the above project, analysis and site comparisons of the candidate EZ locations were conducted Araihazar and Nayanpur were selected as prominent locations for EZ development. The project also undertook pre-feasibility studies for these two locations, and as of July 2017.

Taking into consideration the site location, available infrastructure, existing industries, investors interest and infrastructure and logistic requirement of the proposed industries, Araihazar Economic Zone is more like to be selected for EZ development through FDIPP.

The proposed Araihazar Economic Zone (AEZ) site is located at Mouza: Panchrukhi, Panchgaog, Union: Satgram & Duptara, under Araihazar Upazila, which is adjacent to the Dhaka–Sylhet highway. The total land of Araihazar Economic Zone (AEZ) is approximately218.84 ha or 540.77 acres for 1st phase. Upon completion, AEZ is envisaged to create approximately 10,000 jobs when fully occupied by investors.

To ensure the successful implementation of FDIPP, JICA started to implement a new survey project, "**Special Assistance for Project Implementation under Foreign Direct Investment Promotion Project** (hereinafter the survey)"at Araihazar. A Japanese Survey Team (hereinafter JST) who has been selected by JICA in June 2017 will conduct the survey with corporation with local consultants and engineers.

This EIA will examine the aspects of the project activities, which are likely to interact with and affect the surrounding environment and the community. The EIA report provides an Environmental Management Plan (EMP) and Social Screening issues along with specific mitigation measures with a view to reduce and/or control the level of adverse impacts upon the environment as well as to enhance measures for positive impacts resulting from the proposed project activities.

1.1 Background

BEZA is responsible for total identification and promotion of the economic zones. BEZA identifies the location and develop the necessary off-site infrastructure to make site accessible and buildable. Further a developer is appointed by BEZA to develop the EZ as per EZ Act, 2010. The off-site facilities as planned by the BEZA to be carried out for Araihazar Economic Zone are given below:

- Construction of administration building
- Site Preparation which includes
    - Land filling of 540.77acres
    - Construction of boundary wall for 540.77acres all around the boundary
    - Access road
    - Plan for power generation, transmission and distribution

- Telecommunication plan
- Gas supply plan
- Construction of retention pond, retention canal and pump house
- Plan for roads in the surrounding area
- Drainage channels and a retention pond for controlled drainage discharge

Prospective private developers will plan onsite facilities and industrial area development on later stage. JICA has appointed Japan Development Institute Ltd. (JDI) as consultant for doing the Environment Impact Assessment (EIA) study of the Araihazar Economic Zone.

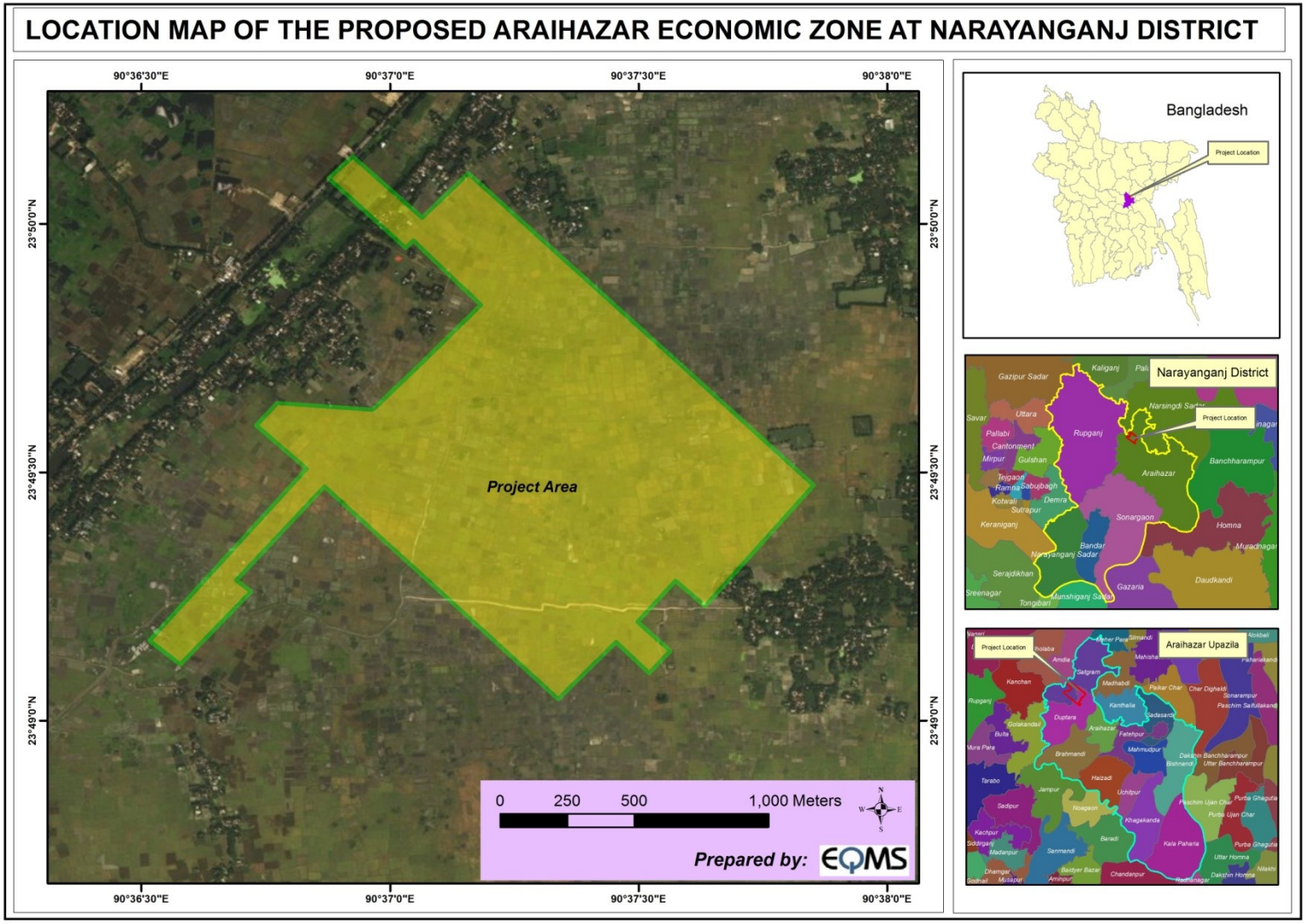
The area size of the EZ shall be 540.77Acre (218.84ha). A careful and mutual decision must be made together with BEZA and other stakeholders at the earliest stage possible. Then, DPP preparation for the sub-projects shall be started with consultation of JICA, BEZA and a candidate Japanese developer.

As per the procedure, the Bangladesh Economic Zone Authority (BEZA) has gotten the approved ToR from the department of Environment. Approved ToR was granted by DoE vide Memo No. 22.02.0000.018.72.003.17/334 dated 21 June 2017. The EIA study for the development of proposed Araihazar Economic Zone has been carried out as per the ToR issued by DoE. Copy of the approved ToR by DoE is attached as ***Annex A***.

1.2 Brief Description

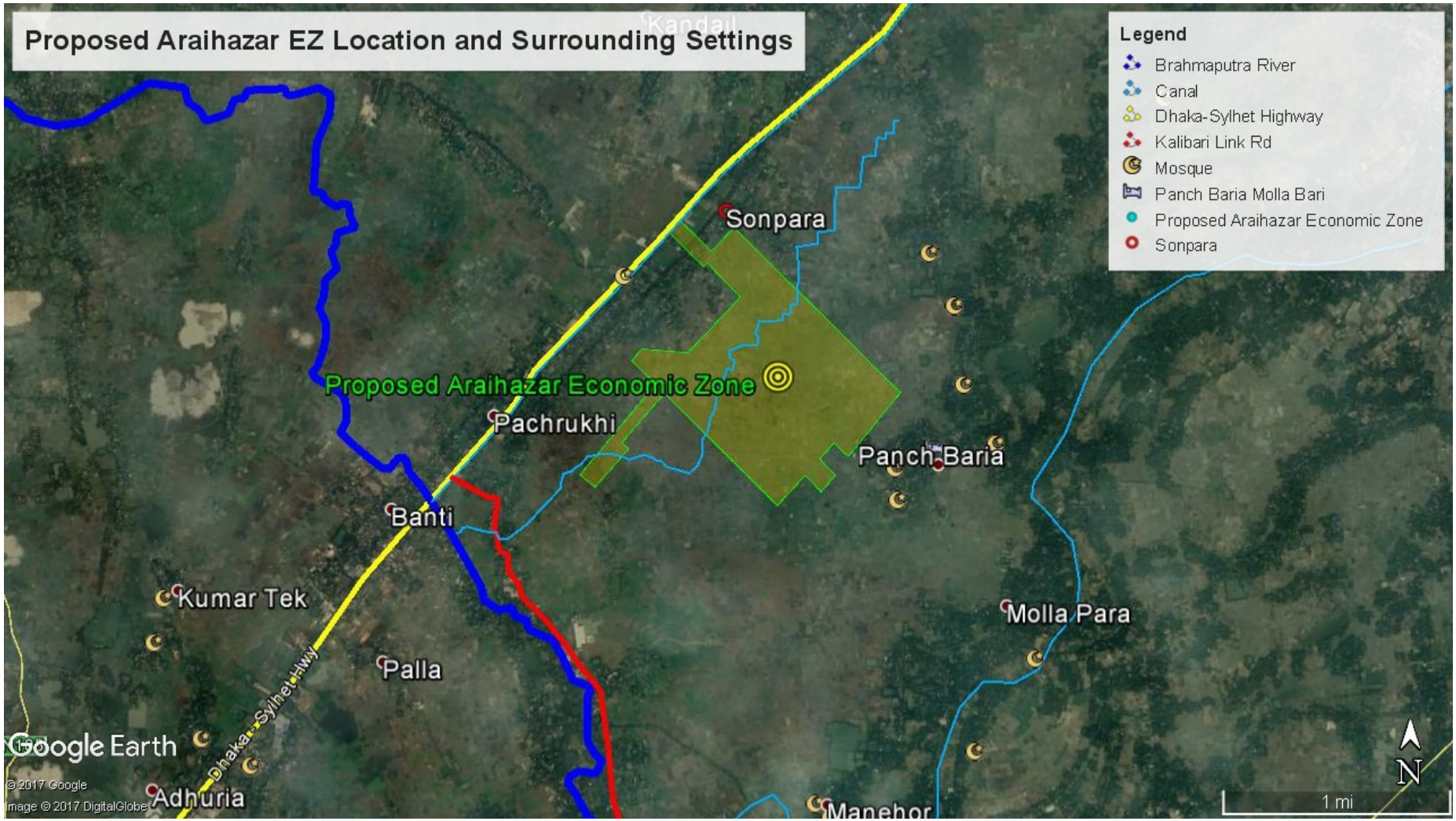
The proposed Araihazar Economic Zone (AEZ) site is located at Satgram & Duptara Union, under Araihazar upazila adjacent to the Dhaka–Sylhet Highway. The total land of the project area is 218.84ha or 540.77 acres. The proposed Araihazar Economic Zone (AEZ) will be the multi sector EZ in the country where Industrial plots (76.42%), Road (5.68%), Green Zone (5.80%), Administration building including OSS (1.35%), WTP& CETP (1.84%), Utility area (5.69%), Waste water discharge canal including retention pond (2.68%), Fire station & Gas station (0.53%) and Telecommunication system including fixed telephone and internets will be covered the development area.

The location map of the proposed project site is presented in ***Figure 1-1***&***Figure 1-2*** showing geographical boundary of proposed Araihazar Economic Zone.



Source: Google Earth

Figure 1-1: Location Map of Araihazar Economic Zone



Source: Google Earth

Figure 1-2: Google Map showing the Proposed Araihazar EZ location and surrounding settings

1.2.1 Description of the Project Site

The project site is near to Dhaka-Sylhet Highway in the north-west direction, Shitalakhya River in west direction whereas settlement, water body and agricultural land in the East, west & south side of the project area. A canal pass through the proposed project boundary and a branch of Meghna River named Brahmaputra river pass through south direction to northwestern direction. The project area is mainly covers agricultural low land.

1.2.2 Connectivity

The project site is near to Dhaka-Sylhet Highway in the north-west direction, Shitalakhya River in west direction and Meghna River is in southeast direction. In addition, this location is suitable to access not only for roadway but also river way. **Airport Access:**30.2km from Hazrat Shahjalal International Airport (Dhaka), 265km from Shah Amanat International Airport (Chittagong) &221km from Osmani International Airport (Sylhet),**Seaport Access:**258 km from Chittagong Sea Port, 248km from Mongla Sea Port &314km from Payra Sea Port, **Road Access:** Adjacent Dhaka-Sylhet Highway, **River Access:**31.5km from Narayanganj River Port &115km from Chadpur River Port and **Railway station:** 30.3km from Kamalapur Railway Station, Dhaka.

Source: Feasibility & Sustainable Department (FSD), EQMS

Figure 1-3: Project Location in National Context

1.3 Rationale of the Project

Bangladesh is primarily an agricultural economy with close to 50% of the labour force employed in agriculture. Industry sector contribution to Gross Domestic Product (GDP) has hovered around 25-30% only for past few years. Manufacturing sector of Industry shows predominance of export led garments and textile industries and comprise of 52% share of total exports in Bangladesh making it the world's second largest garment manufacturer.

But it also reveals relatively low emphasis and export competitiveness of its other items. Therefore, the country needs to bolster exports of other indigenous products, which will happen through enhanced industrial infrastructure, capacity building, and policy initiatives. Similarly, the country may choose to substitute imports of capital goods and other items of domestic consumption, provided there is adequate investment in industrial infrastructure to enable domestic manufacturing.

The Government of Bangladesh has, in the past, successfully provided tailored infrastructure services and business environment conditions through EPZs. EPZs were used as a strategic instrument for attracting Foreign Direct Investment (FDI) and dealing with the shortcomings of the overall investment climate, business registration, licensing, etc. which were restricting investments in the Domestic Tariff Area (DTA).

To overcome the limitations of EZ model, new Economic Zone regime has been adopted by the Government of Bangladesh so as more spill-over can be harnessed by local firms from FDI, additional investments can be encouraged within value chains, more local produce can be procured and better linkages can be established between manufacturing firms and educational institutions.

The AEZ development, a zoned industrialization, is required in Bangladesh to maximize the growth benefits of agglomeration and ease the increasing urban congestion. More importantly, the project will enable new sources of growth, where investor will show their interest.

Araihazar EZ site is one of the forward areas of Araihazar Upazila at Narayanganj district. Development of EZ in such a forward area will boost not only the industrial development in the area but also the infrastructural facilities like improved power supply, gas, water, roads, drainage etc. Employment generation for local people will enhance their living standard and quality of life. AEZ development will lead to development of allied facilities and related developments in the nearby area. Also as per requirement for EZ development, location of AEZ is suitable. Adequate land is available for development of EZ. The land will acquireby government and further land will be required for Phase-2 EZ development. Its location on proximity to Dhaka-Sylhet Highway, Narayanganj River port and Hazrat Shahjalal International Airport makes it suitable location for development of AEZ.

1.4 Scope of the Study

The scope of the study covers the environmental legislative, regulatory & policy guidelines and considerations relating to the implementation of the proposed special economic zone including the following:

- Carried EIA study according to the DoE and JICA guideline
- Collection of environment baseline data (covering one and half month) for the Project site and surrounding area with reference to the physical, biological and social components of environment and preparation of baseline monitoring report;
- Identification, prediction, quantification and evaluation of potential aspects and impacts (both short term and long term) of the proposed Project on various environmental components due to activities envisaged during:
    - Construction activities at the proposed site; and
    - Relevant off-site construction activities;
- Preparation of Emergency Response Plan (ERP);
- Preparation of Stakeholder Engagement Plan (SEP);
- Delineation of Environmental Management Plan (EMP) including mitigation measures and monitoring plan for effective implementation of mitigation measures by the Project Personnel during construction, operation and decommissioning phases of the Project.
- Preparation of Draft EIA report;

1.5 Methodology

The EIA of the proposed economic zone to be constructed at the location of Satgram & Duptara union, Araihazar upazila of Narayanganj district has been conducted following the EIA Guidelines for Industries, prepared by the DoE in 1997 in accordance with the requirement of the Environment Conservation Rules, 1997 under the Environment Conservation Act 1995. This EIA report has been prepared based on the approved ToR by Department of Environment (DoE)and the other relevant regulation of Bangladesh. In addition to the national legal frame works, this report has been prepared in accordance with the JICA Guidelines for Environmental and Social Considerations, 2010 (JICA Guidelines2010) for the purpose of JICA's environmental review before disbursement of the JICA Loan Agreement signed in 2015.

This report is based on the primary data generated during the study period, secondary data from various sources and information from field visits and from the project proponent. Several field visits were undertaken to the project location with a view to reconnaissance and detailed physical survey of the surrounding areas. These were followed by evaluation of the information to delineate the major environmental issues relating to the project. During this process, the following steps have been followed:

- Screening of the project and scoping of anticipated project impacts through stakeholders meeting, etc. at the beginning of the project preparation activities;
- Reconnaissance survey was taken up to collect baseline information in devised formats;
- Compilation of survey/monitoring data. Field survey using a prepared questionnaire conversing a wide cross -section of people in the study area to acquire field -level data on the existing environment and socio economics and apprehended impacts due to the project;
- Analysis and assessment of various alternatives;
- Identification of potential impacts and evaluation of their consequences;
- Formulation of mitigation and avoidance measures was done for identified impacts;
- Stakeholders meeting to disclose draft EIA report;

1.5.1 Approach and Methodology for EIA Study

As the first step, project screening and scoping exercise was undertaken to identify the parameters needed to be considered for the study and to outline the activities for collecting data on each parameter. Data pertaining to all facets of the physical, ecological and socioeconomic environment were collected from the study area (in a radius of 2 km from the proposed Economic Zone) for overall environmental baseline, ecological baseline and social baseline through both primary and secondary sources.

The stepwise activities are detailed in the following subsections:

Preliminary Discussions with Project Proponent

- Discussions held with Bangladesh Economic Zone Authority (BEZA) to understand the proposed project, project milestones, legal requirements and scope;

Screening

- Categorization of the project was completed based on the screening assessment, reconnaissance survey, environmental and social sensitivities, limited consultation and the DoE categorization.

Alternatives Analysis

In order to consider the project area and the shape of the Economic Zone, two alternatives were compared comprehensively from the viewpoint of technical aspect, economical aspect, safety and social and environmental consideration.

Araihazar EZ was selected as the priority option because it has advantages from the viewpoint of technical aspect, economical aspect, safety and environmental/social consideration.

Baseline Data Collection

- Identification of the monitoring locations for air, water, soil and noise as per sensitive receptors;

- The detail baseline data collection, monitoring and analysis for environmental parameters was completed during the period from September, 17 to December, 17;
- Secondary data was also collected from different government departments, local bodies and through literature surveys etc; and
- All the data was compiled and compared with applicable standards where relevant, and is presented in **Chapter 4** of this report.

Impact Assessment and Mitigation Measures

- Analysis of the baseline results and the incremental impacts of the project were assessed in accordance with the Bangladesh national guidelines for air, water and noise emissions; standards stipulated in the Environment Conservation Rules (ECR), 1997
- The impact assessment involved the prediction and evaluation of impacts from the project in different phases, including before construction, construction and operation phase and included consideration of mitigation measures towards the same;
- Impact assessment also involved risk assessment covering hazard identification, consequence analysis and risk reduction measures and recommendations; and
- Impacts have been further classified as significant impact, some impact, impact are not identify and no impact based on the criteria for rating of impacts.

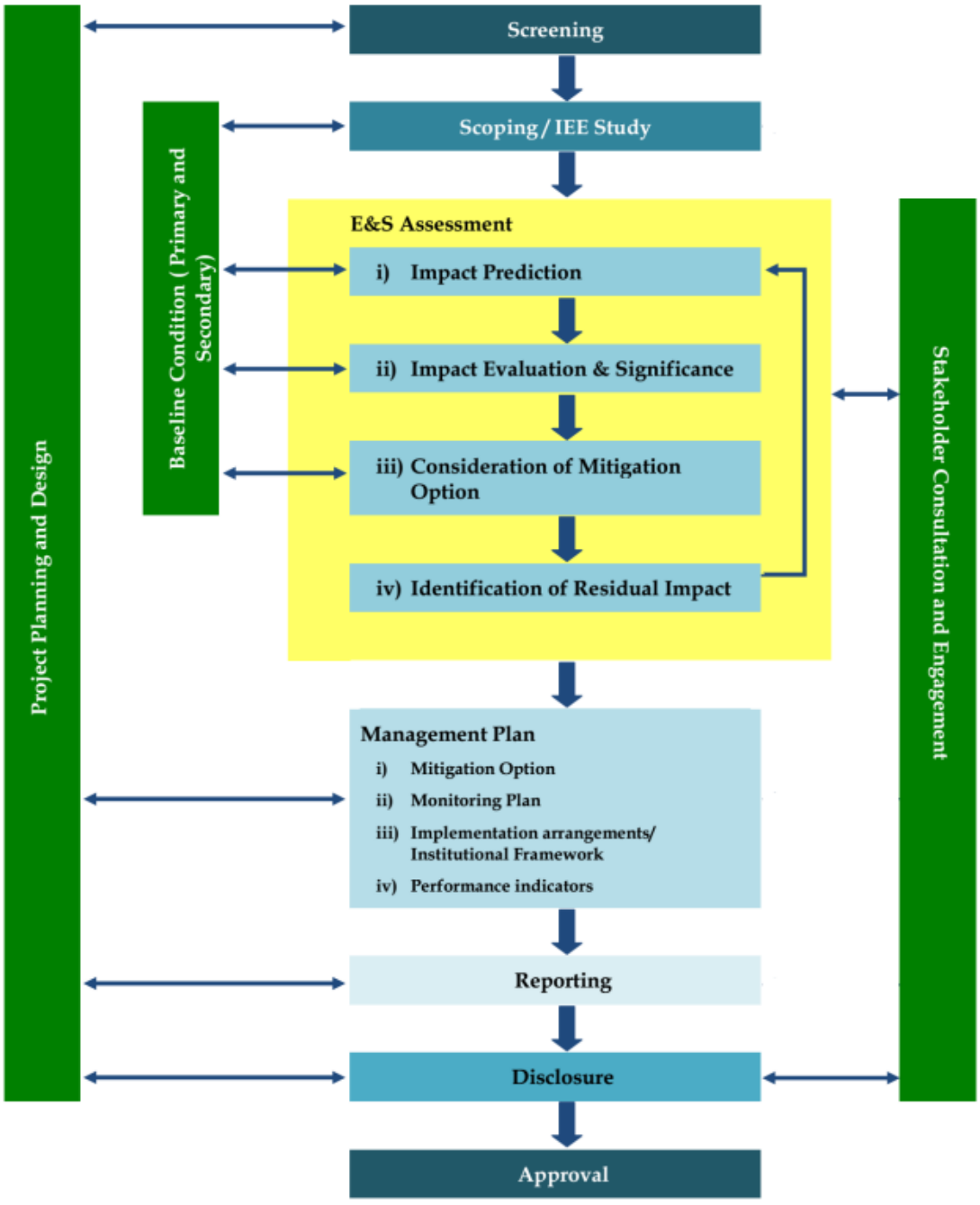
Management Plans

- Environmental Management Plan (EMP) were developed for the mitigation measures suggested and included defined roles and responsibilities for implementation;
- Institutional review and finalization of the EMP was completed in consultation with BEZA.

Stakeholder Consultation

- In accordance with JICA Guidelines2010, the first extensive consultation was conducted with key stakeholders' including the local population, government departments/agencies.
- The 1st public consultation meeting was completed with the intent of collecting baseline information on the environmental and social conditions and sensitivities, developing a better understanding of the potential impacts, informing the public of the proposed project and to gain an understanding of theperspectives/concerns of the stakeholders;
- A summary of the stakeholder engagement process and the profile of the groups and their opinions forms a part of the Information Disclosure, and
- Information gathered was used for formulating mitigation measures and environmental and social management plan/s.
- The second public disclosure meeting will be completed after completion the final EIA report, Meeting minutes will be incorporated after 2nd PDM.

The EIA Report has been prepared with the support from BEZA and various government agencies including Bangladesh Meteorological Department (BMD), Soil Resource Development Institute (SRDI), Bangladesh Bureau of Statistics (BBS), and Department of Environment (DoE).



Source: EQMS

Figure 1-4: Approach for the EIA

1.6 Limitation

The present EIA Report has been prepared based on the Primary field investigations/ assessment, and secondary data from data collected from Department of Public Health and Engineering (DPHE), Bangladesh Meteorological Department (BMD), Department of Environment, Bangladesh (DoEB) and published journals, and books, public consultation and site observations. The environmental and social assessment is based on the information collected from the various agencies, community consultations and observations. Professional judgment and subjective interpretation of facts and observations has been applied for the preparation of the EIA Report.

Additionally on site facilities, sources and alignments are not fixed till date, thus assessment is made on the basis of preliminary information available from JICA and for all the options which could be explored. The onsite (industrial area detailed planning will be carried out by prospective private developer) information are available limited to feasibility assessment.

1.7 EIA Team

EQMS Consulting Limited is a specialist consultancy firm sub contracted by JDI to prepare and deliver the EIA for the Project. EQMS Consulting Limited has utilized a multi-disciplinary team comprising of environmental and social experts. The team members have extensive professional experience working in the fields of environmental impact assessment and social impact assessment in Bangladesh. The composition of the EIA Team can be seen below in ***Table 1-1.***

Table 1-1: Team Composition of EIA Study

SI#	Name	Position
1.	Dr. Kazi Farhed Iqubal	EIA Expert and Project Director
2.	Dr. Golam Mawla	Environmental Engineer
3.	Mirza SA Habib	Ecologist and Project Manager
4.	Rofiul Karim	Sociologist
5.	Abdul Halim	Resettlement Specialist
6.	Mustafizur Rahman	Community Development Expert/ LRP Expert
7.	Salahuddin Ahammad	Environmental Expert/ Pollution Control & Management
8.	Mohammad Mamun Chowdhury	Biodiversity Expert
9.	Tauhidul Hasan	Environmental Expert
10.	Md. Zahidul Islam	GIS Expert
11.	Ashish Dhar	Jn. RAP Expert
12.	Abu Mohammad Nasiruddin	Jn. Social Expert

1.8 References

List of secondary data used for carrying out EIA study and preparation of EIA report is given at the ***Table 1-2*** below.

Table 1-2: Reference Used for EIA Study

Sl#	Reference
Government Departments	
1.	Bangladesh Agriculture Research Council
2.	Bangladesh Economic Zone Authority
3.	Bangladesh Water Development Board
4.	Department of Environment
5.	Bangladesh Meteorological Department
6.	Bangladesh Bureau of Statistics
7.	Bangladesh Food & Agriculture Department (FAO, Bangladesh)
8.	Geological survey of Bangladesh
9.	Disaster Management Bureau (DMB)
10.	Department of Disaster Management (DDM)
11.	Department of Agriculture Extension
12.	Bangladesh Rice Research Institute
13.	Department of Fisheries
14.	Land & Revenue Department, Narayanganj
Journals, Books & Existing Studies	
1.	Hossain, S; Das, N. G.; Sarker, S; Rahaman, Z, National Institute of Oceanography and Fisheries (Egyptial Journal of Aquatic Research), Fish Diversity and Habitat Relationship with Environmental Variables at Meghna River Estuary, Bangladesh, December, 2012
6.	Maps from Bangladesh Agriculture Research Council
7.	Bio-ecological Zones of Bangladesh, IUCN
8.	Community Report, Dhaka Zila, June, 2012, Population & Housing Census, 2011, Bangladesh Bureau of Statistics, Statistics & Information Division, Ministry of Planning
9.	Common Names of plants growing in Bangladesh and West Bengal (Bengali), Govt. of Bangladesh
10.	District Statistics, 2011, Dhaka, December, 2013, BBS, Statistics and Information Division, Ministry of Planning, Govt. of the people's republic of Bangladesh
11.	Fisheries Statistical Yearbook of Bangladesh, 2012-2013, department of Fisheries, Bangladesh, Ministry of Fisheries and Livestock
12.	Sarker, S, U& Sarker, N, J, Department of Zoology, University of Dhaka, 1985, Migratory Raptorial Birds of Bangladesh
13.	Islam, I, 2012, Temporal pattern of Fish Assemblage of Shitalakhya& Meghna River, Dhaka, Bangladesh-Fish Biodiversity of Shitalakhya& Meghna River

Sl#	Reference
14.	Amin, S, M, N; Ara, B; Rahman, M, A; Nahar, S; Haldar, G, C & Mazid, M, A, 2006, Catch Per Unit Effort (Cpue) and Hydrological Aspect of Major Spawning Site of Hilsa, Tenualosa Ilisha in Bangladesh
15.	Annual Report 2010-2011, Bangladesh Agriculture Development Corporation Monitoring Division
Website	
1.	Google maps
2.	http://www.bangladeshtourismdirectory.com/bangladesh-archaeological-sites list.html
3.	Google earth imageries
4.	http://www.saarc-sadkn.org/countries/bangladesh/disaster_mgt.aspx (Bangladesh Disaster Knowledge Network)
5.	https://www.britannica.com/place/Meghna-River
6.	http://www.fao.org/docrep/field/003/AC360E/AC360E03.htm#anxA
Others	
1.	Site visits
2.	Project for development of economic zones and capacity enhancement of Bangladesh economic zones authority, JICA 2017

1.9 EIA Report Format

The EIA study comprises of the following stages.

Executive Summary

The executive summary gives the synopsis of the EIA Report.

Chapter 1: Introduction

This chapter provides background information of the project proponent, need for the EIA study as per prevailing legislation, Location and brief description of the project, methodology adopted for EIA study and structure of the report.

Chapter 2: Legislative, regulation and policy consideration

This chapter deals with the details of the potential legal, administrative, planning and policy framework that have been used in the preparation of the EIA Report;

Chapter 3: Description of the Project

This chapter deals with the details of the proposed EZ such as project requirements, Infrastructure development, environmental consideration, project cost, implementation schedule, etc.

Chapter 4: Environmental and Social Baseline

This Chapter describes the baseline environmental conditions around the project site for various environmental attributes, viz. physical, biological and socio-economic, within the 10 km radial

zone, which is termed as the study area. Topography, soil, water, meteorology, air, noise, and land constitute the physical environment, whereas flora and fauna constitute the biological environment. Demographic details and occupational pattern in the study area constitute socio-economic environment. Baseline environmental conditions are based on the information collected from the various agencies and the secondary data collected from published sources.

Chapter 5: Alternative Analysis

This chapter details the analysis of the key environmental issues and examines the necessity of the project and their most feasible place for the Economic Zone.

Chapter 6: Scoping and Terms of reference for Environmental Impact Assessment

This chapter details the likely significant environmental and social impacts, potential environmental and social impacts of the project were preliminarily identified based on the project description and overall environmental and social conditions in and around Economic Zone.

JICA Survey Team prepared a term of reference (TOR) for identified uncertain impacts summarized for the JICA EIA study and RAP study.

Chapter 7: Environmental and Social Impacts

This chapter details the inferences drawn from the environmental impact assessment of the proposed project. It describes the overall impacts of the project activities and underscores the areas of concern, which need mitigation measures.

Chapter 8: Environmental & Social Management Plan and Monitoring Indicators

This Chapter provides mitigation and control measures to attenuate and/or eliminate environmental impacts, which are likely to be caused by the proposed project. An Environmental Management Plan (EMP) has been developed to mitigate the potential adverse impacts and to strengthen the beneficial impacts. This chapter also provides the environmental monitoring plan proposed for the project.

Chapter 9: Cost Estimation for Environmental Mitigation Measures and Monitoring

This chapter concludes on the findings that emerged from the environmental assessment study and summarizes the key points to be addressed to ensure the environmental sustainability of the project during the construction and operation phases.

Chapter 10: Emergency Response Plan & Disaster Management Plan

This Emergency Response Plan has been developed to provide an organizational and procedural framework for the management of emergencies in the Araihazar Economic Zone project.

Chapter 11: Public Consultation and Disclosure Meeting

This Chapter provides an insight into the process & methodology followed for carrying out the public consultation meetings in study area and proceedings of pubic consultations.

Chapter 12: Conclusions and Recommendations

This chapter concludes on the findings that emerged from the environmental assessment study and summarizes the key points to be addressed to ensure the environmental sustainability of the project during the construction and operation phases.

CHAPTER 2

2. LEGISLATIVE, REGULATION AND POLICY CONSIDERATION

2.1 Introduction

To address the environmental and social risks of any proposed project and its associated components; to protect and conserve the environment from any adverse impacts, the GoB has specified regulations, policies and guidelines.

The activities of the proposed economic zone project fall under the 'red' category according to the Bangladesh Environment Conservation Rules (ECR) 1997 and therefore, we need to conduct EIA studies to obtain site and environmental clearance from the DoE.

The following activities have been carried out under the EIA study:

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

2.2 Environment and Social Related Legislation in Bangladesh

The main Acts and Regulations guiding environmental protection and conservation in Bangladesh are outlined in the following subsections.

2.2.1 Bangladesh Environmental Conservation Act, 1995 (subsequent amendments in 2000 and 2002)

The provisions of the Act authorize the Director General of the Department of Environment (DOE) to undertake any activity that is deemed fit and necessary to conserve and enhance the quality of environment and to control, prevent and mitigate pollution. The main highlights of the act are:

- Declaration of Ecologically Critical Areas;
- Obtaining Environmental Clearance Certification;
- Regulation with respect to vehicles emitting smoke harmful for the environment;
- Regulation of development activities from environmental perspective;
- Promulgation of standards for quality of air, water, noise, and soils for different areas and for different purposes;
- Promulgation of acceptable limits for discharging and emitting waste; and
- Formulation of environmental guidelines relating to control and mitigation of environmental pollution, conservation and improvement of the environment;

2.2.2 Environment Conservation Rules (ECR), 1997 (subsequent amendments in 2002 and 2003)

The Environment Conservation Rules, 1997 are the first set of rules promulgated under the Environment Conservation Act, 1995. These Rules provide for, inter alia, the following:

- The National Environmental Quality Standards (EQS) for ambient air, surface water, groundwater, drinking water, industrial effluents, emissions, noise and vehicular exhaust;
- Categorization of industries, development projects and other activities on the basis of actual (for existing industries/development projects/activities) and anticipated (for proposed industries/development projects/activities) pollution load;
- Procedure for obtaining environmental clearance;
- Requirements for undertaking IEE and EIA's as well as formulating EMP's according to categories of industries/development projects/activities; and
- Procedures for damage-claim by persons affected or likely to be affected due to polluting activities or activities causing hindrance to normal civic life.

Depending upon the location, size and severity of pollution loads, projects/activities have been classified in ECR, 1997 into four categories:

Green, Orange A, Orange B and Red respectively as nil, minor, medium and severe impacts on important environmental components (IECs).

2.3 Environment Related Policies in Bangladesh

The GoB has developed a policy framework that requires environmental issues to be incorporated into economic development planning. The Key tenets of the various applicable policies are detailed in the following subsections.

2.3.1 National Environmental Policy, 1992

The Bangladesh National Environmental Policy, approved in May 1992, sets out the basic framework for environmental action together with a set of broad sectoral action guidelines. Key elements of the Policy are:

- Maintaining ecological balance and ensuring sustainable development of the country through protection, conservation and improvement of the environment;
- Protecting the country from natural disasters;
- Identifying and regulating all activities that pollute and destroy the environment;
- Ensuring environment-friendly development in all sectors;
- Ensuring sustainable and environmentally sound management of the natural resources; and
- Promoting active association, as far as possible, with all international initiatives related to environment.

The Environmental Policy of 1992 requires specific actions with respect to the industrial sector which are as follows:

- To phase-in corrective measures in polluting industries;
- To conduct EIAs for all new public and private industrial developments;
- To ban, or find environmentally sound alternatives for, the production of goods that cause environmental pollution; and
- To minimize waste and ensure sustainable use of resources by industry.

The policy also states that EIA's should be conducted before projects are undertaken and the DoE is directed to review and approve all Environmental Impact Assessments.

2.3.2 National Environmental Management Action Plan, 1995

The National Environmental Management Action Plan (NEMAP) is a wide- ranging and multi-faceted plan, which builds on and extends the statements, set out in the National Environmental Policy. NEMAP was developed to address issues and management requirements related to the environment during the period 1995 to 2005; it also sets out the framework within which the recommendations of the National Conservation Strategy are to be implemented. NEMAP was developed to achieve the following broad objectives:

- Identification of key environmental issues affecting Bangladesh;
- Identification of actions necessary to halt or reduce the rate of environmental degradation;
- Improvement of the natural environment;
- Conservation of habitats and bio-diversity;
- Promotion of sustainable development; and
- Improvement of the quality of life of the people.

To attain the above mentioned objectives, the plan groups all the relevant necessary actions under four headings, namely: *institutional, sectoral, location- specific* and *long-term issues.*

The *institutional* aspects reflect the need of inter- sectoral cooperation to tackle environmental problems which need new and appropriate institutional mechanisms at national and local levels. The *sectoral* action reflects the way the Ministries and agencies are organized and makes it easier to identify the agency to carry out the recommended actions. The *location-specific* action focuses particularly on acute environmental problems at local levels that need to be addressed on a priority basis. The *long-term* actions include environmental degradation to such degree that might become even more serious and threatening, if cognizance is not taken immediately.

2.3.3 National Conservation Strategy, 1992

The National Conservation Strategy, 1992 provides recommendations for sustainable development of the industrial sector. The key aspects of the strategy are as follows:

- All industries shall be subject to an EIA and the adoption of pollution prevention/

control technologies shall be enforced;

- Hazardous or toxic materials / wastes shall not be imported as raw materials for industry;
- Import of appropriate and environmentally-sound technology shall be ensured; and
- Dependence on imported technology and machinery should gradually be reduced in favour of sustainable local skills and resources.

2.4 Regulatory Requirements for the Proposed Project

The Government of Bangladesh has framed various laws and regulation for protection and conservation of natural environment. These legislations with applicability to this project are summarized below in the ***Table 2-1*** below.

Table 2-1: Applicability of Key Environmental Legislation at a Glance

Name	Key Requirement	Applicability	Remarks
Acts/Rules			
Bangladesh Environmental Conservation Act, 1995 (ECA, 1995) and Environment Conservation Rules 1997 (ECR, 1997)	Mandatory requirement of prior environment clearance for certain category of project for conservation and improvement of environment and control and mitigation of pollution of the environment. Standards are described under ECR, 1997	Applicable. Project classified under red category. EIA study required to be undertaken	Site approval certificate is to be obtained from DoE prior carrying out EIA study. EIA study is carried out on basis of ToR approved by DoE.
ECA & ECR amendment 2000	To ascertain responsibility for compensation in case of damage to ecosystem		
ECA & ECR amendment 2002	Restriction on polluting automobiles, sale and production of environmental harmful items;		
Environment Court Act, 2000 and subsequent amendments in 2002	To give high priority to environment pollution prevention;	Applicable, for all projects have potential of environmental threat	All the developments to be carried it as per ECA, 1995 & ECR, 1997 and amendments. Regulatory authority is Judiciary and Ministry of Environment & Forest.

Name	Key Requirement	Applicability	Remarks
Acts/Rules			
Bangladesh Wildlife Preservation Act, 1974 and Revision 2008 (Draft)	No person shall damage or destroy any vegetation in any wild life sanctuary & the wild Animals shall not be hunted or captured. For preservation of Wildlife Sanctuaries, parks, reserves;	**Not Applicable**. Project site is not located within any wildlife sanctuary/national park or any other protected area under this act.	Development activity will not have any interface with wildlife or wild habitat at any stage. Regulatory authority is Ministry of Environment and Forest Bangladesh Wild Life Advisory Board.
The Forest Act 1927, Amendment 2000 (Protected, village Forests and Social Forestry)	Declare any forests land or waste land as protected forests. May stop public or private way or watercourse in the interest of preservation of the forest. Declare a reserved forest area as Village Forests Declare an area as Social forests or launch a social forestry programme in Govt. land or private land with permission.	**Not Applicable**. No forest land diversion is involved.	No forest land will required to be diverted.
The Private Forests Ordinance Act, 1959	Conservation of private forests and for the afforestation on wastelands;	**Not applicable**	No tree cutting will be carried out
The Penal Code	Chapter XIV of the Penal Code provides offences affective public health, safety, convenience, decency and morals; Section 277: Falling Water or Public Spring or Reservoir; Section 278: Making Atmosphere Noxious to Health; Section 284: Negligent Conduct with Respect to Poisonous Substance; Section 285: Negligent Conduct with Respect to Fire or Combustible Matter; Section 286: Negligent Conduct with Respect to Explosive	Applicable	It is required to take all the measures proposed and suggested by DoE, Bangladesh during both construction an operation phase to minimize the environmental pollution

Name	Key Requirement	Applicability	Remarks
Acts/Rules			
	Substance. Section 277: whoever voluntarily corrupts or fouls the water of any public spring or reservoir, to render it less fit for the purpose for which it is ordinarily used will be punished under the law. Section 278: whoever voluntarily vitiates the atmosphere in any place so as to make it noxious to the health of persons in general dwelling or carrying on business in the Neighborhood or passing along a public way will get punishment.		
The Protection and Conservation of Fish Act, 1950 and The Protection and Conservation of Fish Rules, 1985	Prohibit or regulate the construction, temporary or permanent of weirs, dams, bunds, embankment and other structures	applicable	The project site is located adjacent to the Brahmaputra River. And Shitalakhya and Meghna River also cover in 10 km radius study area.So there is a chance to pollute the water body
The Explosive Act, 1884	To prevent any accident due to explosive storage, use or transportation due to careless handling/management	Possibly Applicable depending on quantity of fuel storage	Fuel will be stored and used at site for running various construction machinery and equipment
Water Pollution Control Ordinance 1970	Prevention of water pollution	Applicable from the prospective of prevention of pollution	Applicable primarily during construction stage (e.g. sewage and equipment washing and maintenance liquid waste discharges at

Name	Key Requirement	Applicability	Remarks
Acts/Rules			
			construction camps)
Water Supply and Sanitation Act, 1996	Management and Control of water supply and sanitation in urban areas	Applicable for all development projects	Regulatory authority is Ministry of Local Government, Rural Development and Cooperatives
The ground Water Management Ordinance 1985	Management of Ground Water Resources; Tube well shall not be dug in any place without permission from Upazila Parishad.	Applicable, if tube wells will be dug to develop water supply system during operation phase	Permission should be taken if ground water is used, before digging tube wells
The Embankment and Drainage Act 1952	An Act to consolidate the laws relating to embankment and drainage and to make better provision for the construction, maintenance, management, removal and control of embankments and water courses for the better drainage of lands and for their protection from floods, erosion and other damage by water.	**Applicable** as Phase 1component includes drainage channnel and a retention pond to control the flood around the connecting stream	Regulatory authority Ministry of Water Resources and FCD
Wetland Protection Act 2000	Adhere to a formal environmental impact assessment (EIA) process, as set out in EIA guidelines and manuals for water sector projects or related to alteration of natural drainage. No construction of roads if likely to affect the flow of navigable water ways without clearance from concerned authority's Upland flow in water channels to preserve eco-system. Protection against degradation and resuscitation of natural water-bodies such as lakes, ponds, beels, khals, tanks, etc.	**Not Applicable**	Site is not situated at wetland area

Name	Key Requirement	Applicability	Remarks
Acts/Rules			
	affected by man-made interventions or other causes. Completely stop the filling of publicly-owned water bodies and depressions in urban areas.		
Antiquities Act 1968	Governs preservation of the national cultural heritage, protects and controls ancient monuments, regulates antiquities as well as the maintenance, conservation and restoration of protected sites and monuments, controls planning, exploration and excavation of archaeological sites	**Not applicable** as no structure of national cultural heritage will be affected due to project development	Regulatory authority is Ministry of cultural Affairs
The Building Construction Act 1952 (with amendments)	An Act to provide for the prevention of haphazard construction of building and excavation of tanks which are likely to interfere with the planning of certain areas in Bangladesh.	Applicable as the project involves development of infrastructure	Regulatory authority is Ministry of Works
The Vehicle Act, 1927 The Motor Vehicles Ordinance, 1983 The Bengal Motor Vehicle Rules, 1940	To regulate vehicular exhaust emissions	Applicable as heavy vehicle movement is involved both during construction and operation phase	Regular maintenance and up keeping of the vehicles should be carried out. Regulatory authority is Bangladesh Road Transport Authority
The Land Acquisition Act, 1894 The Acquisition and Requisition of Immovable Property Ordinance 1982 and subsequent amendments in	To provide appropriate compensation for the land acquired	Applicable: All lands shall beacquiredfor the project	Regulatory authority is Deputy Commissioner

Name	Key Requirement	Applicability	Remarks
Acts/Rules			
1994, 1995, 2004&2017			
The Factories Act, 1965 Bangladesh Labour Law, 2006	This Act pertains to the occupational rights and safety of factory workers and the provision of a comfortable work environment and reasonable working conditions.	Applicable as the workers will be employed during construction and operation phase of EZ	Regulatory authority is Ministry of labour
Policies			
National Environment Policy, 1992	For sustainable development	Applicable for all development projects	Usage of energy efficient building material, fuel etc. should be encouraged
National Environment Management Action Plan 1995	Conservation of natural habitats, bio-diversity, energy, sustainable development and improvement of life of people	Applicable for all development projects	Usage of energy efficient material, green building techniques, reduction of carbon foot prints etc.
National Conservation Strategy	Sustainable development of Industrial Sector	Applicable for all development projects	Usage of energy efficient material, green building techniques, reduction of carbon foot prints etc.
The National Forest Policy (1994)	Conserve the existing forest areas and to increase forest cover of country and increase the reserve forest.	**Not Applicable**, no diversion of forest land is involved	Not Applicable
The National Energy Policy, 1995	Protecting the environment by requiring an EIA for any new energy development project, introduction of economically viable and environment friendly technology.	**Not Applicable**. EIA study is to be carried out	Energy efficient materials and techniques should be explored
The National Water Policy, 2000	To ensure efficient and equitable management of water resources, proper harnessing and development of surface and ground water, availability of water to all concerned and	Applicable. Ground water is required to be withdrawn for fulfilling water requirement	Conjunctive use of water should be explored

Name	Key Requirement	Applicability	Remarks
Acts/Rules			
	institutional capacity building for water resource management.	during operation phase	
The National Water Management Plan, 2001	Addresses options for water quality, considerations behind measures to clean up industrial pollution, where effluent discharge monitoring and zoning regulations for new industries are emphasized.	Applicable as it is industrial project and will involve generation of effluent and sewage	Installation of effluent treatment facility within the premises

2.4.1 Environmental Clearance from DoE, Bangladesh

Bangladesh has very simple administrative framework regarding environmental aspect. It has strong interface between local government and federal Government. Department of Environment is responsible for a grant of environmental clearance to a project. In addition there are other ministries to deal with specific area of importance to the country like Forests, Water. According to the Section 12 of the Environment Conservation Act 1995 no project will be established or undertaken without obtaining permission, in the manner prescribed by the Environment Conservation Rules 1997, an Environmental Clearance Certificate from the Director General. Therefore, every development projects/industries which are specified under the Schedule–1 of the Environment Conservation Rules 1997 require obtaining site and environmental clearance from the Department of Environment. According to the Rule 7 (1) of the Environment Conservation Rules 1997; for the purpose of issuance of Environmental Clearance Certificate (ECC), every projects, in consideration of their site and impact on the environment and will be classified into the four categories, i.e. green, orange A, orange B and red. Development of on-site facilities for economic zones will fall under the Red category. Thus EIA study is required to be carried out for the project. The present EIA study has been conducted for the proposed project complying with the approved ToR issued vide Memo No. 22.02.0000.018.72.003.17/334 dated 21stJune 2017. Focus groups and stakeholder consultations have also been conducted to discuss the environmental issues associated with the project. Proceedings of stakeholder consultation have also been included in the report. A schematic representation of the various steps involved in obtaining the Environment Clearance certificate from DoE for Red category projects is given in below.

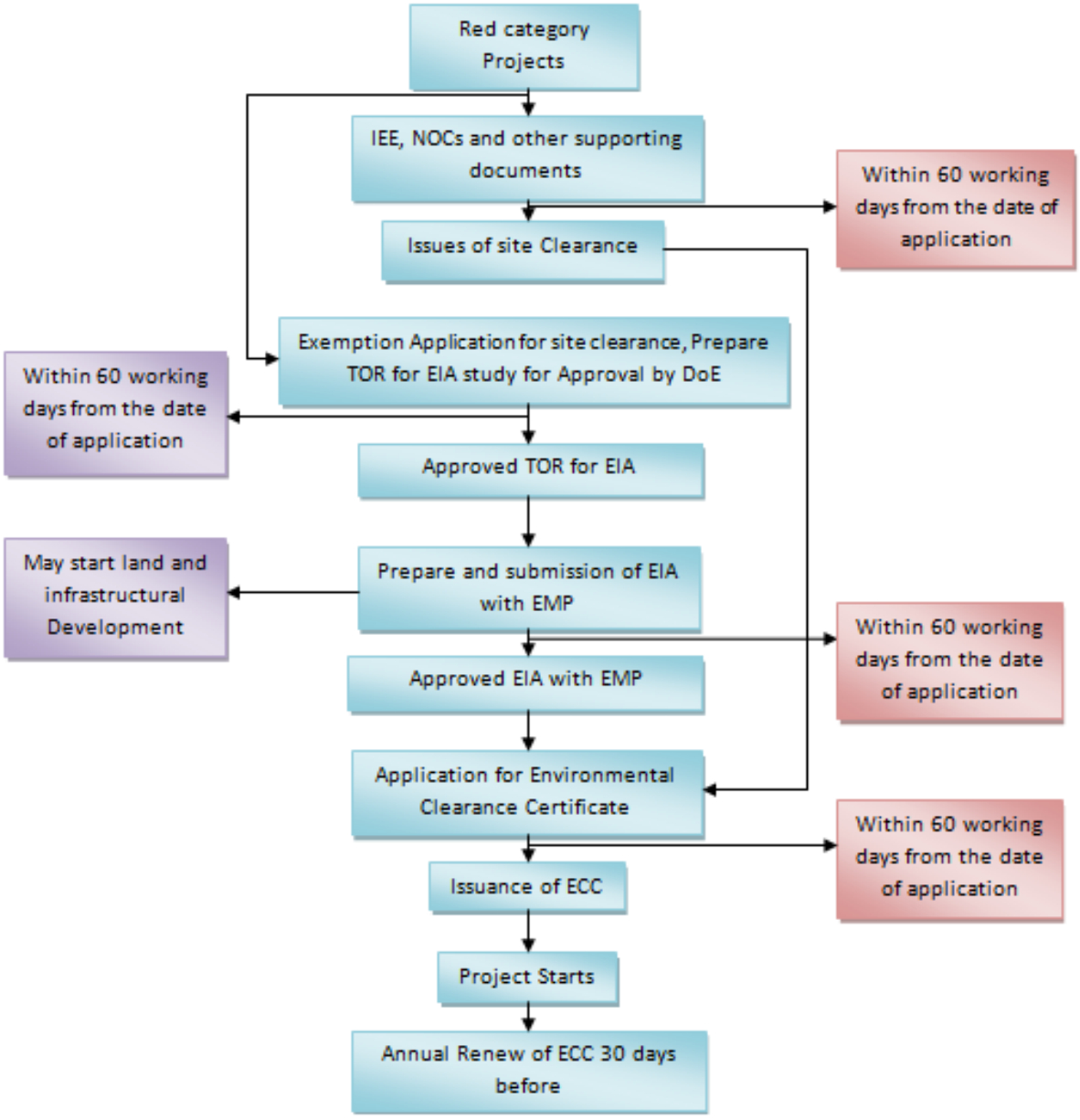


Figure 2-1: Steps for Obtaining Environment Clearance from DoE

2.4.2 Bangladesh Natural Gas Safety Rules (1991)

The *Mineral Gas Safety Rules* are derived mainly from the American Society of Mechanical Engineers (ASME), American National Standard Institute (ANSI) and British Standards (BS) codes and practices, as well as the provisions of the *Petroleum Act*. The Rules deal with the design and construction of gas pipelines in areas including:

- Selection of materials;
- Specifications for pipeline crossings of other infrastructure such as railways;
- Testing and commissioning of pipelines;

- Pipeline operation and maintenance; and
- Reporting of accidents.

The Rules are largely prescriptive and include stipulations as to the separation distances between pipelines and public properties and thoroughfares. The provisions of the rules have been updated most recently through an amendment which was gazette in 2003.

In section 31 of the rules stated for the gas pipeline safety. The following safety distances from protected works shall be maintained for all high-pressure pipelines to be operated above 10 kg/cm^2.

Outside diameter of pipe, cm	Maximum allowable working pressure, kg/cm^2				
	10 to 14	15 to 24	25 to 36	37 to 50	51 and above
	Safest distance (meter)				
Not exceeding 10	3.0	4.0	5.0	7.0	7.5
11-20	6.0	8.0	10.0	13.0	14.0
21-40	6.5	8.5	10.5	13.5	14.5
41-60	7.0	9.0	11.0	14.0	15.0
61-80	7.5	9.5	11.5	14.5	16.0
81 and above	8.0	10.0	12.0	15.0	17.0

The chief inspector may relax the safety distances under sub-rule (1) upon a request from the operator subject to observance of safety measure as per rule 39(1).

The BEZA should have to follow the above mentioned safer distance as per the rules to build any structure or consult with respective authority for their consent.

2.4.3 The Electricity Act 1910

The Electricity Act was enacted in 1910 to amend the laws relating to the supply & use of electrical energy. Under this act, any person can get a license to supply energy and to lie down or place electric supply lines for the conveyance and transmission of energy. The licensee can open and break up the soil and pavement of any street, railway or tramway and can lay down any line or do other work near other utility services (like gas, T&T, water, Sewer, etc.), provided that prior permission is taken from the respective authority, as stated in section 12 – 18 of this Act.

According to section 19 (1) of this Act, the licensee shall make full compensation for any damage, detriment or inconvenience caused by him or by anyone employed by him.

2.4.4 Electricity Rules 1937

The subsection (1) of Section 52 of the Electricity Rules, 1937 advise that the licensee should take precautions to lay down electric supply lines near or where any metallic substance or line cross.

The subsection (1) of Section 52 of the Electricity Rules, 1937 demonstrated that Where an aerial line is on a consumer's or an owner's premises, the height of every conductor from any mineral or refuses dump and from parts of buildings or structures to which persons have access shall, unless the conductors are adequately guarded, be not less than ***15 feet*** or such greater heights as may be necessary to prevent danger.

2.4.5 Electricity Grid Code 2012

Electricity grid code depicted that the following minimum safety working clearances shall be maintained for the bare conductors or live parts of any apparatus in outdoor substations, excluding overhead lines, of medium, high and extra-high voltage installations:-

System Voltage (kV)	Safety Working Clearance (Meter)
11	2.6
33	2.8
66	3.1
132	3.7
230	4.3
400	6.4
800	10.3

As there is a 230 kV transmission line passes through the proposed project area so above mention safety distance will be applicable for AEZ.

2.4.6 National 3R (Reduce, Recycle, and Reuse) Strategy for Waste Management

The National 3R Strategy for waste management has been established by Department of Environment on December, 2010. Sector specific strategies for promotion of 3R are depicted in this national 3R strategy.

The national 3R goal for waste management is achieve complete elimination of waste disposal on open dumps, rivers, flood plains by 2015 and promote recycling of waste through mandatory segregation of waste at source as well as create a market for recycled products and provide incentives for recycling of waste.

The main objective of this 3R strategy is to delineate ways and means of achieving national 3R goals through providing a uniform guideline for all stakeholders. Specific objectives of this strategy are to:

- address the key issues and challenges of waste management acting as a barrier for promotion of 3R in the country ;
- define the roles of various actors to promote 3R in the country; and

- Guide the creation of enabling conditions for success regarding implementation of 3R in the country.

During construction and operation of proposed Araihazar Economic Zone will generate solid waste so the national 3R strategy for waste management should be followed by the BEZA.

2.4.7 Land Acquisition of Private Land

The current legislations governing land acquisition in Bangladesh is the Acquisition and Requisition of Immovable Property Ordinance 1982 (hereinafter, "the Ordinance") and subsequent amendments (1989, 1993, 1994, 2004, 2009, 2011& 2017). The Ordinance provides certain safeguards for landowners and has provisions for payment of 'fair value' for the property acquired. Besides, the 1994 amendment made provisions for payment of crop compensation to tenant cultivators. However, it does not cover project-affected persons without titles or ownership record, such as informal settler/squatters, occupiers and informal tenants and lease-holders (without document) and does not ensure replacement value of the property acquired. It does not permit the affected persons to take the salvageable materials for which compensation have been paid by the Deputy Commissioner (DC). It has no provision of resettlement assistance and transitional allowances for restoration of livelihood of livelihoods of the non-titled affected persons. The ordinance (2009) made provision to refuge the compensation by the authority to those households or individual who constructed or will construct any structure with mal fid intention to get compensation.

In all cases, the DC determines (i) market value of acquired assets on the date of notice of acquisition (based on the registered value of similar property bought and/or sold in crops)due to compulsory acquisition. The DC payments or "awarded" to owners is called Cash Compensation under Law (CCL). The value thus paid is invariably less than the "market value" as owners customarily report undervalued land transaction prices in order to pay lower stamp duty and registration fees. As a result, compensation for land paid by DC, including premium, remains less than the real market price or Replacement Value (RV).

Khas (Government owned) lands should be acquired first when a Project acquires both khas (public) and private land. If a Project acquires only khas, the land will be transferred through an inter- ministerial meeting following the preparation of acquisition proposal submitted to DC /MOL. Places of worship, graveyard and cremation grounds are not to be acquired for any purpose.

The DC processes land acquisition under the Ordinance and pays compensation to thelegal owners. There is provision for Arbitration Appellate Tribunal on compensation assessment by the DC, but the law allows only 10 percent enhancements on the DC "award."Of the acquired land, the Ministry of Lands (MOL) is authorized to deal with land acquisition through the DCs.

2.5 International Treaties

Bangladesh has signed most international treaties, conventions and protocols on environmental protection. ***Table 2-2*** shows relevant international treaties, conventions and protocols signed by Bangladesh.

Table 2-2: Relevant International treaties, conventions and protocols signed by Bangladesh

Treaty or Convention	In	Brief Description	Responsible Agency
International Convention for Protection of Birds, Paris	1950	Protection of birds in wild state	Department of Environment/ Department of Fisheries
International Plant Protection Convention, Rome	1951	To secure coordinated, effective action to prevent and to control the introduction and spread of pests of plants and plant products	Department of Environment
International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, Brussels	1969	Civil liability on oil pollution damage from ships	Department of Environment/ Ministry of Shipping
Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention), Ramsar	1971	Protection of wetlands	Department of Environment/ Department of Fisheries
Convention Concerning the Protection of the World Cultural and natural Heritage, Paris	1972	Protection of major cultural and natural monuments	Department of Archaeology
Convention on International Trade in Endangered Species of Wild Fauna and flora (CITES), Washington	1973	Ban and restrictions on international trade in endangered species of wild fauna and flora	Department of Environment/ Department of Fisheries
Convention Concerning the Prevention and Control of Occupational Hazards caused by Carcinogenic Substances and Agents, Geneva	1979	Conservation of migratory species of wild animals	Department of Environment/ Department of Fisheries
Convention Concerning the Protection of Workers Against Occupational	1974	Protect workers against occupational exposure to carcinogenic substances	Ministry of Health and Family Welfare

Treaty or Convention	In	Brief Description	Responsible Agency
Hazards in the Working Environment due to Air Pollution, Noise and Vibration, Geneva		and agents	
Convention on the Conservation of Migratory Species of Wild Animals, Bonn	1977	Protect workers against occupational hazards in the working environment	Ministry of Health and Family Welfare
Convention Concerning Occupational Safety and Health and the Working Environment, Geneva	1981	Prevent accidents and injury to health by minimizing hazards in the working environment	Ministry of Health and Family Welfare
Convention Concerning Occupational Health Services, Geneva	1985	To promote a safe and healthy working environment	Ministry of Health and Family Welfare
Vienna Convention for the Protection of the Ozone Layer, Vienna	1985	Protection of ozone layer	Department of Environment/Ministry of Environment and Forest
Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal, Basel	1989	Safe methods for transport of dangerous goods by road, railway and inland vessels	Ministry of Communication
International Convention on Oil Pollution Preparedness, Response and Cooperation, London	1990	Legal framework and preparedness for control of oil pollution	Department of Environment/ Ministry of Shipping
London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, London	1990	Control of global emissions that deplete ozone layer	Department of Environment/ Ministry of Environment and Forest
United Nations Framework Convention on Climate Change (UNFCCC), New York	1992	Regulation of greenhouse gases emissions	Department of Environment/Ministry of Environment and Forest
Convention on Biological Diversity (CBD), Rio De Janeiro	1992	Conservation of bio-diversity, sustainable use of its components and access to genetic resources	Department of Environment/ Ministry of Environment and Forest

Treaty or Convention	In	Brief Description	Responsible Agency
Kyoto Protocol to the United Nations Framework Convention on Climate Change, Kyoto	1997	International treaty on climate change and emission of greenhouse gases	Department of Environment/ Ministry of Environment and Forest
Cartagena Protocol on Biosafety to the Convention on Biological Diversity, Montreal	2000	Biological safety in transport and use of genetically modified organisms	Department of Environment/ Ministry of Environment and Forest
Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity	2010	Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity	Minister for Environment and Forests of Bangladesh
Paris Climate Agreement	2015	Climate Change	Minister for Environment and Forests of Bangladesh

2.6 JICA Guidelines

2.6.1 Overview of Guidelines

The Guidelines for Environmental and Social Considerations (JICA 2010) define the overarching framework for environmental management on the Economic Zone project. In those Guidelines, JICA sets out the international imperative for environmental management and social equity as applied to technical cooperation, loan and grant aid projects; and formulation and adoption of guidelines via committee and public consensus, in keeping with those of other multilateral and bilateral development agencies. JICA's policy is set out in the Guidelines: to "take steps to assure fairness," to attend "to factors such as environmental and social impacts on developing countries," and "inclusion of environmental and social costs in development costs [by means of a] social and institutional framework" that ensures "stakeholder participation, information transparency, accountability, and efficiency."

JICA guidelines support environmental impact assessment (EIA) that incorporates social assessment on a par with environmental assessment. JICA identifies seven principles to guide the assessment process:

1) A wide range of impacts must be addressed
2) Measures for environmental and social considerations must be implemented from an early stage to a monitoring stage
3) JICA is responsible for accountability when implementing cooperation projects
4) JICA asks stakeholders for their participation
5) JICA discloses information

6) JICA enhances organizational capacity
7) JICA makes serious attempts at promptness

JICA confirms an approach consistent with "the laws or standards related to the environment and local communities in the central and local governments of host countries" and "that projects do not deviate significantly from the World Bank's Safeguard Policies." JICA categorizes projects in a way that does not materially differ from the methods of other international and national agencies. Category A projects are those that, among other criteria, are found in sensitive sectors, which includes "Industry." JICA lists a number of environmental considerations to be assessed through EIA, with additional emphasis on "social impacts, including migration of population and involuntary resettlement, local economy such as employment and livelihood, utilization of land and local resources, social institutions such as social capital and local decision-making institutions, existing social infrastructures and services, vulnerable social groups such as poor and indigenous peoples, equality of benefits and losses and equality in the development process, gender, children's rights, cultural heritage, local conflicts of interest, infectious diseases such as HIV/AIDS, and working conditions including occupational safety."

Degrees of uncertainty and absences of information are taken into consideration in the JICA Guidelines. JICA recognizes the integrated role of EIA in the process of project development through preparatory survey, project formulation, classification and disclosure. Details of requirements for consideration in the EIA are provided in Appendix 1 of the Guidelines, including "multiple alternatives examined in order to avoid or minimize adverse impacts," "appropriate follow-up plans and systems, such as monitoring plans and environmental management plans prepared," "impacts on human health and safety, as well as on the natural environment," and "derivative, secondary, and cumulative impacts." Further, "Projects must be adequately coordinated so that they are accepted in a manner that is socially appropriate to the country and locality in which they are planned. For projects with a potentially large environmental impact, sufficient consultations with local stakeholders, such as local residents, must be conducted via disclosure of information at an early stage, at which time alternatives for project plans may be examined. The outcome of such consultations must be incorporated into the contents of project plan," and "Appropriate consideration must be given to vulnerable social groups, such as women, children, the elderly, the poor and ethnic minorities."

Monitoring is a key feature of the Guidelines and JICA sets out that "after projects begin, project proponents etc. monitor whether any unforeseeable situations occur and whether the performance and effectiveness of mitigation measures are consistent with the assessment's prediction. They then take appropriate measures based on the results of such monitoring."

The content and main elements for EIA Reports are provided in Appendix 2 of the Guidelines, which are consistent with the World Bank Operational Policy – OP4.01, Annex B. The JICA Guidelines are comprehensive and practical; this cursory review does not cover all aspects.

Further details on the JICA Guidelines can be obtained by consulting the Guidelines themselves.

2.6.2 JICA Involuntary Resettlement Policy

The key principle of JICA policies on involuntary resettlement is summarized below.

1) Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.
2) When, after such an examination, avoidance is proved unfeasible, effective measures to minimize impact and to compensate for losses must be agreed upon with the people who will be affected.
3) People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.
4) Compensation must be based on the full replacement cost[1] as much as possible.
5) Compensation and other kinds of assistance must be provided prior to displacement.
6) For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy, OP 4.12, Annex A.
7) In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.
8) Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.
9) Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.

Description of "replacement cost" is as follows.

Land	Agricultural Land	The pre-project or pre-displacement, whichever is higher, market value of land of equal productive potential or use located in the vicinity of the affected land, plus the cost of preparing the land to levels similar to those of the affected land, plus the cost of any registration and transfer taxes.
	Land in Urban Areas	The pre-displacement market value of land of equal size and use, with similar or improved public infrastructure facilities and services and located in the vicinity of the affected land, plus the cost of any registration and transfer taxes.
Structure	Houses and Other Structures	The market cost of the materials to build a replacement structure with an area and quality similar or better than those of the affected structure, or to repair any partially affected structure, plus the cost of transporting building materials to the construction site, plus the cost of any labor and contractors' fees, plus the cost of any registration and transfer taxes;

The above principles are sanctioned by the World Bank's OP 4.12, since it is stated in the JICA Guideline that "JICA confirms that projects do not deviate significantly from the World Bank's Safeguard Policies." Additional key principles based on World Bank OP 4.12 are as follows:

1) Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits;

2) Eligibility of Benefits include, the PAPs who have formal legal rights to the land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census information collection but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying;

3) Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based;

4) Provide support for the transition period (between displacement and livelihood restoration;

5) Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities, etc;

6) For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, an abbreviated resettlement plan is to be prepared.

In addition to the above core principles of the JICA policy, it also laid emphasis on a detailed resettlement policy inclusive of all the above points; project specific resettlement plan; institutional framework for implementation; monitoring and evaluation mechanism; time schedule for implementation; and, detailed Financial Plan etc.

Gap between Bangladeshi Legal Frameworks and JICA Policies:

To be competed based on the ongoing process of land acquisition discussion between relevant authorities and BEZA.

Table 2-3: Summary of gaps between the Bangladeshi Legal Framework and the JICA Environmental Guidelines

Sl.	JICA Environmental and Social Considerations Guidelines (JICA Guidelines)	Laws of Bangladesh	Gaps between JICA Guidelines and Laws of Bangladesh
1.	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.	Not specified	The 1982 ordinance legislated nothing, while the JICA guidelines require to avoid/ minimize resettlement/ loss of livelihood
2.	When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken.	Not specified for non-titled people	There are no provisions for compensation to the non-titled residents in Bangladesh ordinance, while JICA guidelines acknowledge all affected persons whether legally residing or not, eligible for compensation
3.	People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.	Not specified for keeping living standard of affected people the same or above pre-project levels.	There are no provisions for maintaining the living standards of affected people at the same or above pre-project levels in Bangladesh ordinance, while JICA guidelines require that no one is worse off as a result of resettlement and would maintain their living level at original levels at least.
4.	Compensation must be based on the full replacement cost as much as possible.	Compensation is made based on the pre-determined government prices as	Compensation is made based on the pre-determined government prices that are usually

Sl.	JICA Environmental and Social Considerations Guidelines (JICA Guidelines)	Laws of Bangladesh	Gaps between JICA Guidelines and Laws of Bangladesh
		are usually quite cheaper than market prices	lower than replacement cost.
5.	Compensation and other kinds of assistance must be provided prior to displacement.	Payment is made on predetermined time, regardless before or after the construction starts	Compensations and other assistances are made regardless before or after construction, while JICA guidelines requires to make it prior to relocation
6.	For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public.	There is no provision for the formulation of RAP and public hearing. Deputy Commissioner contacts to land owner through Land Acquisition Officer (LAO), and if land owner has no objection, confirmation operation for compensation amount etc. will be proceeded	There is no provision for preparation of resettlement action plan that describes all features of resettlement requirements and ready to disclose to the public.
7.	In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance.	The 1982 Ordinance have provisions to notify the owners of property to be acquired.	There is no provision in the law for consulting the stakeholders but the land allocation committees at district, division, and central government level.
8.	When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.	No description	Requirements of JICA guidelines are not specifically mentioned in the Bangladesh laws and rules.
9.	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.	There is no provision for the monitoring related activities with the participation of affected people.	There is no provision in Bangladesh ordinances, while JICA guidelines recommend participation of affected people in planning, Implementation, and

Sl.	JICA Environmental and Social Considerations Guidelines (JICA Guidelines)	Laws of Bangladesh	Gaps between JICA Guidelines and Laws of Bangladesh
			monitoring of RAP.
10.	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.	Incase AP has any objection to the compensation amount, the AP should protest and entrust the matter to the Arbitrator. If AP has any appeal against the Arbitrator's decision, then AP should file a law suit to the court and wait for the sentence.	The laws of Bangladesh states appeal to Arbitrator and court case, while JICA guideline recommends establishing appropriate grievance mechanism for amicable settlement to minimize legal confrontation.
11.	Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including a population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits.	No such an activity required	There is no provision in Bangladesh ordinances, while JICA guidelines recommends identification of affected people the earliest possible time preferably at the project identification stage
12.	Eligibility for benefits includes, the Project Affected Persons (PAPs) who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of any census but have a claim to such land or assets and the PAPs who have no recognizable legal right		

Sl.	JICA Environmental and Social Considerations Guidelines (JICA Guidelines)	Laws of Bangladesh	Gaps between JICA Guidelines and Laws of Bangladesh
	to the land they are occupying.		
13.	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based.		
14.	Provide support for the transition period (between displacement and livelihood restoration).	There is no provision for support for the transition period.	There is no provision in Bangladesh ordinances, while JICA guidelines require providing support for the transition period
15.	Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc.	There are no provisions for either acknowledgement of or compensation to vulnerable groups	There are no provision in Bangladesh ordinances, while JICA guidelines require providing special attention to vulnerable people and groups.

CHAPTER 3

3. DESCRIPTION OF THE PROJECT

3.1 Introduction

The Government of Bangladesh (hereinafter referred to as GoB) has declared in its vision 2021 development plan that; Bangladesh would become a middle-income nation by 2021, and is promoting its industrialization policy with medium- to long-term goals. By identifying the policy for attracting FDI as one of its chief priorities, the GoB has been working on the development of an Economic Zone (EZ) at Araihazar Upazila. These efforts have been coupled with the further promotion and diversification of exports, as well as the improvement of infrastructure such as electricity, ports, roads and railroads. In 2010, the Bangladesh Economic Zone Act was enacted and the direction of EZ development in Bangladesh was outlined, while at the same time the Bangladesh Economic Zone Authority (BEZA) was established. Although BEZA has been promoting EZ development with the support of the World Bank and other institutions since 2012,Under these circumstances, the government of Bangladesh has requested the government of Japan to provide Yen loan for "the Foreign Direct Investment Promotion Project (hereinafter FDIPP)" in order to establish a new EZ mainly targeting Japanese companies and to further facilitate investments from Japan. The loan agreement for FDIPP was already signed in December 2015. The loan is expected to provide both short term and mid to long term low-interest financing for operation and capital investment of the EZ.

To ensure the successful implementation of FDIPP, JICA will implement a new survey project, "**Special Assistance for Project Implementation under Foreign Direct Investment Promotion Project** (hereinafter the survey)"at Araihazar. A Japanese Survey Team (hereinafter JST) who has been selected by JICA in June 2017 will conduct the survey with corporation with local consultants and engineers.

The proposed Araihazar Economic Zone (AEZ) site is located at Satgram & Duptara Union, under Araihazar Upazila which is adjacent to the Dhaka– Sylhet highway. The total land of Araihazar Economic Zone (AEZ) is approximately 218.84 ha or 540.77 acres for 1st phase. Upon completion, AEZ is envisaged to create approximately 10,000 jobs when fully occupied by investors.

The proposed project involves development of economic zone and associated off-site facilities for the upcoming Araihazar Economic Zone. At present both economic zone and off-site facilities will be constructed. The economic zone and off-site development will include the following:

The basic infrastructure

1. Internal Roads,
2. Storm water drainage system and a detention pond,

3. Water supply from deep wells or surface water will be selectedto supply with water tower and water supply pipeline,
4. Waste water pipeline & waste-water treatment plant,

Other facilities and Buildings

1. Gate/Security Guards booth,
2. Administration & OSS building with Garden/Pond,
3. Access Road: Garden/walkway/parking,
4. Rental Multi-story Factory
5. Housing & Commercial Development

The total area of the upcoming AEZ is about 218.84 ha or 540.77acres. EZ can have following components as per EZ Act, 2010:

- **Export Processing Zone:** Specified for Export-oriented industries;
- **Domestic processing area:** Specified for industries to be established to meet the demand of domestic market;
- **Commercial area:** Specified for business organization, banks, warehouses, offices or any other organization;
- **Non-processing area:** Specified for residence, health, education, amusements etc;

The developer will carry out EZ development at later stage. As per the planning, industries like Textile garment, Textile Accessary, Motorcycle Assembly, Automobile Assembly, Metal, Nonferrous Metal, Electronics, Machinery Parts, General Assembly, Plastic Processing, Agriculture and food Processing, Pharmaceuticals industry will come up within EZ. According to the ECR 1997, developer before development of EZ will carry out a separate detailed Environment Impact Assessment study.

3.2 Project Objective and Options

The project is aimed to develop economic zone of international standards. The EIA study is also being undertaken with the intent of integrating best environmental management practices in the project design.

BEZA is the agency responsible for establishment of EZ in the potential areas of Bangladesh including the backward and undeveloped regions. This area has been identified considering factors such as land use, land ownership, accessibility & connectivity, linkage to economically important towns/cities, infrastructure availability and engineering, environmental and social feasibility of the site.

This proposed land site is private own land. The proposed land site does not lie within any city Corporation, Municipality and Cantonment Board Area as per requirement of sub-section 3 of section 5 of Economic Zone Act, 2010.

The following table shows the project description for finally selected project sites of "Araihazar

EZ.

As the Infrastructure Development Plan for the Surrounding Area of Araihazar, the following terms are thought to be the works of the Government of Bangladesh (GOB: EZ implementing agency).

1. Access road connecting the EZ candidate site and the nearby national highways;
2. Gas supply piping;
3. Provision of land used for middle voltage to low voltage substation facilities as for power supply;
4. Provision of land used for logistic center facilities inside the EZ site.

3.3 Project Description

3.3.1 Project Components

Table 3-1: Summary of Project

Araihazar Economic Zone	
Location and district	Union: Satgram & Duptara, Upazila: Araihazar, District:Narayanganj
Mouza	Panchrukhi, Panchgaog
Development area	Phase-1 development: 218.84ha or 540.77 acres
Landuse	Farmland, double cropping
Site preparation	Embankment: 0.6- 2.6m (Avg.1.6m),Land elevation: Approx.6-m above MSL, Flood water level due to rivers ofShitalakhya and Meghna: Approx.7.52m (1/100),Elevation of landpreparation: 8.6m
Environmental and social conditions	Need resettlement of houses and peoples; No precious ecology and cultural heritages sites exist
Development Concept and Advantages	Development concept of the Project focuses a Multiple Export-oriented EZ but domestic-market oriented industries shall also be of interest to pursue. The EZ shall be developed as a competitive EZ against the similar facilities in the neighboring countries and equipped with a full line of the infrastructure of global standard, competitive business environment, highest investors satisfaction by One-stop-services (OSS), due consideration to environment and society, and low-cost operations.
Industries to be promoted	Agriculture/food processing industry, Plastic and Rubber Products, RMG/ apparels, Wooden Products, Knitting and Textile, Yarn, Spinning, Jute and Jute Goods Materials, Pharmaceutical and Healthcare Goods, Footwear and Leather Goods, Bi-cycle, Automobile/Motor cycle parts, Electrical and Electronics, Garments Accessories and Light Engineering industry
Road	**Access road** The access road is planned directly connecting from the national

	highway No.2 (Dhaka-Sylhet Expressway) to the Araihazar EZ with approximate length of 400 m. Access roads are designed with two lanes on each side including a median strip, sidewalks and space for utilities (gas transmission, telecommunication, etc.). They also have space for parking areas for container trucks under entry permission procedure and commuting vehicles near the EZ entrance gate. **Internal roads** Inside the Economic Zone, a road starting at the gate and passing through the center of EZ will be the internal main road and will have four lanes. And the internal roads from the main road to each block will have 2 lanes. All internal roads will be planned to ensure width of 2.5m as the shoulders on their sidewalk sides so that accidents and trucks etc. parking while waiting will not obstruct traffic.
Canal	Rainwater drainage ditches will be located on both sides of internal roads and will drain rainwater to the canal located along the 60m main road. The total area of the main planned site is about 189.52 ha.The flow rate to be carried downstream is the 50-year return period rainfall, and the concentration time from the furthest location for the completed 200ha plan is hypothesized to be1 hour, and the rainfall intensity is calculated as about 100mm/hour. The planned flow rate is about 33.3m^3/s. The flow capacity of the planned canal is, assuming the roughness coefficient is 0.035 and the water surface gradient is 0.02%, about 33.3m^3/s when the water depth is 3.6m (if the canal bottom elevation is considered to be 2.5m, water surface elevation of 6.1m), and it can carry the planned flow rate.
Retention Pond	In the land use plan, the retention pond use land is planned as 18.55 ha. It will be located at the terminal of the canal, and it will have storage functions enabling it to perform the function, preventing the impact of the change of the runoff rate accompanying land preparation, and part of the pump drainage functions during flooding. If the water level outside the surrounding level is nearly 5m, discharge by natural flow will be difficult, so the gate of the surrounding level will be closed and the system switched over to pump drainage. The study of pump capacity assumed the scale able to withstand 115mm/3hours of the largest past rainfall of July 18, 2005.
Utilities	**Power distribution line:** On-site developer will prepare on-site power distribution plan. Interface between On-site and Off-site is external cable terminals at 11kV Switchgears in Substation in Off-site because jointing of 11kV

	cables in On-site area is not recommendable from electrical safety/maintenance point of view. **Water/Sewage Pipe:** The water supply facility will be close to N2 so that construction is possible from the first stage at a location where it is expected to supply water to the future expanded area. Araihazar water supply facility data is given below PVC Water-supply Pipes – 200 mm dia. - 2,300 m PVC Water-supply Pipes – 150 mm dia. - 9,400 m PVC Water-supply Pipes – 100 mm dia. - 2,400 m High pressure PVC Pipes, for hydrant – 100 mm dia.- 12,500 m **Gas Distribution Pipeline:** In the EZ, gas supply facility use land will be ensured adjoining the wastewater treatment facility use land. And use in the EZ is predicted to be general use rather than industrial use or power generation use, so gas will be supplied in 75mm diameter pipes. **Communication services:** At Araihazar EZ, communication services will be provided by installing wire (optical fiber etc.) feed cables to provide services under contracts completed by each attracted enterprise with local service providers. The wires will be installed on electric power supply poles or in underground communication line use conduits following consultations with EZ management. The largest PSTN in Bangladesh is the Bangladesh Telecommunication Company Ltd. Mobile phone operators, which in this region include Grameen Phone, Teletalk, Robi Axiata, Banglalink, supply internet communication and call services. As for IPTSP (Internet Protocol Telephony Service Provider), more than 40 companies supply internet communication services. They offer both high-speed internet communication services and IP call services.
Water supply	**Quantity of Water Supplied** The predicted attracted industries are assumed to be mainly manufacturing industries that use relatively little water, assembling and sewing for example, and the basic unit of the quantity of water used is considered to be 35m^3/day/ha for the total development area. And the total quantity is 7,000 m^3/day for the initial 189.52 ha development. In fact, the area of factory use land will be about 145 ha, so it is about 45.74 m^3/ day/ha. **Supplying water to fire hydrants** Assuming that one fire hydrant will cover an area with a radius of about 100m, fire hydrants will be installed at intervals of about 150m. **Water supply facility** The water storage tank scale will be equivalent to one day's requirement of 7,000 m^3. An elevated water tank will ensure capacity for about 1 hour.

Sewage Treatment Plant (On site infra.)	Living wastewater of each tenant factory (kitchen and toilet wastewater) is treated by the central processing facility in the EZ candidate site. Industry wastewater from each tenant factory should be processed to an acceptable drainage level at each plant.
Industrial Waste Treatment	Processing by contract with the outsourcing of waste disposal company with improvement of local government policies
Project Cost	**USD 145 ,883, 747/ BDT 12,105,433,326**

3.4 Interventions under selected options and project activities

Araihazar Economic Zone (AEZ) site has been selected for development of economic zone. Scope of the proposed project is to develop off-site facilities for upcoming EZ zone.

These EZ facilities will be developed by BEZA. The EZ area will be developed by prospective developer who will also undertake detailed planning for the same. Proposed off-site facilities will help in improving the infrastructure of the area and will attract developers. Proposed interventions at the selected site are given below

1. Access Road
2. Administrative & Residential building
3. Industrial Plot
4. Rental Factory
5. Warehouse Zone
6. Solid waste treatment plan
7. Treatment Plant (Water supply & Waste Water)
8. Power Plant & sub-station
9. Pump House
10. Retention canal
11. Green Zone
12. External water supply system
13. External gas supply to the project site

Total area of selected site is 218.84 ha or 540.77acres. Dhaka-Sylhet Highway is located adjacent to the project area. A green buffer of 3.5 m all around the EZ site will be developed to protect the EZ and also direct exposure to industrial units.

3.5 Project Activities

Total area of the proposed EZ is approximately 218.84 ha or 540.77acres. Details of the project activities are given in below ***Table 3-2***.

Table 3-2: Project activities during pre-construction, construction and operation stage

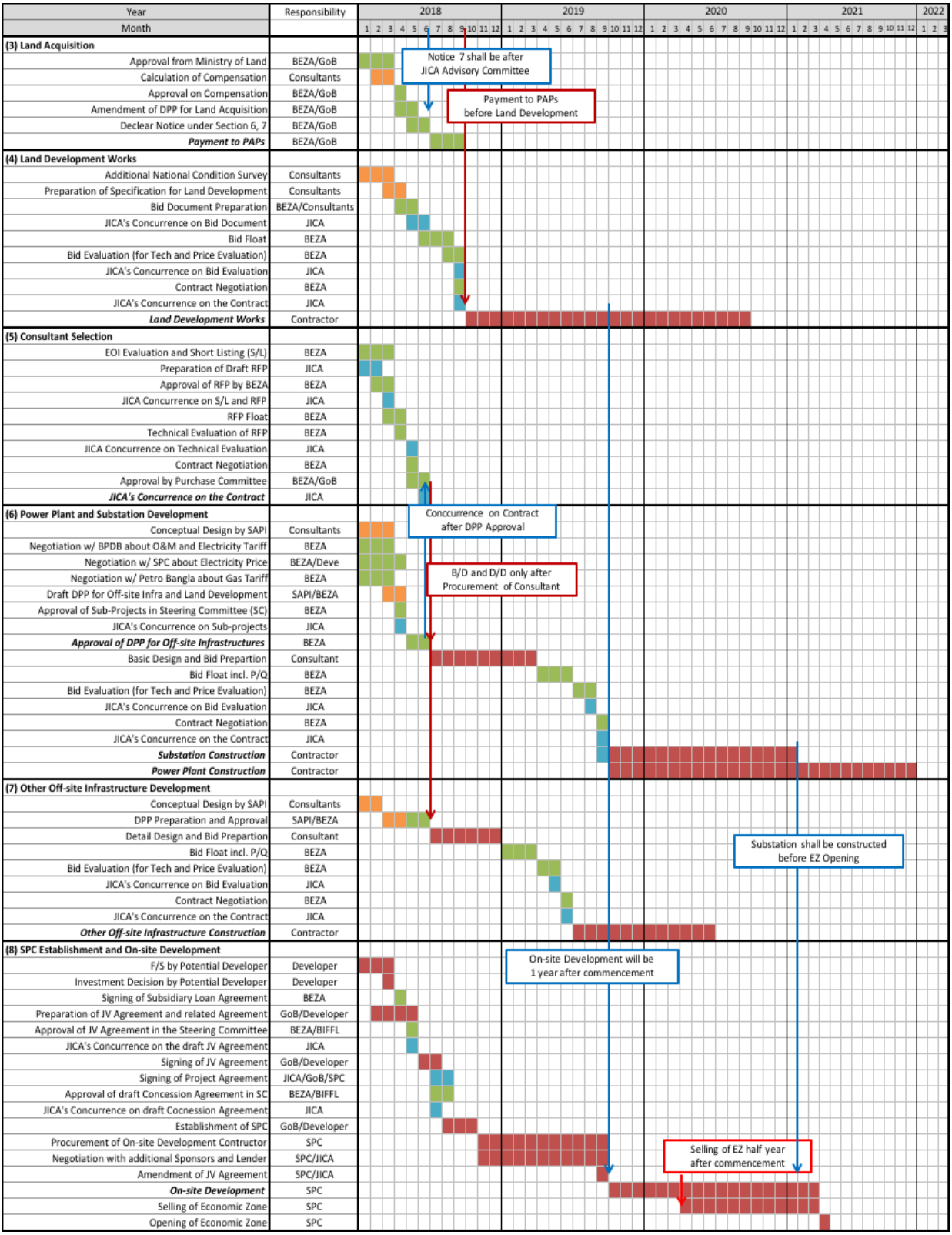
Activities	Unit	Quantity
Pre-construction stage		
1. Temporary Works & Mobilization & Demobilization	I.s	2
2. Land Filling	m^3	7,960,000

Activities	Unit	Quantity
Construction stage		
Civil Works		
1. Access Road Construction	m^3	36,000
2. Access Road Utilities	L.S	2
3. Road Construction	m^2	122,640
4. Boundary Canal Construction	m^3	70,000
5. Storm Water Drainage	m	22,640
6. A Retention Pond	m^2	98,900
7. Boundary Fence	m	15,500
8. Land Scarping	m^2	328,240
Utility Work		
1. Central Effluent Treatment Plant	ton	6,000
2. Sewerage Piping	m	21,260
3. Fresh Water and Fire Water Piping	m	27,880
4. Electric Power Distribution and Poles	m	22,340
5. Power Sub Station	MW	50
6. Water Treatment Reservoir Tank	ton	7,000
7. Water Elevated Tank	ton	300
8. Road Lighting	Nos.	1500
Building Works		
• EZ Administration Office	m^2	2,700
• Common Buildings	m^2	1,600
• Utility Maintenance Shop and office	-	600
• Rental Factories	m^2	40,000
• Security Gatehouse	m^2	200
Operation stage		
1. Selection of Logistic Company/Common Utility's Operator / Negotiation ofElectric Company	-	-
2. Establish of SPC	-	-
3. Factory Inviting (Marketing)	-	-
4. Start of Factory Construction	-	-
5. Establishment of EZ Organization	-	-
6. Management Training / Operation	-	-

Source: JICA Feasibility Report

3.6 Project Schedule

The foreign direct investment (FDI) is indispensable in order to achieve the economic growth of Bangladesh. This project is aimed pushing that the EZ development could be urgent tasks to be accepted the foreign factory's investment as the FDI. BEZA is an implementation agency of EZ. The implementation schedule including construction schedule for the Araihazar for Phase I project is shown in below ***Figure 3-1***.



Source: JICA Feasibility Report

Figure 3-1: Project Schedule of Araihazar Economic Zone

3.7 Planning for Economic Zone Development

The off-site facilities as planned by the BEZA to be carried out for Araihazar Economic Zone are given below:

- Construction of Administration building
- Site Preparation which includes
  - Land filling of 540.77 acres
  - Construction of walls for 540.77 acres all around the boundary
  - Access road
  - Plan for power generation, transmission and distribution
  - Telecommunication plan
  - Gas supply plan
  - Construction of retention pond, retention canal, and pump house
  - Plan for roads in the surrounding area
  - Drainage channels and a retention pond for controlled drainage discharge

A Developer will be appointed as per the guidelines mentioned in EZ Act, 2010. Preliminary planning has been made for the economic zone on the basis of market and feasibility study. The following industries are planned to be proposed for the Araihazar Economic zone.

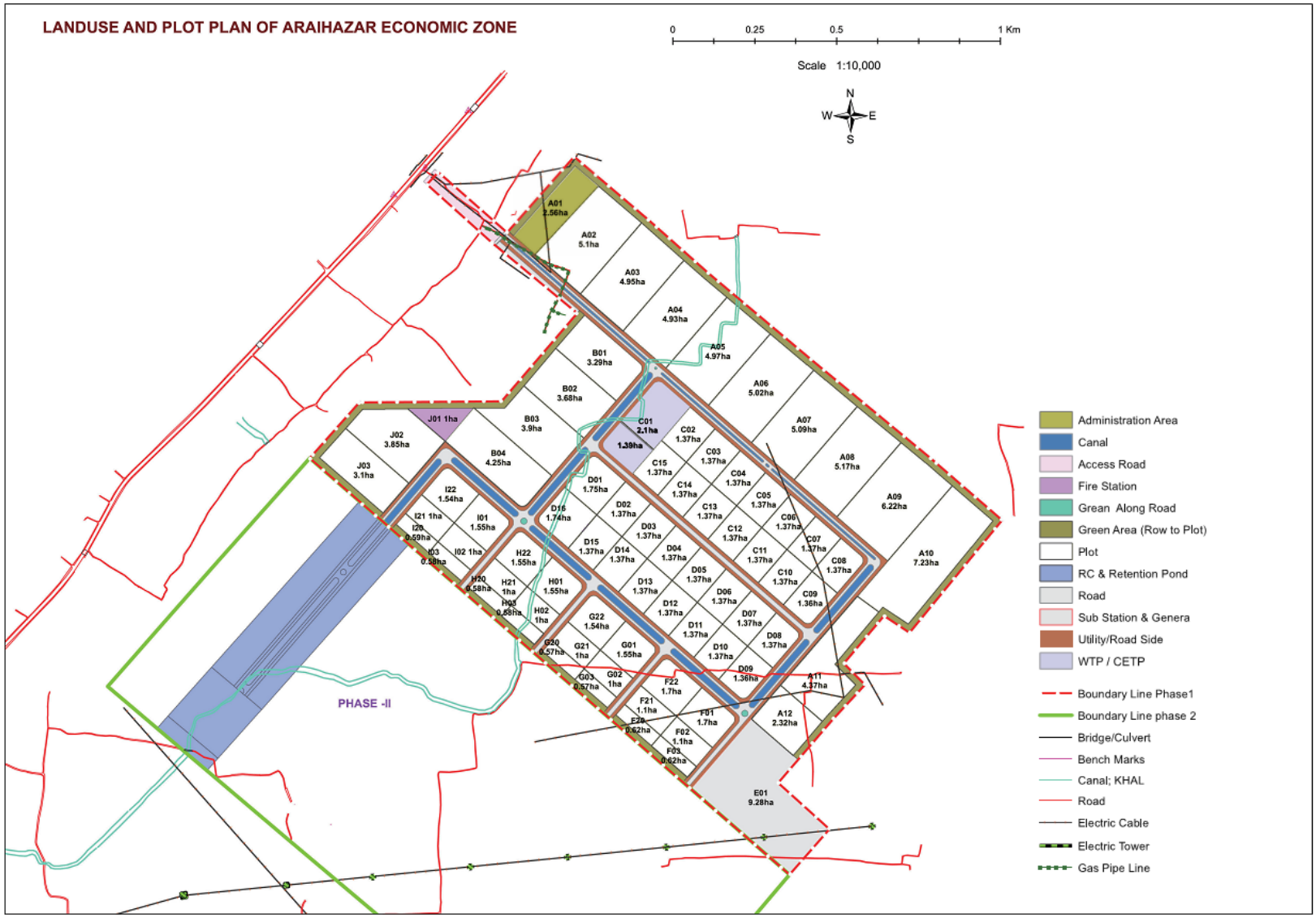
1. Textile garment,
2. Garments Accessories,
3. Motorcycle Assembly,
4. Automobile Assembly, Metal,
5. Nonferrous Metal,
6. Electronics, Machinery Parts,
7. General Assembly,
8. Plastic Processing,
9. Agriculture and food Processing,
10. Pharmaceuticals

After appointment of a developer, that developer will explore other options as per the investor's interest and there may be changes in the planning. The Developer will carry out a separate EIA study as per any revised planning that takes place and will obtain separate approval from DoE, Bangladesh if required. Other developments like roads, internal storm water drainage, power distribution, water distribution network, plotting, water treatment plant etc. will be carried out by BEZA. Preliminary land use planning for the EZ zone is given below in Table 3-3. A layout map for EZ as per preliminary planning is given in ***Figure 3-2***. The industrial zoning map is shown in the Figure 3-3.

Table 3-3: Summary of General Land use

Land Use pattern	Hectares	Acres	Percentage (%) Area
Factory Lot	144.84	357.91	76.42 %
On-site Infrastructure			
Administrative Area	2.56	6.32	1.35%
Road (asphalt)	10.76	26.59	5.68%
Utility Area	10.79	26.66	5.69%
Internal Canal	5.08	12.55	2.68%
CETP	2.10	5.19	1.11%
WTP	1.39	3.43	0.73%
Fire Station & Gas Station	1.00	2.47	0.53 %
Green Area	11.00	27.18	5.80%
Sub-Total	**189.52**	**468.31**	**100%**
Off-site Infrastructure			
Access Road	1.49	3.68	-
Retention Canal, Retention Pond, Pump House	18.55	45.84	-
P/S, S/S, G/S	9.28	22.93	-
Sub-Total	**29.32**	**72.45**	-
Total	**218.84**	**540.77**	-

Source: JICA Study Team (Master plan)



Source: JICA Study Team

Figure 3-2: Proposed Layout Plan of Araihazar Economic Zone

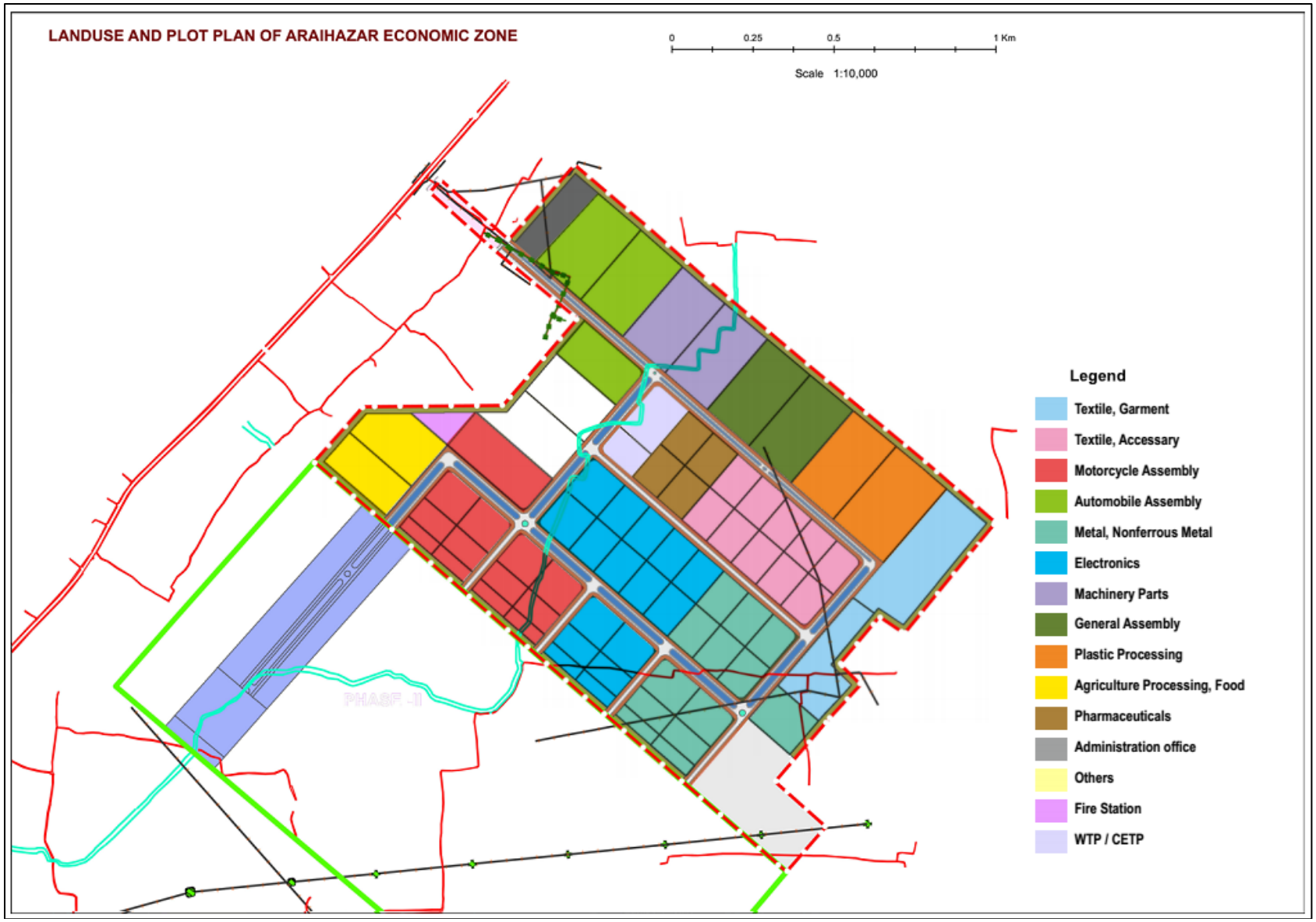


Figure 3-3: Proposed Industrial Zoning Map of Araihazar Economic Zone

3.8 Land Grading Plan

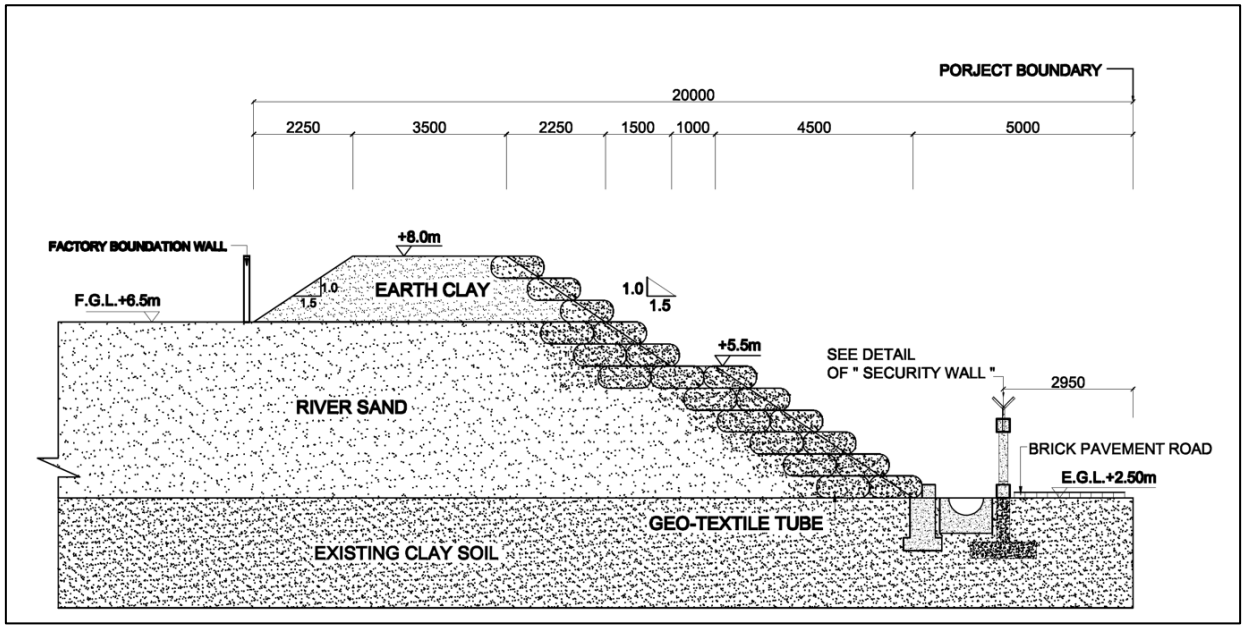
The land grading elevation for Araihazar EZ development has been decided as follows:

The probable high water levels at existing gauge stations of Bangladesh are calculated for each defined return period. Then the high water level of each candidate EZ site was calculated by the weighted average method, based on the calculated probable high water levels of nearby water stations (3 locations for each EZ site).

The difference between calculated probability water level and the terrain elevation obtained by other methods, such as digital mapping, is the minimum value of land grading height (thickness). The final site formation height is the sum of land grading height, margin height for rainwater drainage, and freeboard (Further explanation will be made in the next report).

<Planning Policy>

- Maximum flood level is EL. 6.5m and 100 year flood level is EL. 7.4m;
- The standard land grading level is set at EL. 6.5m, where factory lot is not flooded even if maximum flood occurs or drain pumps not working;
- The top elevation of the bank is set at EL. 8.0m which is 100 year flood level plus 0.5m freeboard. When the water level is higher than the water level inside, water is drained by pumps;
- Surplus water shall be retained in the retention pond with the balance between runoff coefficients after the development (0.6) and before the development (0.3);



Source: JICA FS Team

Figure 3-4: Slope Protection Works (Cross-Section)

3.9 Resources and Utility Demand

3.9.1 Road Plan

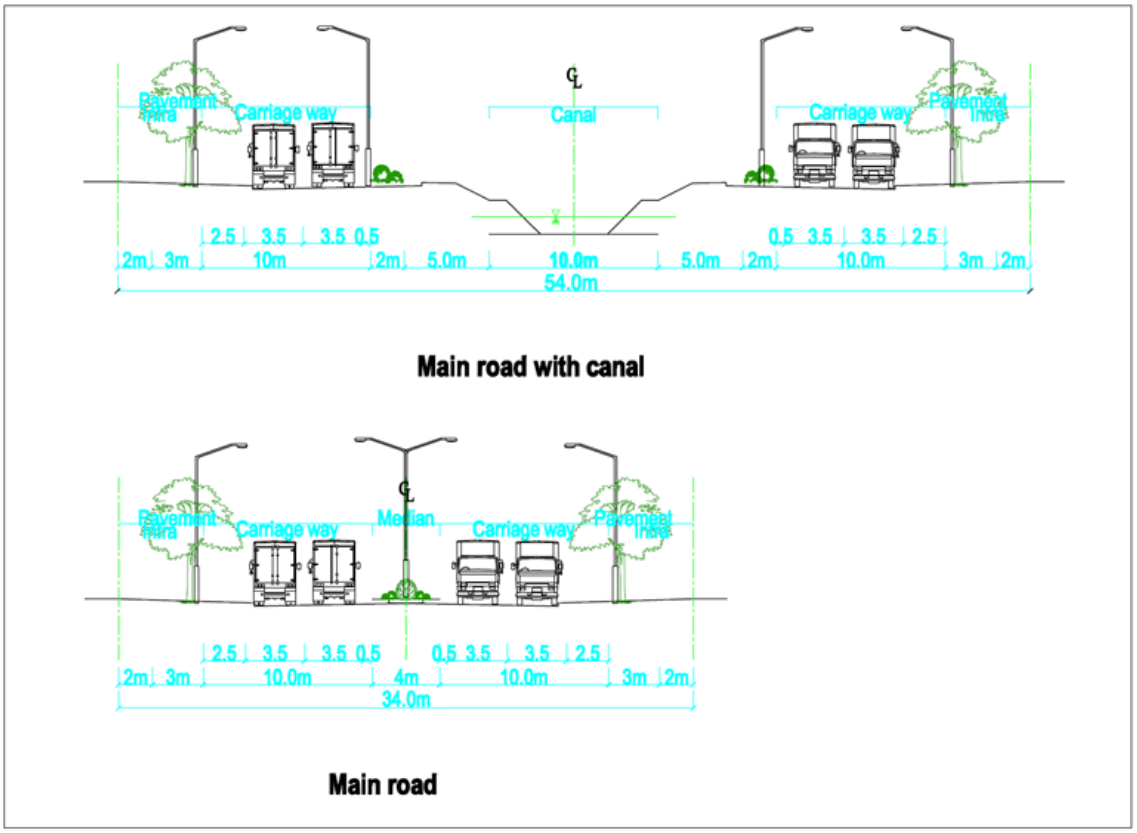
Internal roads

Inside the Economic Zone, a road starting at the gate and passing through the center of EZ will be the internal main road and will have four lanes. Road type A have a 20m width retention canal in the center, and the total road width is 54m.All internal roads in the Araihazar EZ area have four (4) lanes carriageway, with 2.5m shoulders on their sidewalk sides so that accidents and parking of trucks and other vehicles while waiting will not obstruct traffic.

Table 3-4: Araihazar EZ Road Plan

Road section	Road Width (m)	Road Area (m²)	Area (ha)
A	54 m (including 20m canal)	Road 180,200 (Water surface 63,500m²)	12.25
B	34 m	Road 30,600	
Total		**210,800**	

Source: JICA Feasibility Study



Source: JICA Feasibility Study

Figure 3-5:Internal road section plan of Araihazar EZ

3.9.2 Rainwater Drainage Plan

Rainwater drainage facilities

Rainwater drainage ditches will be located on both sides of internal roads and will drain rainwater to the canal located along the 54m main road. A retention pond will be located at the terminal of the canal, and it will have storage functions enabling it to perform the function, preventing the impact of the change of the runoff rate accompanying land preparation, and part of the pump drainage functions during flooding. The rainwater drainage facility plan will apply the 10-year return period rainfall intensities. The runoff rate from the site of each factory etc. is planned as 0.6, hypothesizing a building coverage ratio from 50 to 60%. The rainwater drainage facility gradient is planned as 0.1%.

Discharge point

The rainwater falls in EZ is planned to be discharged to the southern small river as current. The small river merges into Brahmaputra River.

Canal

The total area of the main planned site is about 218.84ha.The flow rate to be carried downstream is the 50-year return period rainfall, and the concentration time from the furthest location for the completed 200ha plan is hypothesized to be1 hour, and the rainfall intensity is calculated as about 100mm/hour. The planned flow rate is about 33.3m^3/s.

The flow capacity of the planned canal is, assuming the roughness coefficient is 0.035 and the water surface gradient is 0.02%, about 33.3m^3/s when the water depth is 3.6m (if the canal bottom elevation is considered to be 2.5m, water surface elevation of 6.1m), and it can carry the planned flow rate.

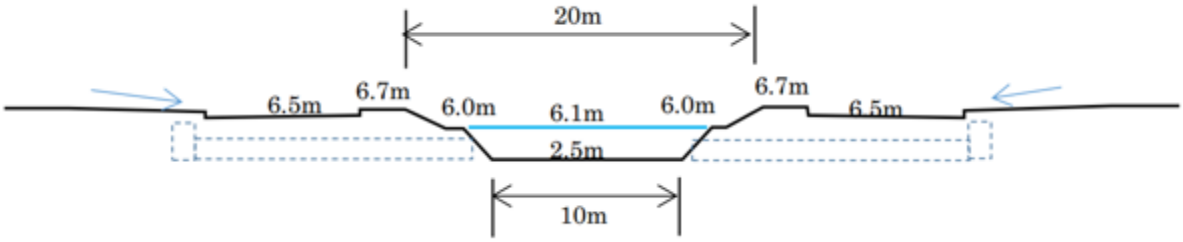
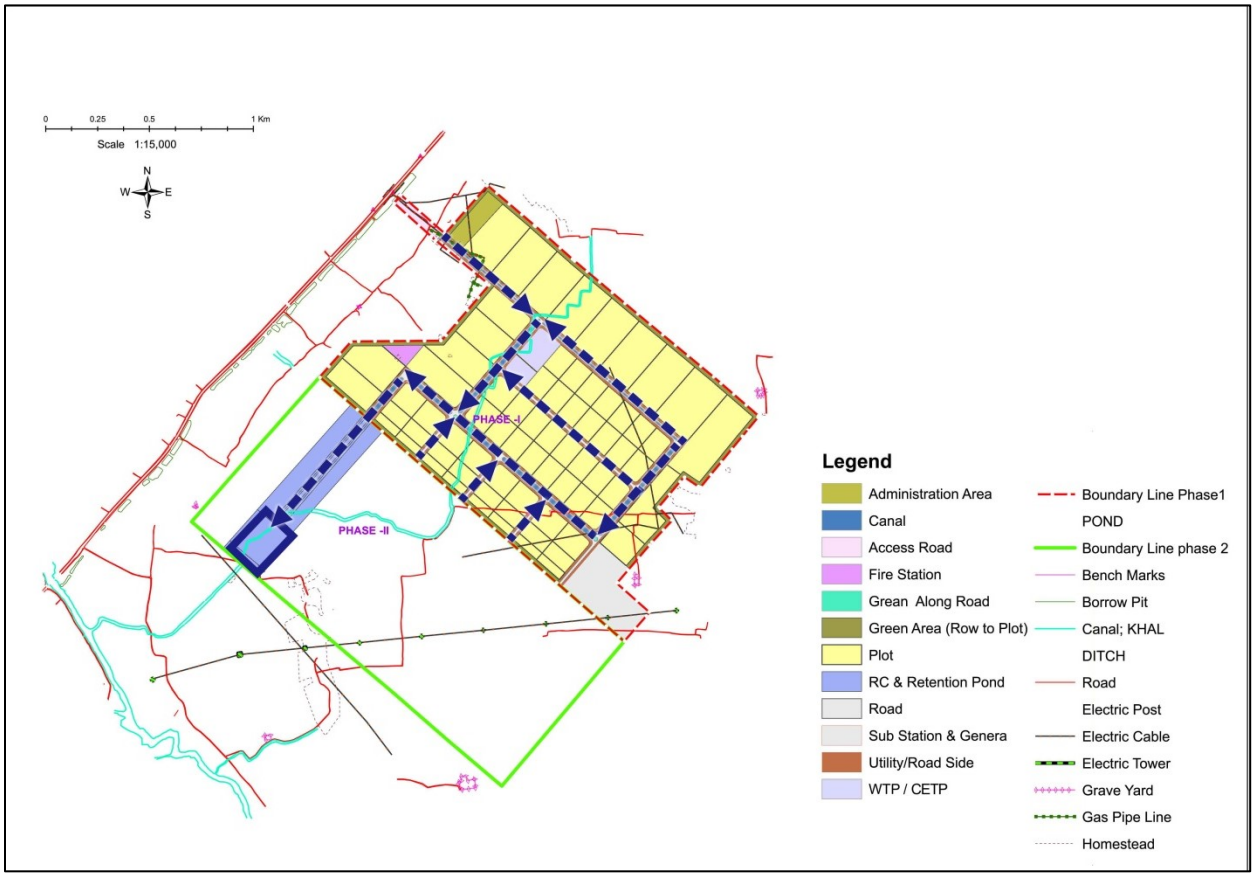


Figure 3-6: Plan for main road canal in Araihazar



Source: JICA Study Team

Figure 3-7: Layout plan of Rainwater drainage plan of Araihazar EZ

3.9.3 Electric Power Supply Plan

Power Distribution Line

On-site developer will prepare on-site power distribution plan.

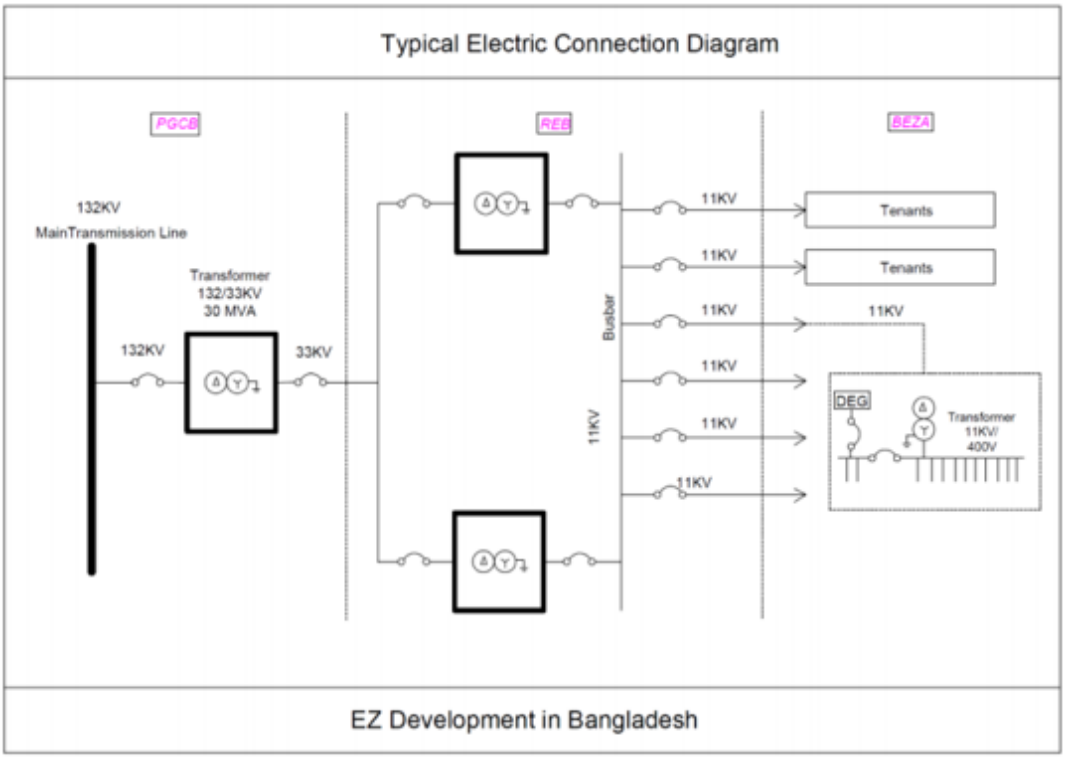
Interface between On-site and Off-site is external cable terminals at 11kV Switchgears in Substation in Off-site because jointing of 11kV cables in On-site area is not recommendable from electrical safety/maintenance point of view.

Street lighting

Street lights able to ensure road surface luminance, 250W natrium lamps for example, will be installed.

Emergency power supply

An emergency power supply for street lighting, water supply facilities, waste water treatment facilities, and others requiring power during a power failure will be constructed on the transformer site.

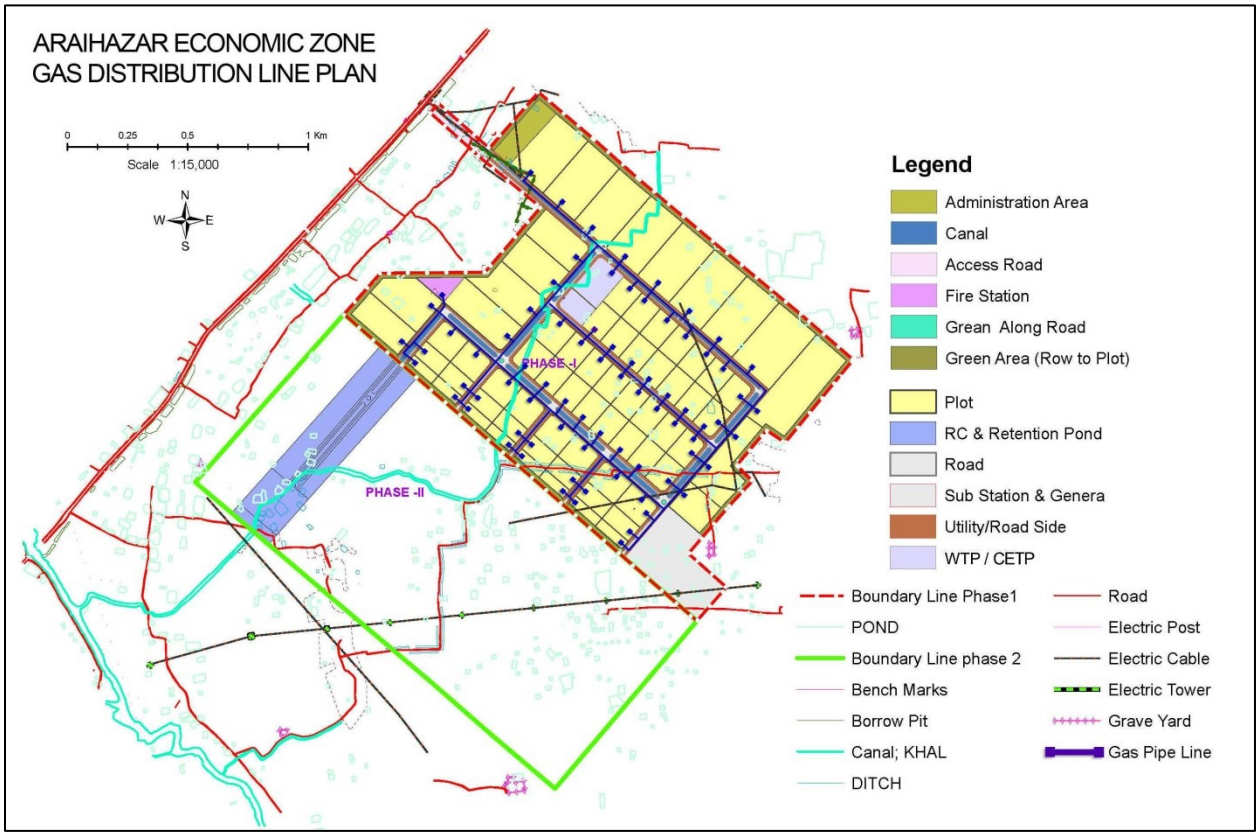


Source: JICA Feasibility Study

Figure 3-8: Outline of electric power reception/transformer plan for Araihazar

3.9.4 Gas Distribution Plan

In the EZ, gas supply facility use land will be ensured adjoining the waste water treatment facility use land. Moreover, use in the EZ is predicted to be general use rather than industrial use or power generation use, so gas will be supplied in 75mm diameter pipes. Layout of gas distribution pipeline is given in ***Figure 3-9.***



Source: JICA Study Team

Figure 3-9: Layout Plan of Gas Distribution Pipeline

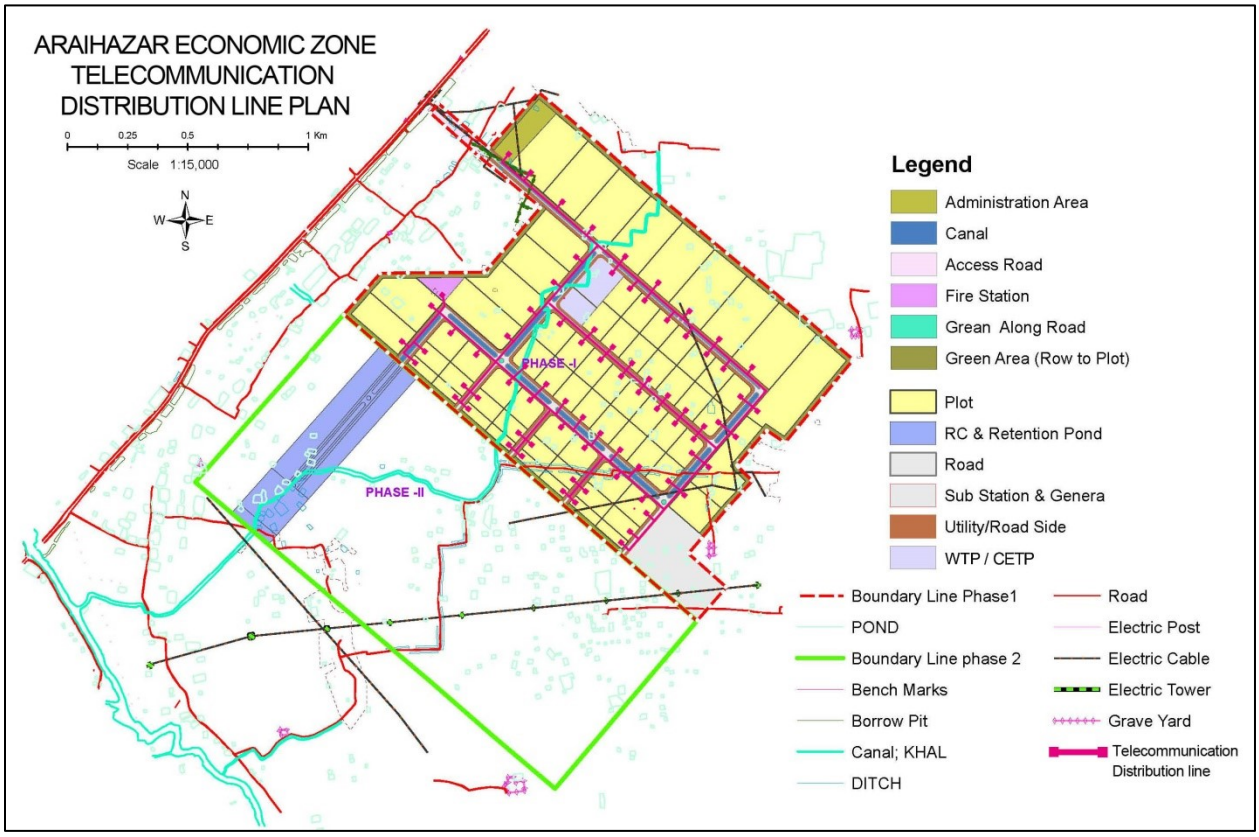
3.9.5 Telecommunication Line

At Araihazar EZ, communication services will be provided by installing wire (optical fiber etc.) feed cables to provide services under contracts completed by each attracted enterprise with local service providers. The wires will be installed on electric power supply poles or in underground communication line use conduits following consultations with EZ management. In Bangladesh, it is possible to obtain service from the following three kinds of communication companies.

- Public switched telephone network (PSTN)
- Mobile phone operators
- Long distance operators (as per ILDTS Policy 2007)

The largest PSTN in Bangladesh is the Bangladesh Telecommunication Company Ltd. Mobile phone operators, which in this region include Grameen Phone, Teletalk, Robi Axiata, Banglalink, supply internet communication and call services.

As for IPTSP (Internet Protocol Telephony Service Provider), more than 40 companies supply internet communication services. They offer both high-speed internet communication services and IP call services. The Layout Plan of Optical Fiber Telecommunication Line is given in ***Figure 3-10.***



Source: JICA Study Team

Figure 3-10: Layout Plan of Optical Fiber Telecommunication Line

3.9.6 Water Supply Plan

Water Sources

Since Araihazar EZ candidate sites do not have existing public water supply facilities, it is necessary to utilize the nearby rivers as wells as water sources. It is important to bear in mind the following points when using these water sources. In the case of river water, there is saltwater intrusion. In the case of groundwater, water intake capacity of underground aquifer and water quality should be confirmed (especially the presence of arsenic) at project site. But the JICA survey team (Survey 2000) was conducted on 55 TWs altogether, 38 STWs (69.1%) and 17 DTWs (30.9%); 26 (47.3%) in Duptara Union and 29 (52.7%) in Satgram Union.Most of the area is relatively safe with only two TWs in Duptara Union having arsenic exceeding the Bangladeshi standard for drinking water of 50ppb. The water of 23 TWs (79.3%) out of 29 in Satgram Union was within the Bangladeshi standard of 0.3-1 ppm whereas only 14 TWs (53.8%) out of 26 in Duptara Union contained iron within the Bangladeshi standard. And High conductivity value was found in two TWs in Duptara Union at 2005µs/cm (DTW of 645ft) and 3050µs/cm (STW of 170ft), indicating high salinity.

The nearby rivers of Araihazar EZ (Shitalaksha River and Meghna River) are likely to be affected by seawater, and the effect becomes stronger especially in the dry season. The area is located on the boundary line of an arsenic influence area (<10µg/Liter). It is necessary to

confirm the possibility of a method of collecting groundwater from the aquifer that has low arsenic content. The water source will be 200m deep wells. A past survey estimated the arsenic contamination concentration to be low enough to not be a problem.

Quantity of water supplied

The predicted attracted industries are assumed to be mainly manufacturing industries that use relatively little water, assembling and sewing for example, and the basic unit of the quantity of water used is considered to be 35m^3/day/ha for the total development area. Moreover, the total quantity is 7000m^3/day for the initial 200 ha development. In fact, the area of factory use land will be about 145 ha, so it is about 48.28m^3/day/ha. The water supply facility will be close to N2 so that construction is possible from the first stage at a location where it is expected to supply water to the future expanded area.

The 11 industries to be attracted in EZs are focused on labor-intensive procedure such as assembling and packaging rather than manufacturing procedure; therefore, the unit rates of labor-intensive industries such as garment, sewing and furniture have been applied. The water demand of 50-60 ton/ha/day in each industry has been assumed. The basic unit of the quantity of water supply was set referring the forecasted demand that was ***Table 3-5***.

Table 3-5: Water Demand Projection by Industry (Araihazar Phase I)

Industry	Ha	m^3/ha/d	m^3/d
Textile, Garment	20.1	60	1206.1
Textile, Accessory	34.9	60	2091.2
Motorcycle Assembly	12.0	60	720.0
Automobile Assembly	6.7	50	336.3
Metal, Nonferrous Metal	13.4	50	668.8
Electronics	13.4	50	668.8
Machinery Parts	6.7	50	336.3
General Assembly	6.7	50	336.3
Plastic Processing	6.7	50	336.3
Agriculture Processing, Food	6.7	50	336.3
Pharmaceuticals	6.7	60	403.6
Service Facilities	10.8	50	538.9
Total	**144.8**		**7978.8**

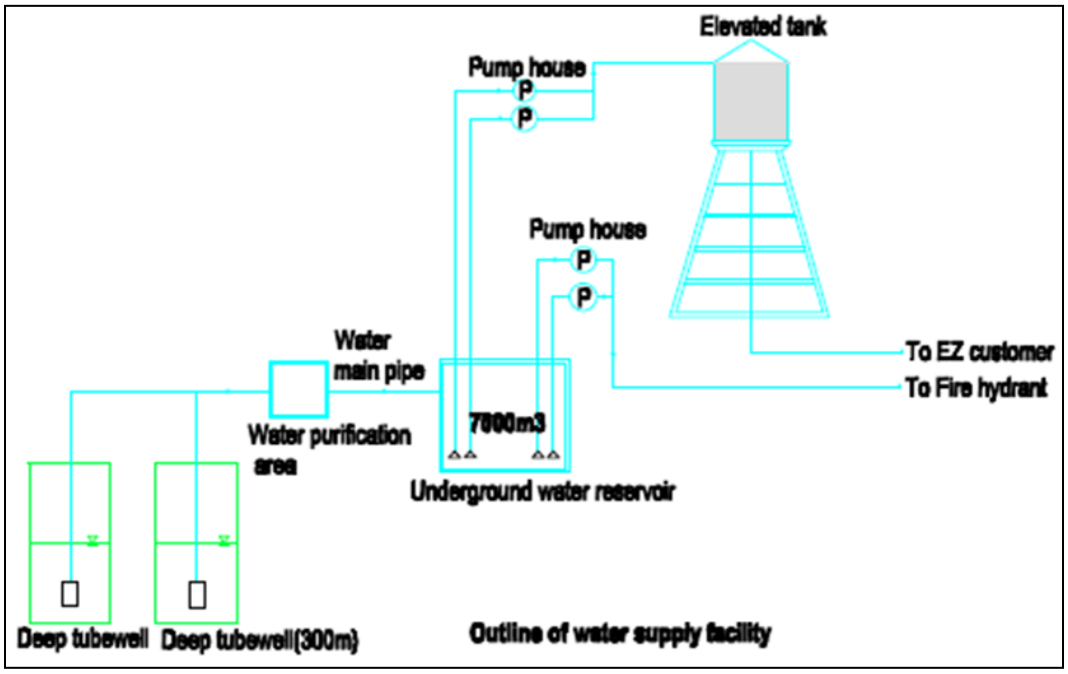
Source: JICA Feasibility Study

Supplying water to fire hydrants

Assuming that one fire hydrant will cover an area with a radius of about 100m, fire hydrants will be installed at intervals of about 150m.

Water supply facility

The water storage tank scale will be equivalent to one day's requirement of 7,000 m^3. An elevated water tank will ensure capacity for about 1 hour.



Source: JICA Feasibility Study

Figure 3-11: Outline of the water supply facility at Araihazar

Table 3-6: Araihazar water supply facility data

Sl	Water supply facility	Data
1.	PVC Water-supply Pipes – 200 mm dia.	2,300 m
2.	PVC Water-supply Pipes – 150 mm dia.	9,400 m
3.	PVC Water-supply Pipes – 100 mm dia.	2,400 m
4.	High pressure PVC Pipes, for hydrant – 100 mm dia.	12,500 m
5.	Water connection terminal points (blank/ sealed)	124 places
6.	Fire Hydrants on internal roads	130 places
7.	Underground Reservoir Tank	7000 m^3
8.	Overhead Reservoir Tank	300m^3
9.	Pumping Facilities (Water Supply, Fire hydrant)	4 systems, 8 pumps

3.9.7 Wastewater Treatment Plant

The domestic waste (Kitchen and toilet waste) and industrial waste will treat in the pre-treatment facility of each tenant company. The pre-treated wastewater will transport through pipe to central effluent treatment plant/central sewage treatment plant. The central wastewater treatment facility (central effluent treatment plant/central sewage treatment plant) for the Araihazar economic zone will be decided based on the finally selected industry type and their effluent characteristic.

Industry wastewater and domestic waste from each tenant factory will be primarily treated by their own pre-treatment facility. Treated water from each factory will discharge to the central ETP/central STP. The CETP/CSTP will treat domestic waste (Kitchen and toilet waste) as well as preliminary treated water from each tenant factory. The treated water from the Central ETP/Central STP will discharge in the retention pond after comply the schedule 10- Standard for waste from industrial unit or project waste of ECR, 1997. The online-based monitoring system will be installed to monitor the CETP/CSTP. The treated wastewater will be used in some extend in the economic zone like gardening, washing and domestic purpose. Figure 3-12 shows the wastewater treatment process of Ariahazar economic zone.

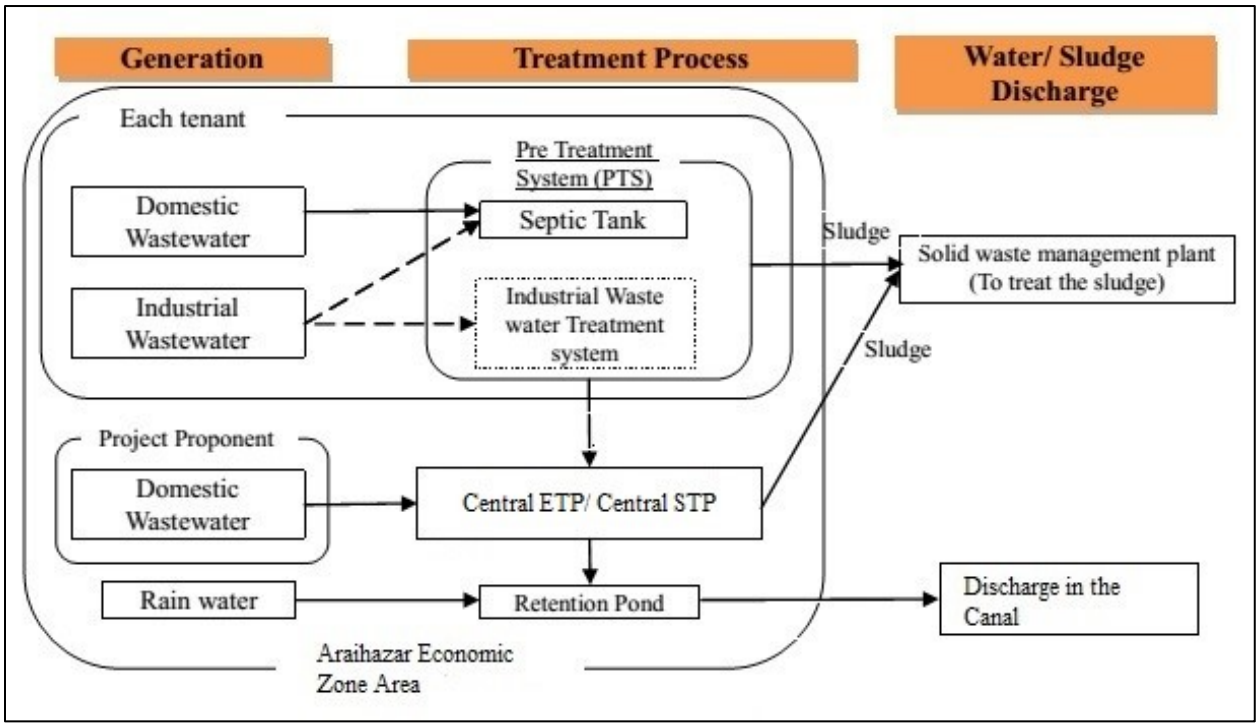


Figure 3-12: Wastewater Treatment Process in Araihazar Economic Zone

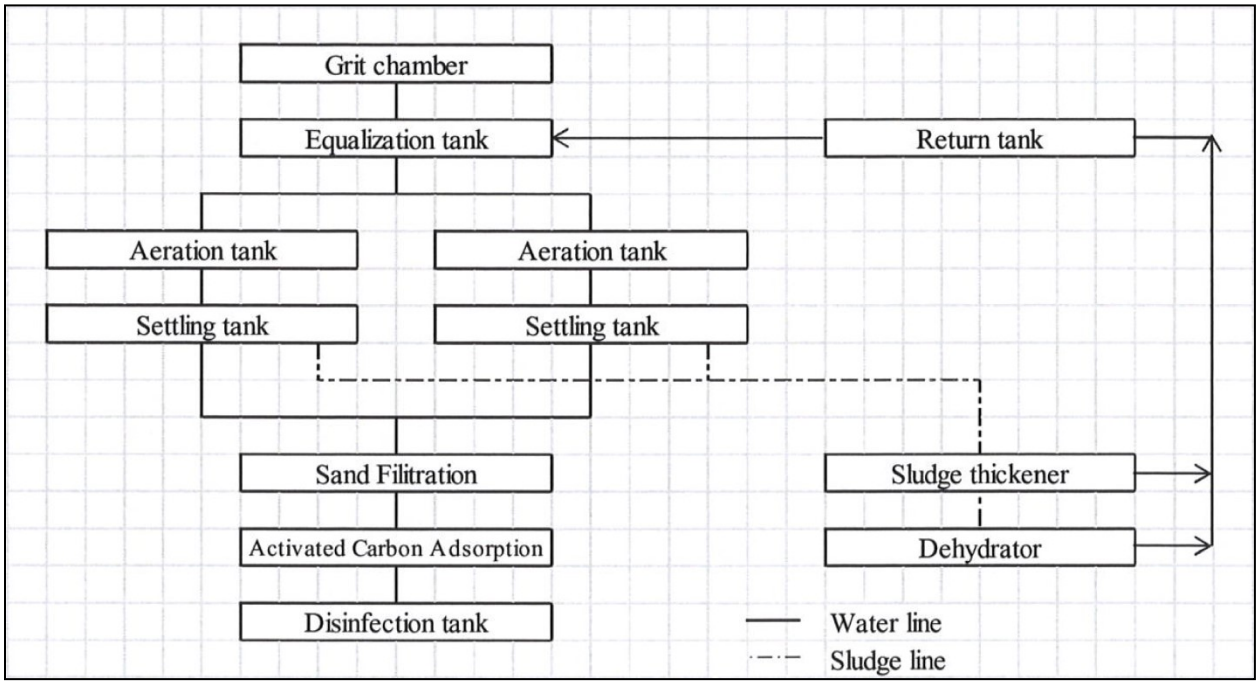


Figure 3-13: System Block Flow Chart of CETP/CSTP

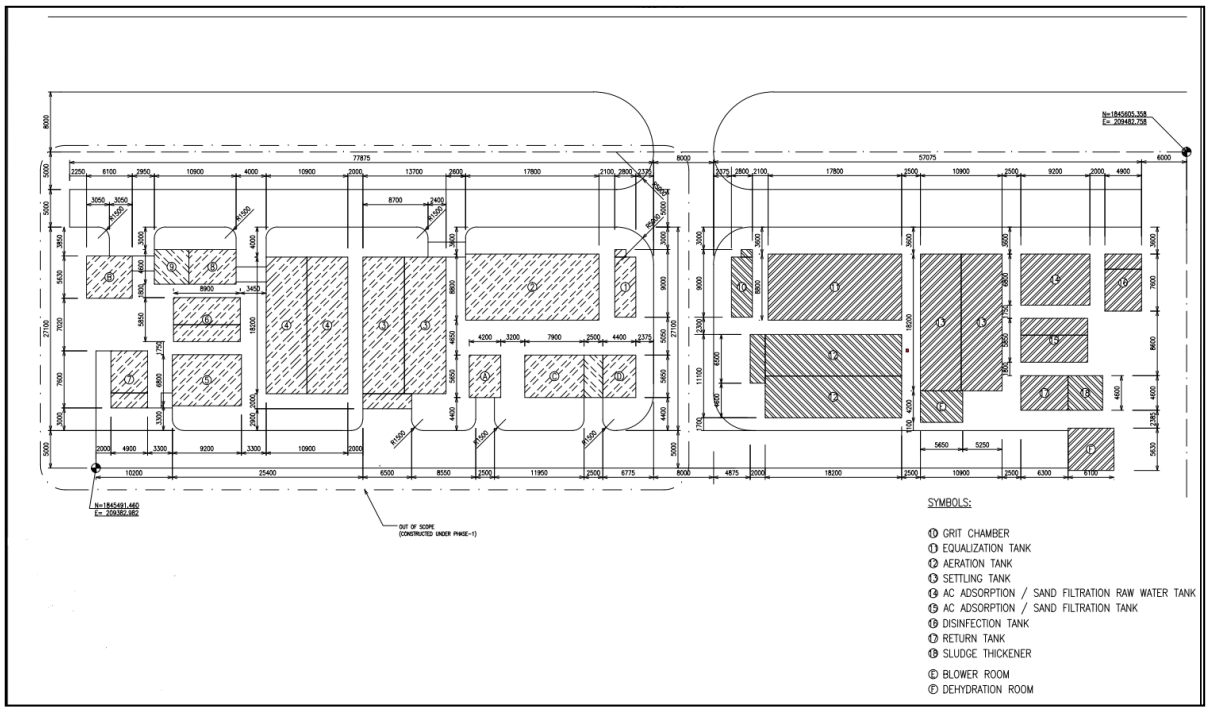


Figure 3-14: General Layout of Central Effluent Treatment Plant/ Central Sewage Treatment Plant

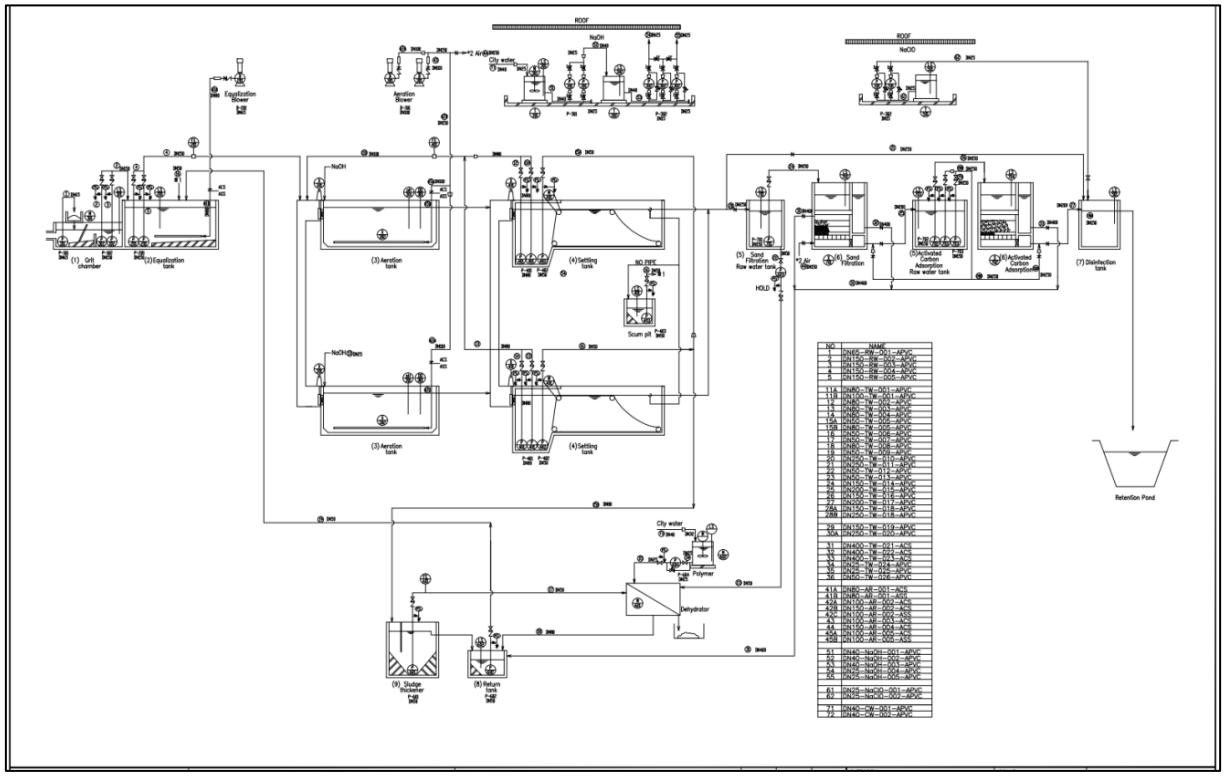


Figure 3-15: Flow sheet of Central Effluent Treatment Plant// Central Sewage Treatment Plant

Waste water pipes

Minimum diameter of 300mm, gradient of 0.3%, flow rate of at least 0.6m/s, and soil cover of at least 0.5m will be ensured.

Table 3-7: Araihazar waste water pipe data

SL	Waste water pipe	Data
1.	Concrete pipes- 300 m dia.	8,250 m
2.	Concrete pipes- 500 m dia.	1,450 m

Source: JICA Feasibility Study

3.9.8 Solid Waste Management

At Araihazar EZ, solid waste (ordinary waste (kitchen garbage etc.), industrial waste) will be treated and disposed of by local treatment and disposal companies under contracts entered into separately with each attracted enterprise. Therefore, the EZ will not construct solid waste collection plants and treatment/disposal plants. The result of the waste generation estimation for AEZ is shown in the table below. The total industrial generation is 5,128 ton/year.

Table 3-8: Result of Waste Generation Estimation at AEZ

	Area (ha)	%	Factory No.	Non-HW	HW	Total Generation	Recycling Non-HW	Recycling HW	Non-Recycling Non-HW	Non-Recycling HW
				(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)
Textile, Garment	12.1	9.09	4.78	124	0	124	97	0	27	0
Textile, Accessary	14.16	10.64	5.60	324	8	332	254	0	70	8
Motorcycle Assembly	12.76	9.59	5.04	517	101	618	406	1	112	100
Automobile Assembly	10.58	7.95	4.18	26	67	93	21	0	6	67
Metal, Nonferrous Metal	17.24	12.96	6.82	873	15	888	684	0	189	15
Electronics	17.24	12.96	6.82	562	798	1,361	441	6	121	793
Machinery Parts	10.58	7.95	4.18	98	20	118	77	0	21	20
General Assembly	10.58	7.95	4.18	98	20	118	77	0	21	20
Plastic Processing	10.58	7.95	4.18	133	62	194	104	0	29	61
Agriculture Processing, Food	6.65	5.00	2.63	806	0	806	632	0	174	0
Pharmaceuticals	2.72	2.04	1.08	5	43	48	4	0	1	43
Others	7.86	5.91	3.11	324	103	427	254	1	70	102
Total	133.06	100.00	52.60	3,891	1,237	5,128	3,050	9	840	1,229

Source: Calculated by JICA Study Team

The breakdown of the waste generation estimation is summarized in the table below.

Table 3-9: Summary of Waste Generation Estimation for AEZ (ton and percentage)

	Non HW	HW	Total
	(ton/year)	(ton/year)	(ton/year)
Generation	3,891	1,237	5,128
Recycling	3,050	9	3,059
Non-recycling	840	1,229	2,069

	Non HW	HW	Total
Generation	76%	24%	100%
Recycling	78%	1%	60%
Non-recycling	22%	99%	40%

Source: Calculated by JICA Study Team

It is assumed that the sludge from the ETP of each tenant is included in the above estimation. However, the sludge quantity is separately estimated below as a reference purpose, based on the data from the CETP of Dhaka EPZ. The wastewater of the CETP of Dhaka EPZ is currently 20,000m^3/day while the generated sludge after de-watering is 2ton/day. In case of AEZ, the expected wastewater quantity for the 200ha is 5,656m^3/day, which could generate sludge of about 0.5ton/day (183ton/year). The details of the estimation by industry are shown in the table below.

Table 3-10: Summary of Sludge Generation Estimation for AEZ

Industry	Area	Unit rate	Water demand	Wastewater demand
	ha	m3/ha/d	m3/d	m3/d
Textile, Garment	12.1	60	726	580.8
Textile, Accessary	14.16	60	849.6	679.68
Motorcycle Assembly	12.76	60	765.6	612.48
Automobile Assembly	10.58	50	529	423.2
Metal, Nonferrous Metal	17.24	50	862	689.6
Electronics	17.24	50	862	689.6
Machinery Parts	10.58	50	529	423.2
General Assembly	10.58	50	529	423.2
Plastic Processing	10.58	50	529	423.2
Agriculture Processing, Food	6.65	50	332.5	266
Pharmaceuticals	2.72	60	163.2	130.56
Others	7.86	50	393	314.4
Total	133.06		7,070	5,656

Source: Calculated by JICA Study Team

3.9.8.1 Possible Options for industrial waste

1. **Clinker (Cement) factory (Option-1)**

- Lafarge Holcim Cement Ltd provide Waste Co-processing Service
  - Location: Chattak, Sunamganj (300km from Dhaka)
  - Disposal capacity: 1,000ton/yr (currently by manual) (5,000ton/yr from late 2018 with automation)
  - Disposal fee range:150-1,000$/ton
- Non-HW from Food ind.:150$
- HW from Pharmaceutical:550$
- HW from Agrochemical:600$
- HW from Petro:500$
  - Transportation fee 250$/10-12ton truck (21-25$/ton)
- Current customers
  - Syngenta Bangladesh, Chevron, NestleBangladesh, Novartis Bangladesh,
  - SanofiAventis, GSK, Renata, Bayer Crop Science, Unilever, P&G, CocaCola etc.
- There is Limitation in acceptance such as heavy mental content (to be informed)

2. **DSCC's Matuail Landfill Site (Expansion Area) (Option-2)**

- Matuail Landfill site has expansion plan which area is approximately 30.5 ha. And the total budget of DSCC's DPP for this project is 72,448.50 lac taka
- However, "waste from outside Dhaka city" and "industrial waste" are out of Dhaka South City Corporation (DSCC)'s duty.

- Therefore, Acceptance of waste from AEZ depends on negotiation by BEZA with DSCC.

3. Waste Management Plan for Narayanganj City Corporation (NCC) (Option-3)

- Functional components (6 acres) : 6 acres=2, 61,360.0 square feet
  - Compost Plant (200*100 sq.ft)
  - Incinerator+ Hospital Waste Management center (100*80 sq ft)
  - ETP (300*200 sq feet)
  - Segregation Shed (200*100 sq.ft)
  - Sub-station (40*40 sq.ft)
  - Recycling center+Bio-Gas Plant(100*50 sq ft)
  - Canteen (30*20 sq.ft)
  - Administrative Building (100*50 sq.ft)
  - Garage/Parking Area (70*30 sq.ft)
  - Leachate Pond (128*128sq.ft)
  - Water tank
  - Septic tank
  - Guard room (15*10 sq.ft)
- Land filling site (17 acre): 17acres=7,40,520.0 square feet
  - (10 feet under the ground and 30 feet on the ground=total 40 feet land filling)
- NCC's duty is only Waste from Narayanganj City (not all district). Acceptance depends on negotiation.
- Budget is approved. Currently Land Acquisition Stage. Specs/capacity is to be decided after acquisition.

4. Development of PPP Industrial Waste Treatment Facility in Govt. Land (Option-4)

- Japanese Waste Disposal companies may be interested in investing industrial waste treatment facility as a PPP project
- Their decision depends on conditions such as land price, public support etc.
- Example: In case of Matuail expansion PPP RDF Project (proposal by South Korean company), conditions of 25 yr concession, free land, assured supply of waste, 80:20profit sharing is proposed.

5. Development of Industrial Waste Treatment Facility by Bangladesh Government (Option-5)

- With increasing number of EZs planned, the capacity of existing facilities for industrial wastes may not be sufficient in near future.
- There are a number of new EZ projects within 30km distance in Dhaka surrounding area, esp. Narayanganj District.
- It is reasonable to develop a common-use industrial waste treatment facility in Narayanganj District.
- After developed by Bangladesh Govt., the operation of the facility can be done by private sector;

6. Development plan of new landfill Site of North Dhaka City Corporation (Option-6)

- Dhaka North City Corp (DNCC)has Amin Bazar Landfill site.
- A new Landfill Site is to be developed by DNCC in Nasirabad
- However the Budget and Plan is still currently under consideration by DNCC
- However, "waste from outside Dhaka city" and "industrial waste" are out of Dhaka North City Corporation (DNCC)'s duty.
- Therefore, Acceptance of waste from AEZ depends on negotiation by BEZA with DNCC.

The Realistic/Short-term solution (available within 5yr) for industrial waste of Araihazar Economic Zone would be Waste Co-Processing at Cement factory (5,000ton/yr) and Medium-long term solution (5-10 years) would be Development of Industrial Waste Treatment Facility by PPP in Govt. land or Development of Industrial Waste Treatment Facility by Bangladesh Govt. with private operation.

3.9.9 Green Belt Development

Green buffer will be developed all around the EZ site. In addition to this, all industries will develop green belt all around their respective plots. Native plant species are consuming less water and requiring less monitoring. List of such species are given below.

SL	Name of Tree	Total Quantity for particular of tree numbers	Remarks
01	Neem	450	Neem and Orjun is medicine tree that refresh the air a big counting area.
02	Orjun	450	
03	Krishnochura	450	Krishnochura is visually popular tree for its red flower and green leaf.
04	Jackfruit	450	Fruits tree
05	Mango	450	
06	Mehagony	450	Korai, Mehgoni is hard and branches wood tree which is good protection for storm disaster.
07	Korai	450	
08	Coconut	1,350	Coconut is good for ground protection.

Total Tree= 4,500 pieces

(**Both side of the internal road, access road and retention pond**: 15,000 /5m = 3,000 pieces)

(Boundary belt: 7443m/5m= 1488.6 pieces= 1,500 pieces)

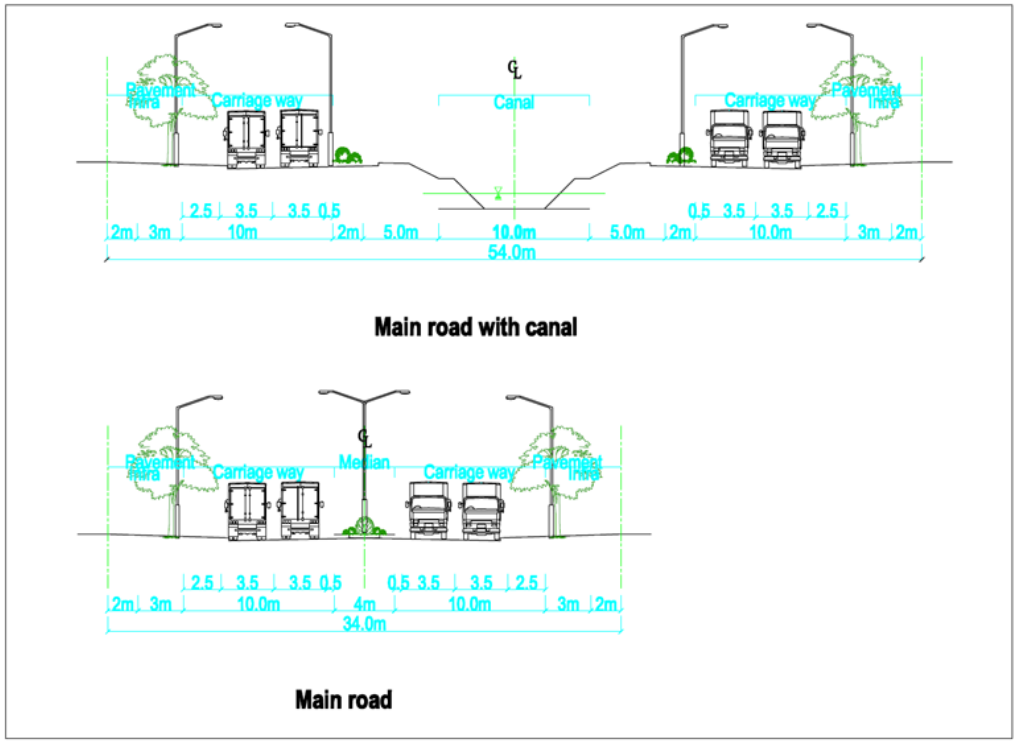


Figure 3-16: Green belt development beside the roadside

a) Total Length of green belt area surroundings of the site = **7443 m (boundary belt) and 15,000 m (both side of the internal road, access road and retention pond)**
(By the reference of the site lay out)
b) Width of Green belt = **3.5m** (by the reference of Slope Cross section drawing below)
c) Distance between trees is **5m**
d) **Single Layer** tree plantation (single line)
e) On boundary belt area, all trees will be planted on the top flat surface of the slope,asindicated with the green in the slope drawing below.

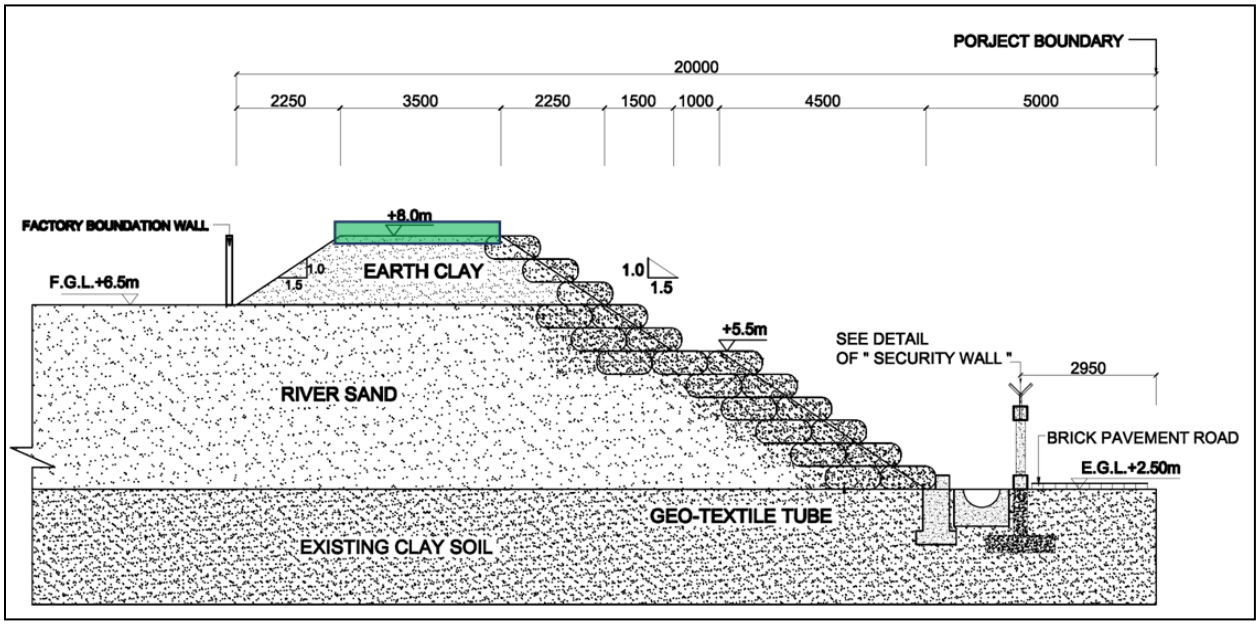
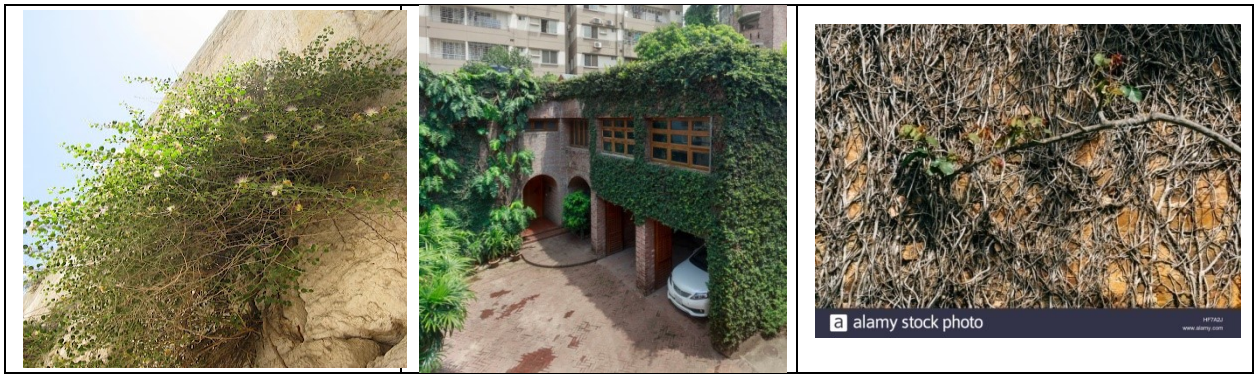


Figure 3-17: Green belt development in slope drawing

f) Additionally, for the slope protection, planting caper (not tree) which is suitable for enforcing the slope rigidity is suggested. Sample pictures are shown below:

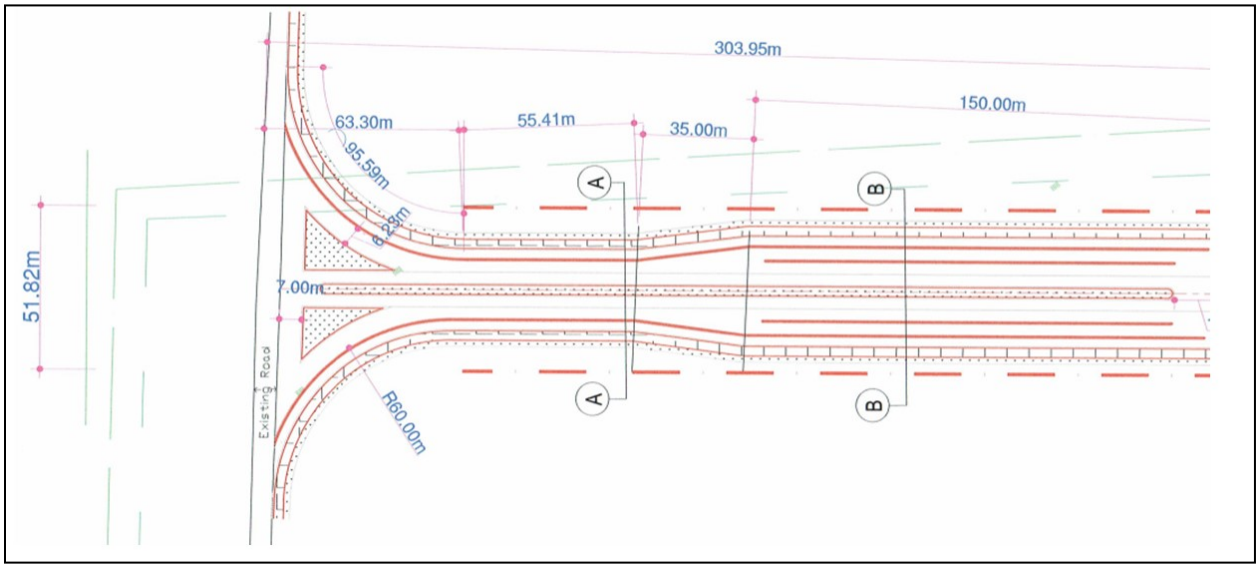


3.10 Off-site basic infrastructure sub-projects

3.10.1 Access Road

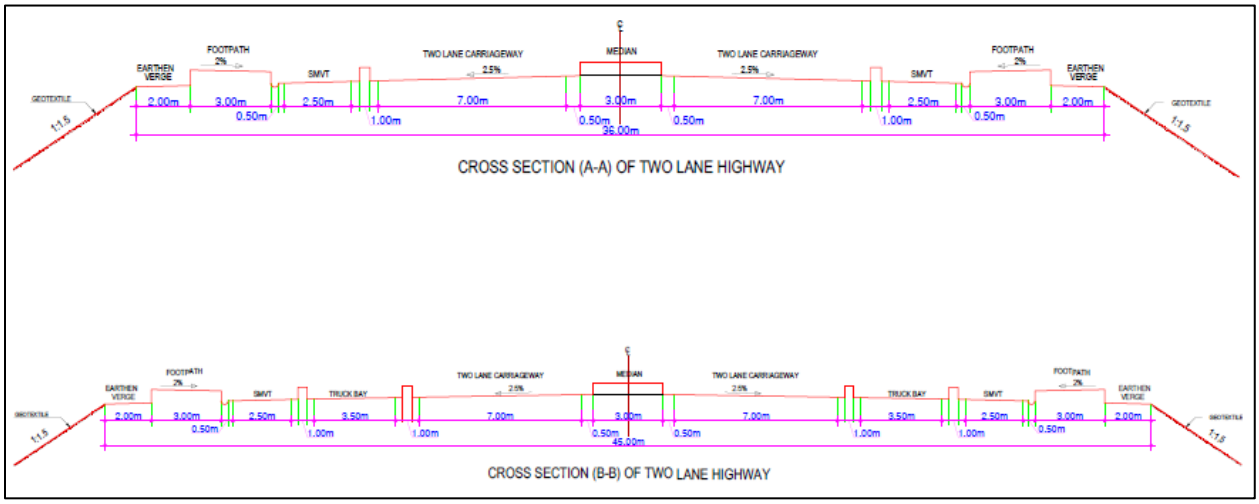
The access road is planned directly connecting from the national highway No.2 (Dhaka-Sylhet Expressway) to the Araihazar EZ with approximate length of 400 m.

Access roads are designed with two lanes on each side including a median strip, sidewalks and space for utilities (gas transmission, telecommunication, etc.). They also have space for parking areas for container trucks under entry permission procedure and commuting vehicles near the EZ entrance gate. The plan and cross-section of the access roads are shown in



Source: JICA Study Team

Figure 3-18: Proposed plan of the access road



Source: JICA Study Team

Figure 3-19: Standard cross-section of the access road

3.10.2 Retention Pond and Canal

Retention pond

In the land use plan, the retention pond used land is planned as 18.55 ha in the case of 200 ha development, and it will regulate the amount of increase in the runoff rate, assumed to be 0.6 from areas for factory use land and 0.3 from agricultural fields.

Table 3-11: Araihazar retention pond data - 1

	Average water surface area (m^2)	Effective depth of retention pond（m）	Retention capacity (m^3)
Retention pond for total development	22,500	2	45,000

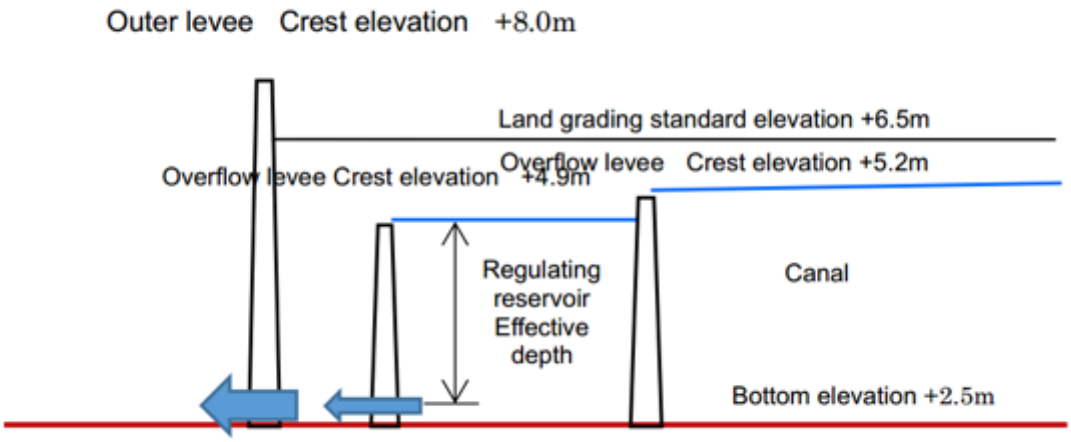


Figure 3-20: Cross-section of Araihazar regulating reservoir and canal

Table 3-12: Araihazar retention pond data -2

	Concentration time (min)	Rainfall intensity (mm/hour)	Pre-development runoff (Runoff rate: 0.3)	Post-development runoff (Runoff rate: 0.6)
200ha development	60	100	43.33	86.67

As shown below, if the convergence time of flow from the furthest location during each level of development is considered, the retention function will be one hour or longer, even in the event of the 50-year probability rainfall.

For 200ha development:

Orifice discharge rate: Q= (86.67-43.33)/2= 43.34 (m^3/s)

Retention capacity t＝45,000 (m^3)/43.34 (m^3/s)＝1,038(sec) or about 17 minutes

If the water level outside the surrounding level is close to 5m, discharge by natural flow will be difficult, and therefore the gate of the surrounding levee will be closed and the system is switched over to pump drainage.

Table 3-13: Araihazar regulating reservoir data

	Retention pond		Canal		Total stored (m^3)
	Storage use depth	Stored (m^3)	Storage use depth	Stored (m^3)	
200ha development	1.5m (6.5～5.0m)	45,000	1.0m (6.5～5.5m)	63,500	108,500

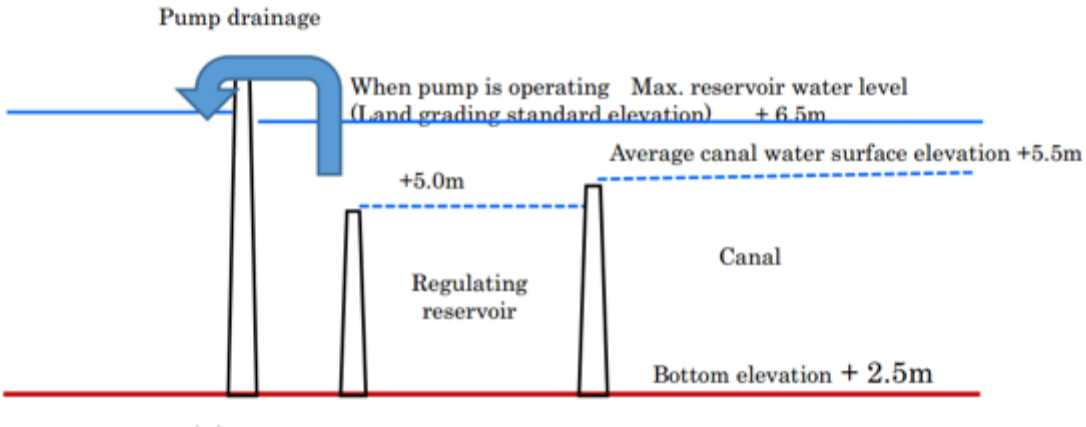


Figure 3-21: Retention pond and canal water levels during outer water flood (when pump is operating) at Araihazar

The study of pump capacity assumed the scale capable of withstanding the largest rainfall of 115mm in three (3) hours that occurred on July 18, 2005 (Source: Sherpur EZ final Report).

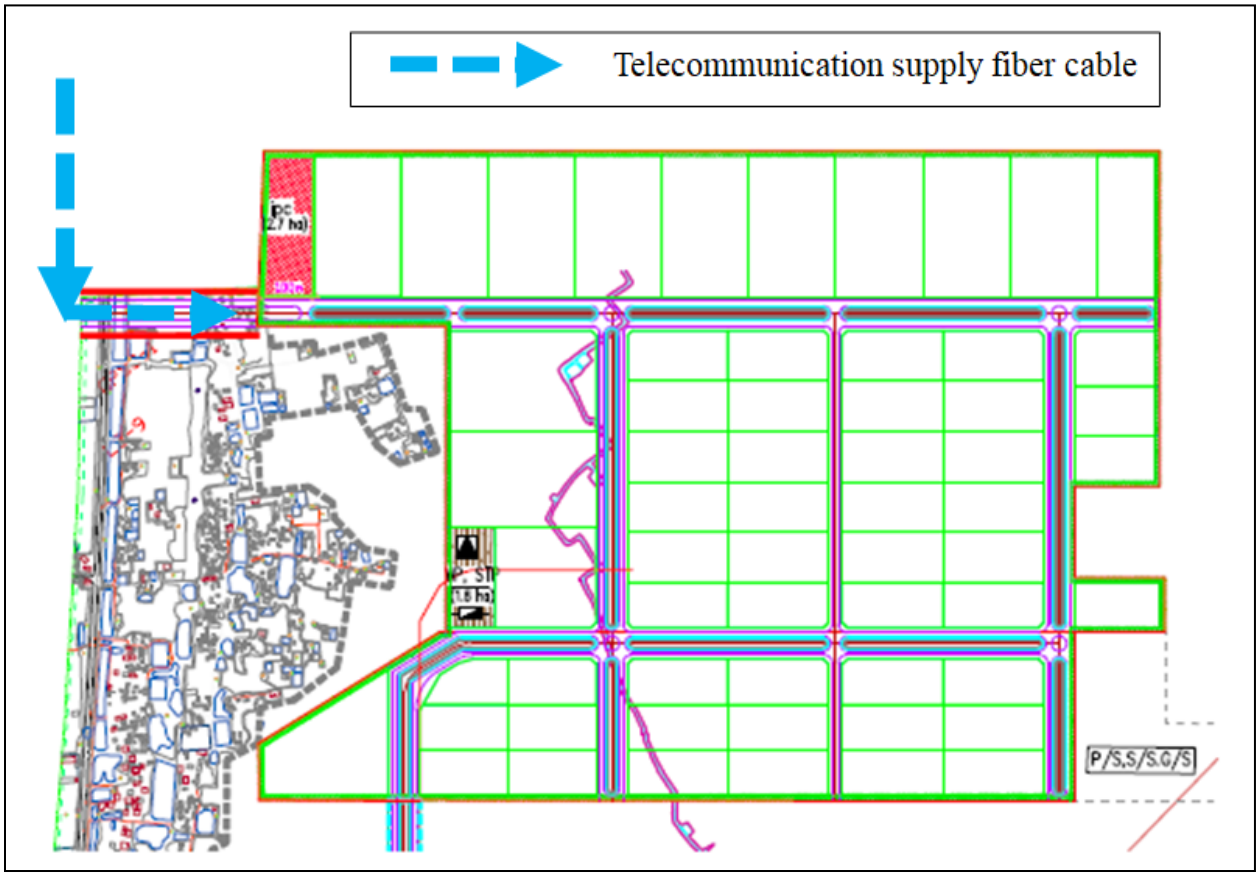
Table 3-14: Data for pump capacity required at Araihazar

	3-hour runoff (m^3)	Storage capacity (m^3)	Required drainage quantity (m^3)	Pump capacity (m^3/s)
200ha development	138,000	108,500	29,500	2.73

(Pump capacity is assumed the scale permitting three hours of drainage.)

3.10.3 Telecommunication supply plan

The Bangladesh Post and Telecommunication Corporation (BPTC) will ensure the installation of telecommunication cables (optical fiber) and the provision of telecommunication services. SPC will provide telecommunication distribution lines to each tenant.



Source: JICA Study Team

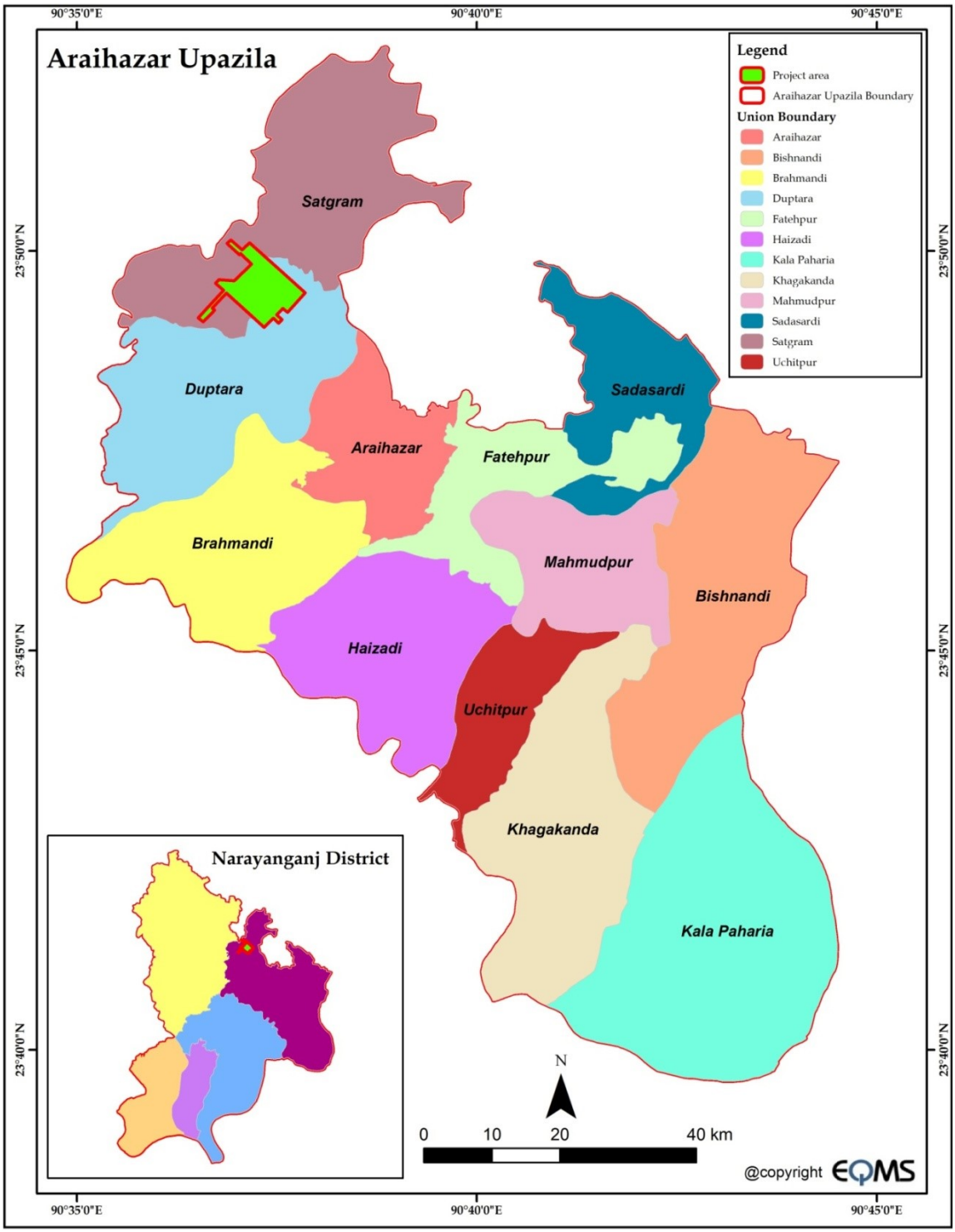
Figure 3-22: Telecommunication Supply Plan

3.11 Map and Survey Information

3.11.1 Project Location

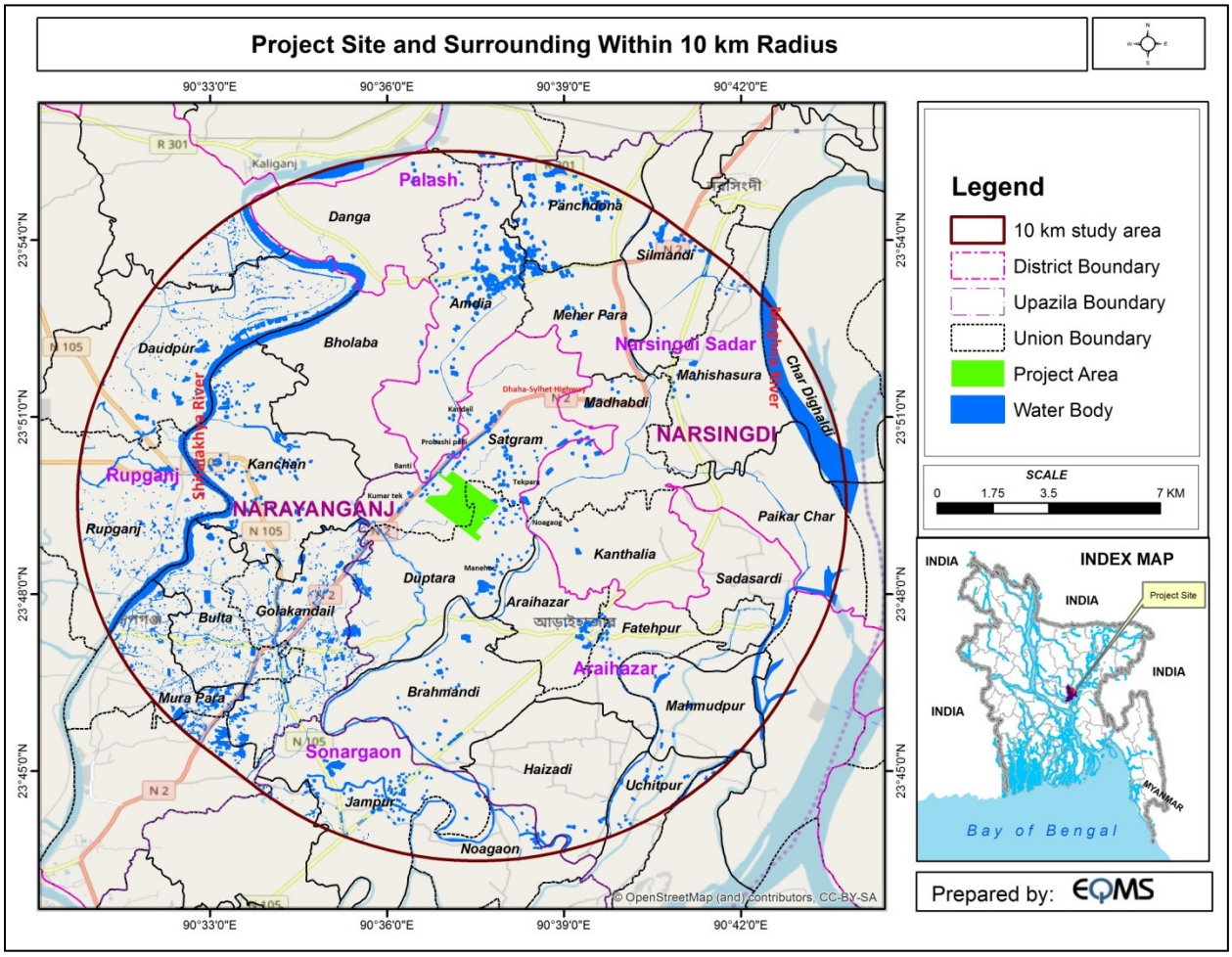
The proposed Araihazar Economic Zone (AEZ) site is located at sonpara village, Mouza: Panchrukhi & Panchgaog, Union: Satgram & Duptara, under Araihazar Upazila which is adjacent to the Dhaka– Sylhet highway. The total land of Araihazar Economic Zone (AEZ) is approximately 218.84ha or 540.77 acres for 1st phase. The project site is near to Dhaka-Sylhet Highway in the north-west direction, Shitalakhya River in west direction and Meghna River is in southeast direction. A canal pass through the proposed project boundary and a brance of Meghna River named Brahmaputra river pass through south direction to northwestern direction. The project area is mainly covers agricultural low land and this location is suitable to access not only for roadway but also river way. The Project site is well connected with Hazrat Shah Jalal International Airport. **Airport access:**30.2 km from Hazrat ShahJalal International Airport (Dhaka), 265 km from Shah Amanat International Airport (Chittagong) & 221 km from Osmani International Airport (Sylhet), **Seaport access:**258 km from Chittagong Sea Port, 248 km from Mongla Sea Port & 314 km from Payra Sea Port, **Road access:** Adjacent Dhaka-Sylhet Highway, **River access:**31.5 km from Narayanganj River Port & 115 km from Chadpur River Port, **Railway station:** 30.3 km from Kamalapur Railway Station, Dhaka. Araihazar Upazila

map showing location of the proposed project site in ***Figure 3-23***. The project surrounding within 10 km region is shown in ***Figure 3-24*** below.



Source: Feasibility & Sustainable Department (FSD), EQMS

Figure 3-23: Economic Zone Location of Araihazar Upazila Map



Source: Open Street Map (and) contributors, CC-BY-SA

Figure 3-24: Project site and surroundings within 10 km radius

3.11.1.1 Existing Infrastructure in and around the Project Site

The proposed AEZ site is located only 300m south-east of Dhaka-Sylhet Highway in Shatgram & Duptara Union of Araihazar Upazila under Narayanganj district. The proposed site is well connected to the capital of Dhaka city through Purbachal Express Highway (N301). In addition, AEZ is well communicable through the country's major river network system. Recently established Pangaon Inland Container Terminal (PICT) established in Keraniganj is only within 32km from the AEZ site.

The site has no infrastructure development at present and requires development of access roads and drainage. The site is on a naturally depressed area, which remains submerged during monsoon and dry in winter. Dhawrakhali canal flows at the middle of the project site which width is approximately 5-7 meters. It's downstream connected with Brahmaputra River which width is 24-27 meters. Brahmaputra River is also connected with Meghna River. After consultation with local fishermen the survey team try to identify the fishing condition of these

khals which were enriching in fish. But now the water becomes polluted for discharging untreated water from various kinds of factories.

Site is required to sand filling. The sand will be transported by engine boat or trawler through Shitalakhya River flowing on the west side of the proposed EZ site. The average water level of Shitalakhya River a 100-year return period is 7.21 m. An existing 132kv Electric Transmission line falls under the project area. Photographs of the proposed EZ site and proposed off-site facility locations are given in ***Figure 3-25*** below.

Proposed Araihazar Economic Zone site

Existing access road of the project

Existing 132kv Electric Transmission Line

Dhaka-Sylhet Highway (N2)

Dhawrakhali Canal inside the EZ

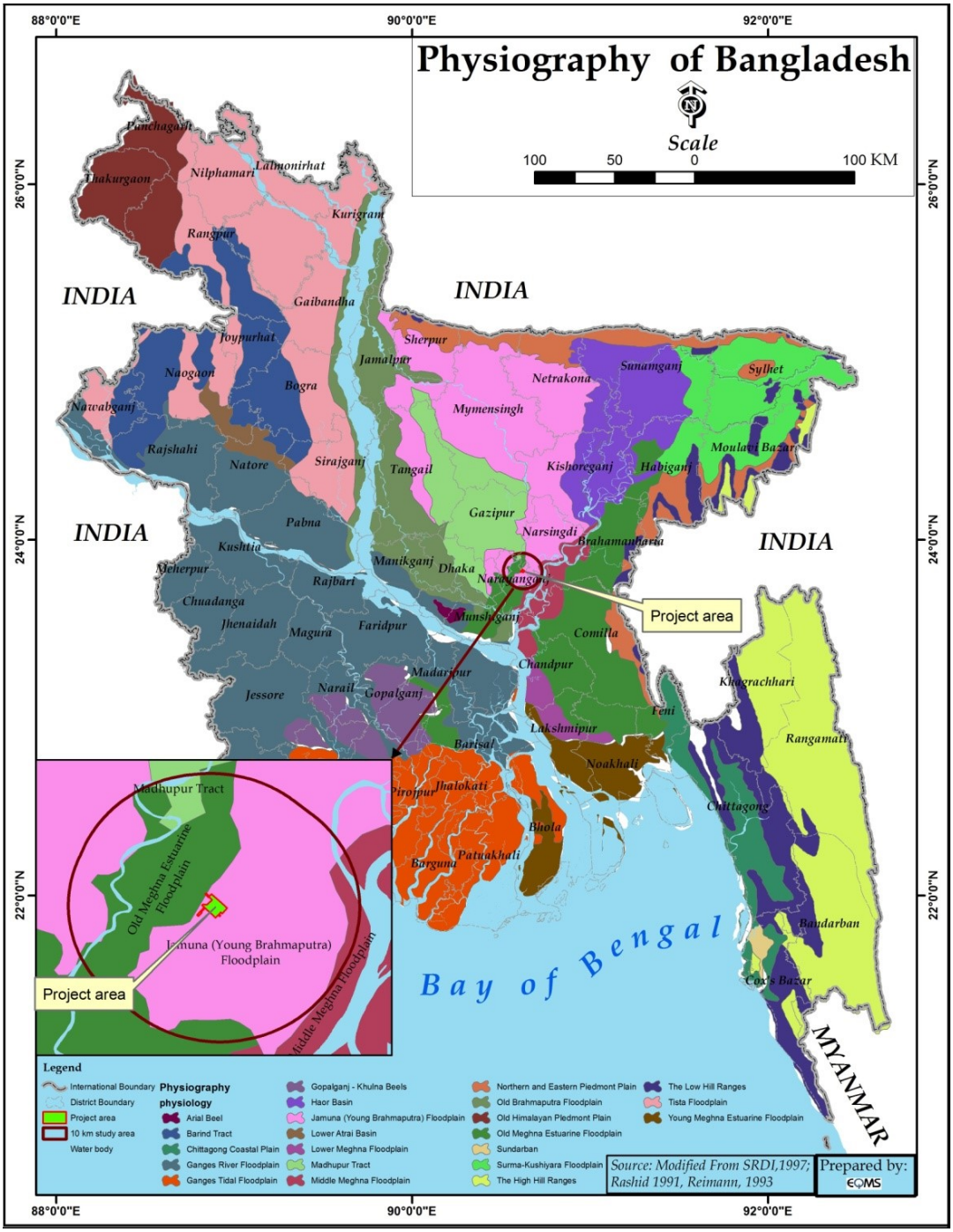
Canal besides Dhaka-Sylhet Highway

Figure 3-25: Photographs of the project site and surrounding area

3.11.2 Topography

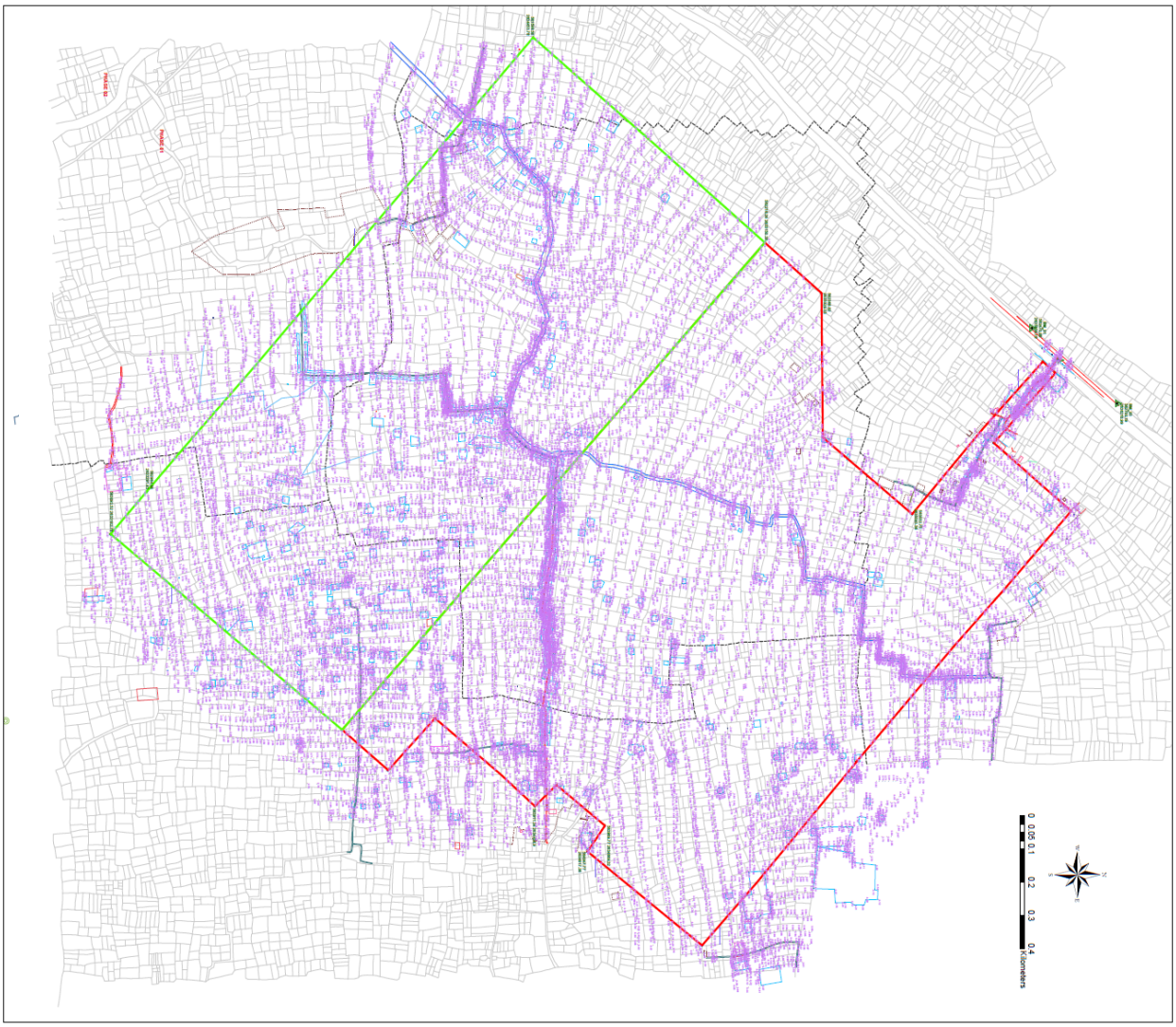
The EZ site is a naturally depressed area, which remains submerged during monsoon and dry in winter. The land use of the project site is agricultural land. Area is classified as a Jamuna (Young Brahmaputra) Floodplain. A river network is present close to the site that floods during monsoon season. A physiographic map of Bangladesh is depicted in ***Figure 3-26***. The Araihazar candidate site is flat agricultural land (paddy field) with an elevation of MSL + 2.5 m, and is submerged in the rainy season. A canal named Dhawrakhali canal pass through the proposed project boundary. The canal has been used for transportation of agricultural products and fertilizers by small boats. The area on the northwestern side of the candidate site, along National Road N2 and along the southwestern side of the river are MSL +4 ~ +5.5 m higher than the agricultural land with scattered village roads, houses, and water ponds. The pavement elevation of the National Highway N2 is higher than local land. It has dropped from MSL +10 m at the southwestern side of the bridge to about MSL +7 m at the northeastern side. Rainwater inside the EZ candidate site flows from the northeast to the southwest and drains into the southwestern side of the river, connecting to the Meghna River. The elevation of the candidate

site is lower than past flood levels of surrounding large rivers such as the Meghna River and the Shitalakshya River. Hence, it is necessary to ensure a surface water diversion around the candidate site after site formation. Topographical Map of Araihazar Economic Zone is given in ***Figure 3-27***. A contour map of 10 km radius area is shown in ***Figure 3-28***.A DEM map of Project area and 10 km radius area is shown in ***Figure 3-29***&***Figure 3-30***.



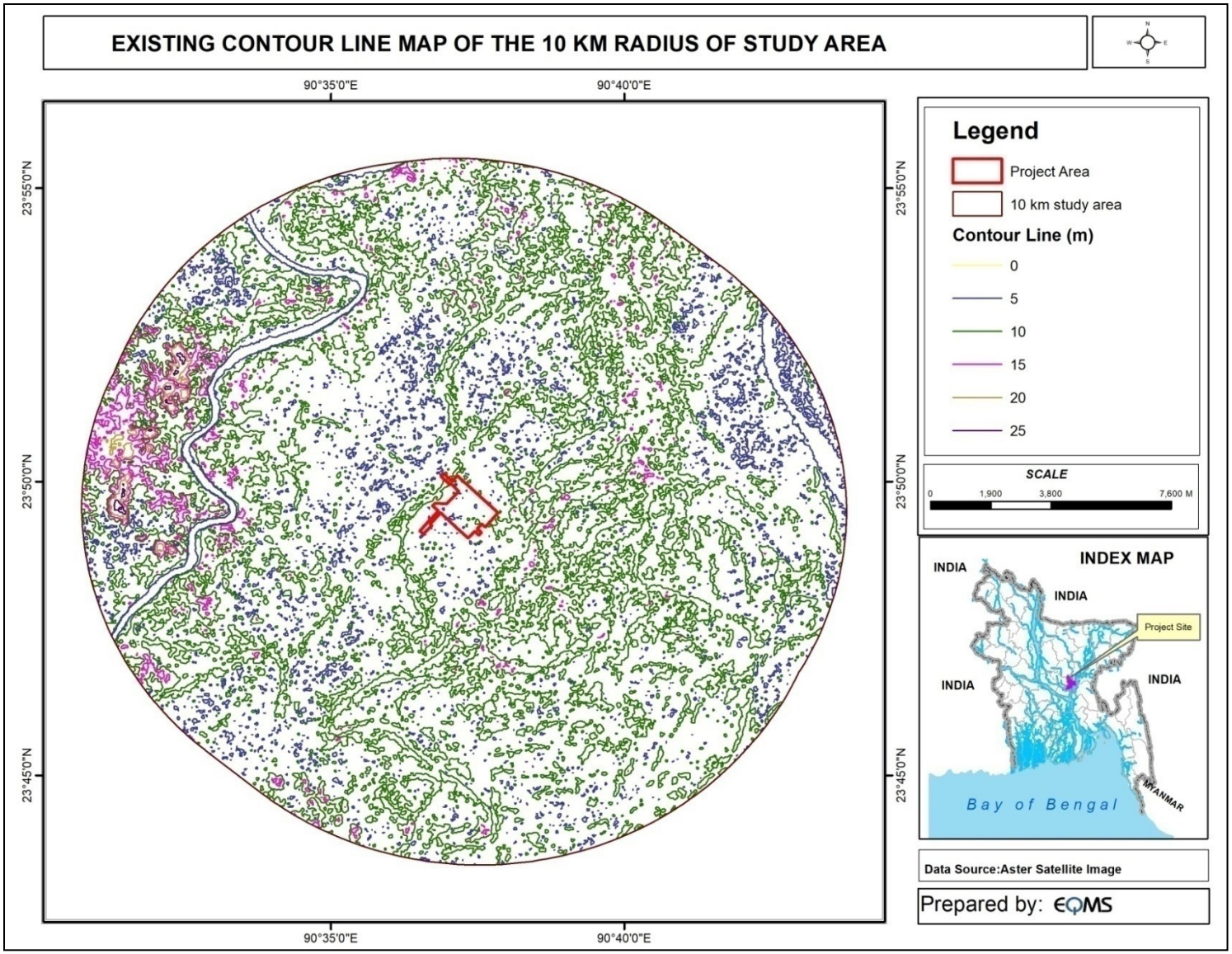
Source: Modified From SRDI, 1997; Rashid 1991, Reimann, 1993

Figure 3-26: Physiographic Map of Bangladesh



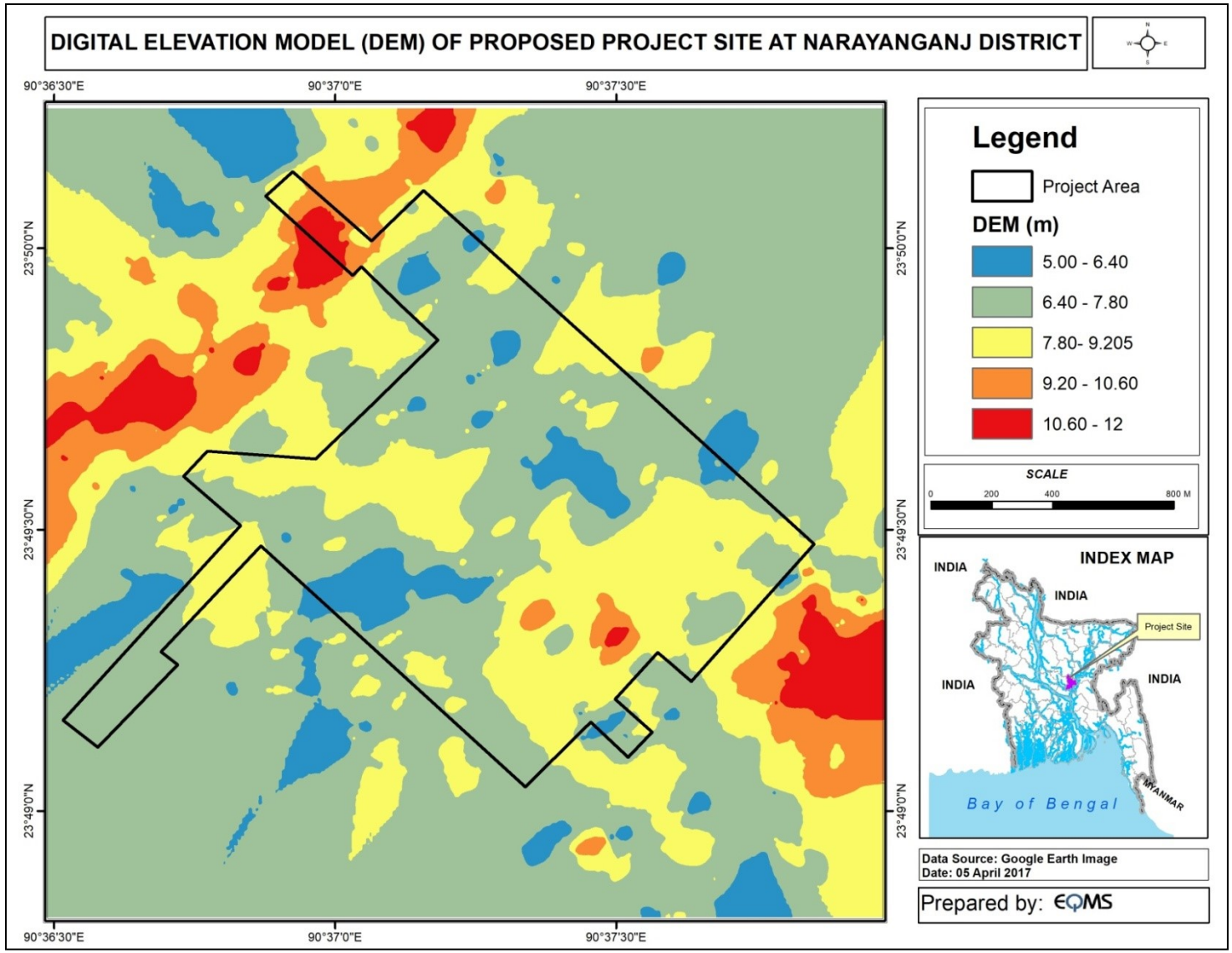
Source: JICA Study Team

Figure 3-27: Topographical map for Araihazar EZ (In progress)



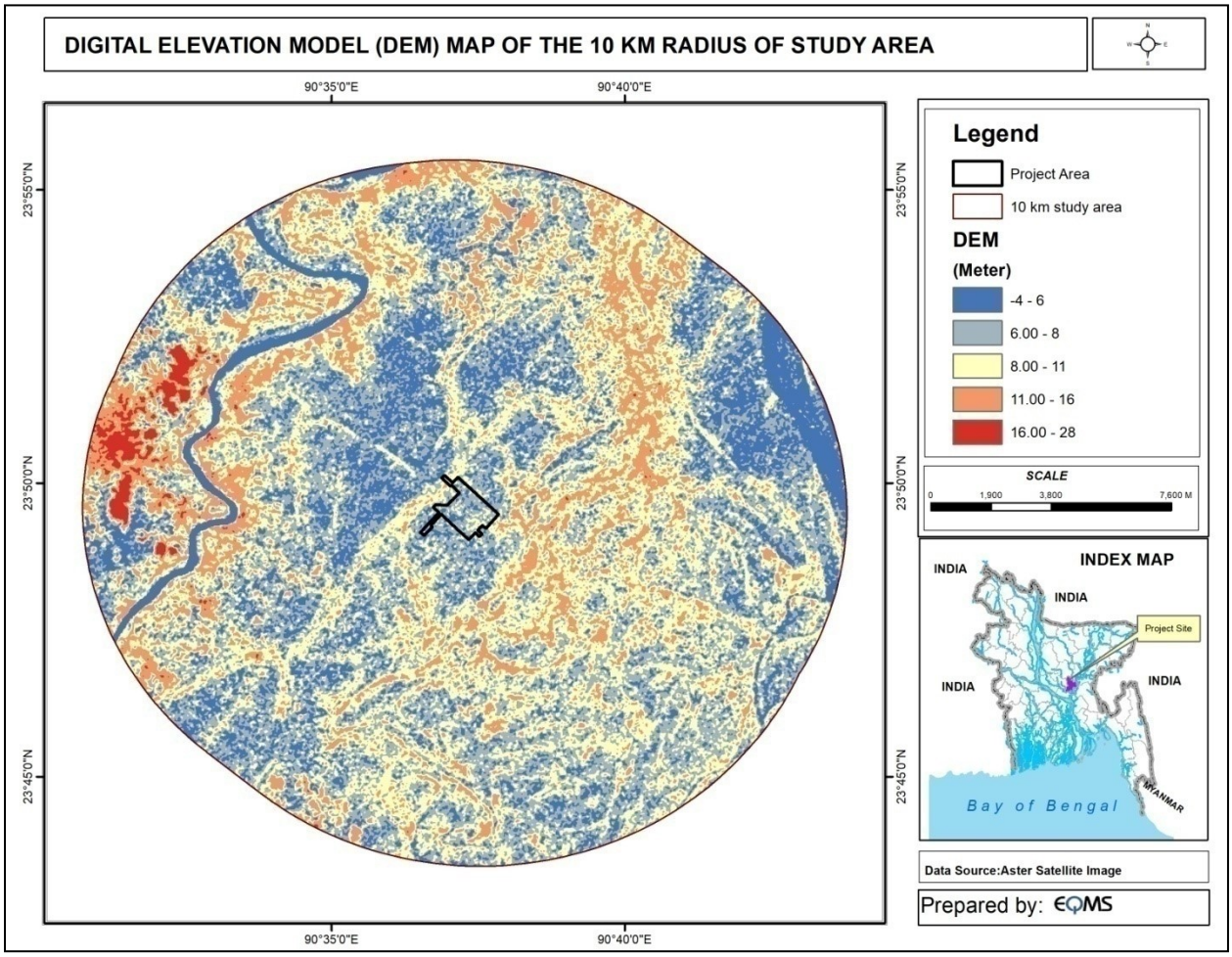
Source: Aster Satellite Image

Figure 3-28: Contour Map of the 10 km radius of Study Area



Source: Google Earth Image

Figure 3-29: DEM Map of the AEZ area



Source: Aster Satellite Image

Figure 3-30: DEM Map of the 10 km radius of Study Area

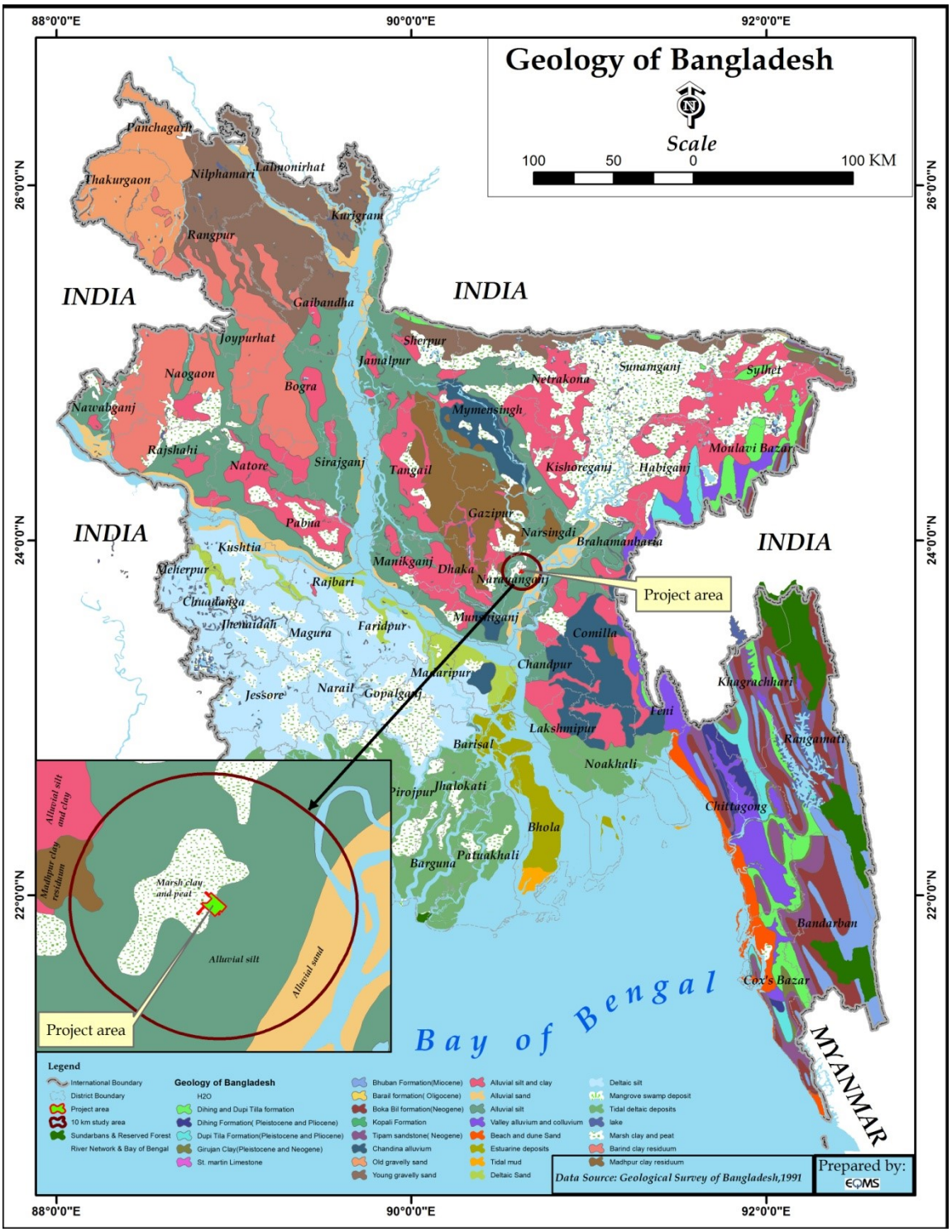
3.11.3 Geology

The study area covers two geology types they are the Marsh clay and peat and Alluvium Silt. The Project area is shown in the geology of Bangladesh Map ***Figure 3-31***.

The geology type of the project area is Marsh clay and peat which is Grey or bluish-grey clay, black herbaceous peat, and yellowish-grey silt. Alternating beds of peat and peaty clay common in bills and large structurally controlled depressions; peat is thickest in deeper parts. Thin beds of peat and clay are inter bedded with alluvial silt in the north-central sylhet depression. Chains of linear lakes north of the Ganges River and south of the Shillong Plateau in the Sylhet depression suggest these areas are subsiding.

The geology type of the project area is alluvial silt light to medium-grey, fine sandy to clay-lade silt. Commonly poorly stratified; the average grain size decreases away from main channels. Chiefly deposited in flood basins and inter stream areas. Unit includes small back swamp deposits and varying amounts of thin, interstratified sand, deposited during episodic or unusually large floods. Illite is the most abundant clay mineral. Most areas are flooded

annually. Included in this unit are thin veneers of sand spread by episodic large floods over flood-plain silts. Historic pottery, artefacts, and charcoal (radiocarbon dated 500-6,000 years BP) are found in upper 4 m.

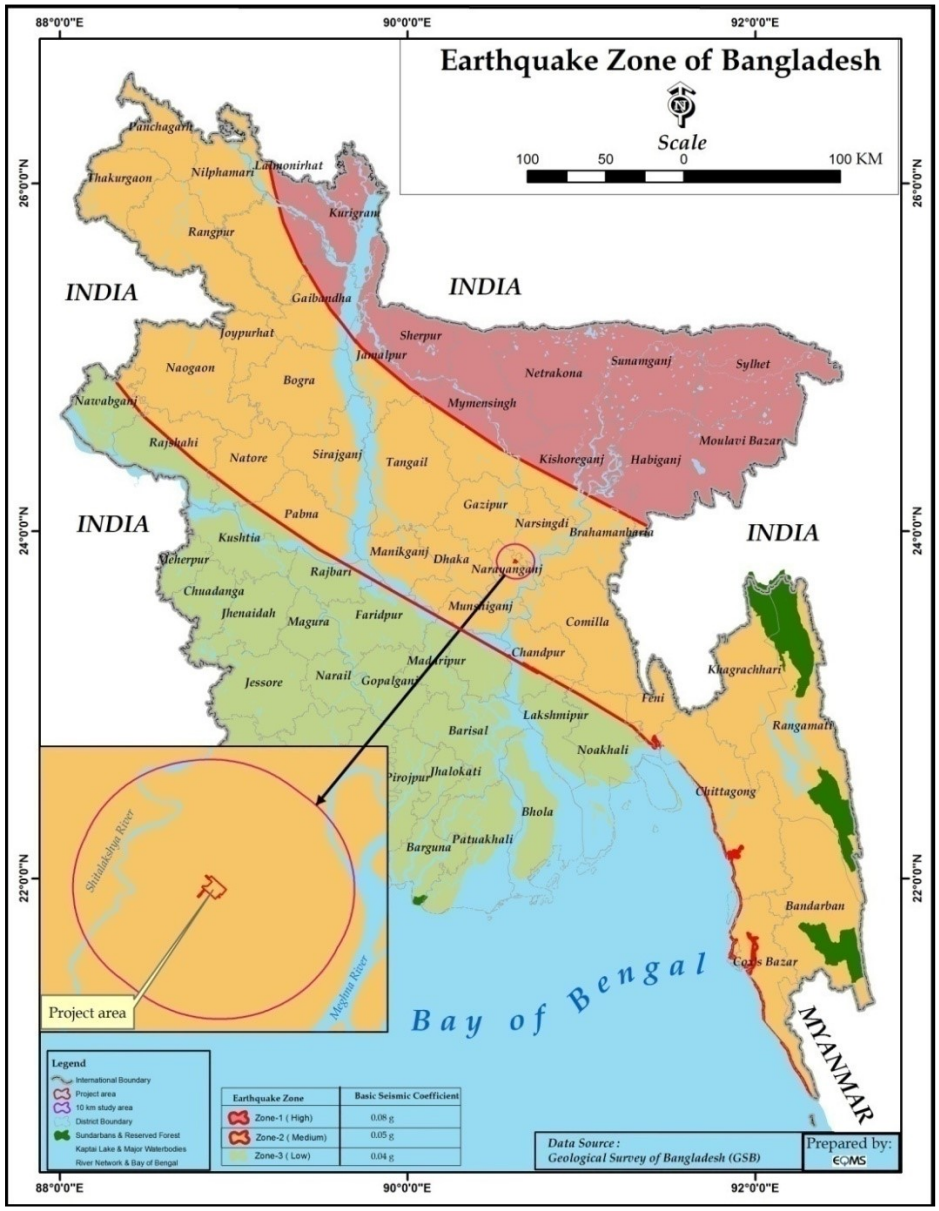


Source: Geological Survey of Bangladesh, 1991

Figure 3-31: Geology of Bangladesh

3.11.4 Seismology

Information on earthquakes in and around Bangladesh is available covering the last 250 years. The earthquake record suggests that since 1900 more than 100 moderate to large earthquakes occurred in Bangladesh, out of which more than 65 events occurred after 1960. There is a slight increase in the frequency of earthquakes in the last 30 years. This increase in earthquake activity is an indication of fresh tonic activity or propagation of fractures from the adjacent seismic zone. However, the most serious damage has occurred in the northern part of Bangladesh and virtually none has been found in the Dhaka region. The AEZ is located in the Zone 2 and its seismic coefficient is 0.05g.



Source: Geological Survey of Bangladesh (GSB)

Figure 3-32: Earthquake Zones of Bangladesh

CHAPTER 4

4. ENVIRONMENTAL AND SOCIAL BASELINE

4.1 Prelude

The environmental status around the proposed project site is analyzed for valuedenvironmental components viz., air, water, land, noise, soil, ecology and socio-economic in a 10km radial radius around the site. The baseline provides the basis for assessment of impact (likely changes in the baseline conditions) due to the proposed interventions (EZ development project).

4.2 Site Description and its Environment

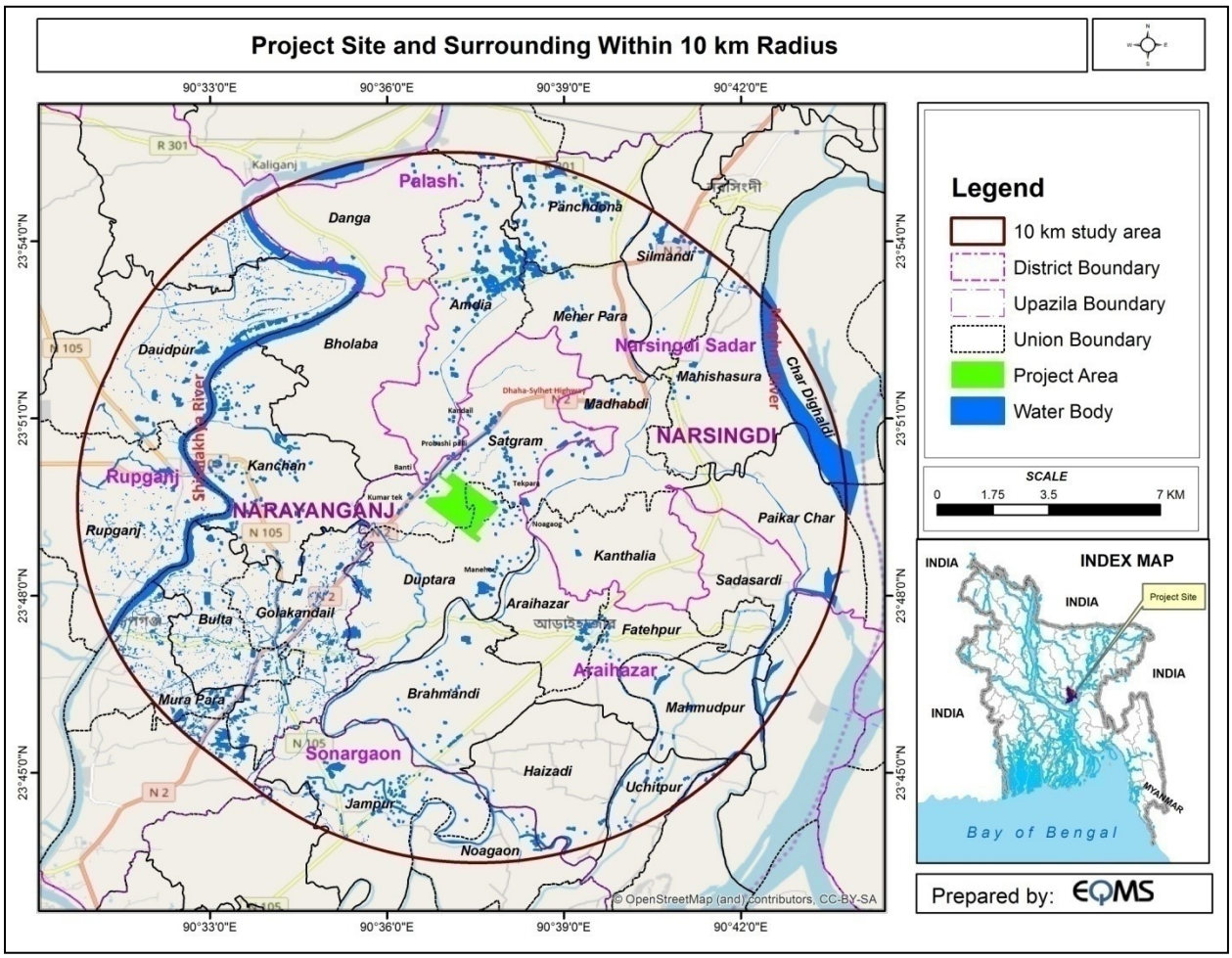
The site and surrounding detailshave already been presented under ***chapter 3***. The study area considered major settings, roads, river, airport, railway and port distance around the AEZ site. The project activity areas are considered as core area and remaining study area as buffer zone. Environment setting around AEZ site and surroundings of access road are given in ***Table 4-1***below.

Table 4-1: Environmental Setting

Particulars	Details
Location	Site is located at Union: Satgram & Duptara, Upazila:Araihajar, District: Narayanganj
Mouza	Panchrukhi& Panchgaon
Nearby Villages	West- Banti, Kumartek North- Kandail, Prabashi palli South-Manehor East- Tekpara, Noagaon
Project Area	Existing area approximately 198.7ha or 540.77 acres
Road Access	Adjacent Dhaka-Sylhet Highway
River Access	Approx. 1.5 km from Brahmaputra River Approx. 5.5 km from Shitalakhya River Approx. 9 km from Meghna River 31.5 km from Narayanganj River Port & 115 km from Chadpur River Port,
Nearest Airport	30.2 km from Hazrat Shah Jalal International Airport (Dhaka), 265 km from Shah Amanat International Airport (Chittagong) 221 km from Osmani International Airport (Sylhet)
Nearest Railway Station	30.3 km from Kamalapur Railway Station, Dhaka
Nearest Port	258 km from Chittagong Sea Port, 248 km from Mongla Sea Port & 314 km from Payra Sea Port

Particulars	Details
Climatic conditions	Avg. Monthly wind speed– 2-5 m/s; Avg. Monthly Min. Temp. – 19.0°C January 1991; Avg. Monthly Max. Temp. – 40.2°C in April 2014; Annual Avg. Rainfall – 1994.6 mm; Average maximum humidity ranges – 94% to 97%; Average minimum average ranges – 31% to 64%;
Seismic Zone	Zone II
Forests / National Parks	None within 10 km
Archaeologically important places/monuments	No Archaeologically importantplaces/monuments near to the site

Source: Google Earth & Site Visits



Source: Open Street Map (and) contributors, CC-BY-SA

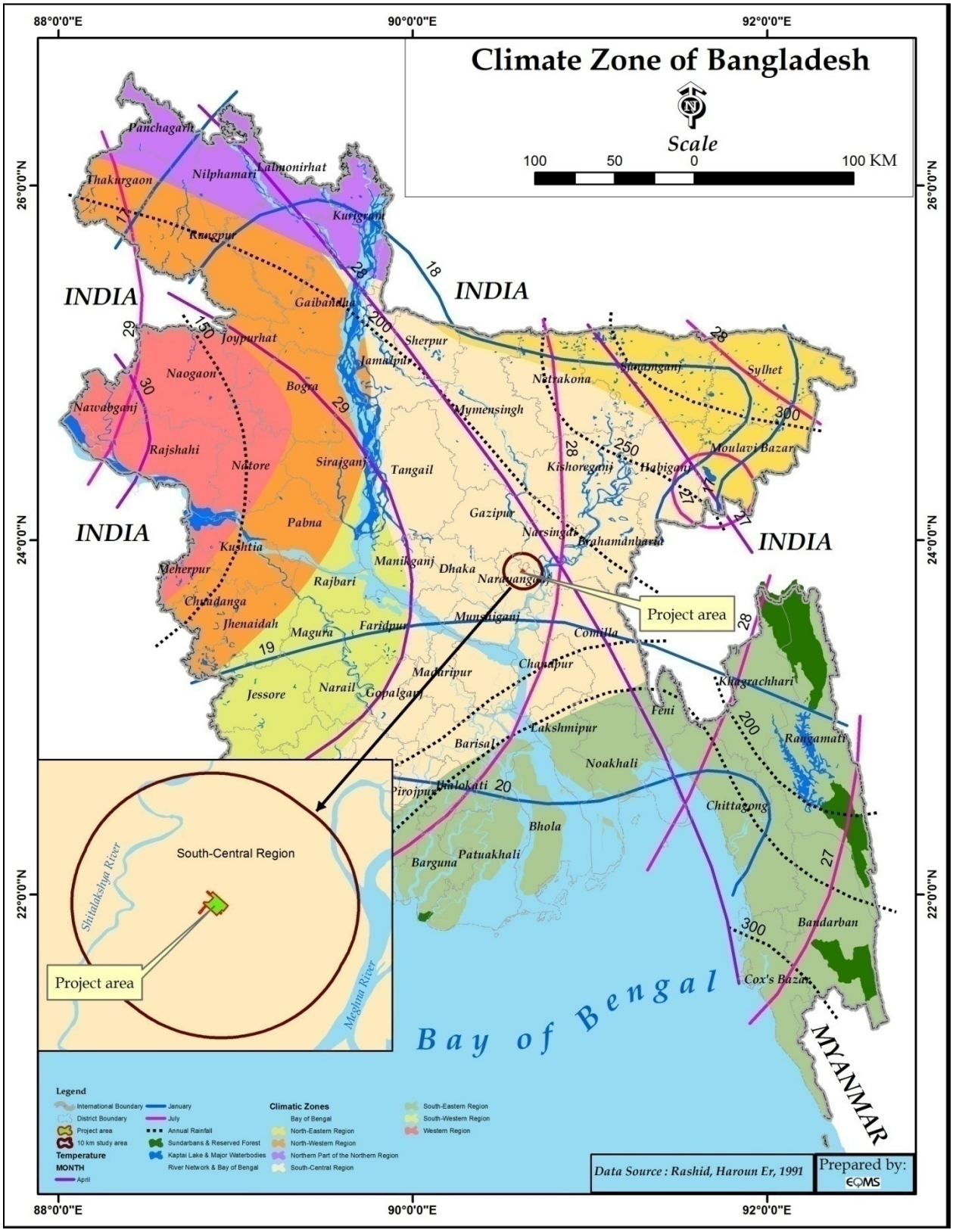
Figure 4-1: Project site and surrounding within 10 km radius

4.3 Meteorology

Bangladesh experiences a subtropical monsoon climate, which is characterized by wide seasonal variations of rainfall, high temperatures and humidity throughout the year. There are three distinct seasons in Bangladesh: hot and humid summer stretches from March to June; a wet and cool rainy season from June to October; and a dry and cold winter from October to March. In general, for most parts of the country, summer temperatures ranges between 30°C to 40°C. April is the warmest month of the calendar. Whereas, January is the coldest month, when the average temperature overmost parts of the country lies around10°C;

Within the study area, Araihazar, falls in the south central climatic sub zone of Bangladesh (***Figure 4-2***). This sub climatic zone experiences abundant rainfall (more than 1,900 mm) and moderate temperatures. Eighty percent 80% of the rain falls during the monsoon season. Hail storms and nor westers are also observed in this area. However, in order to investigate the climatic conditions of the study area Araihazar, data from different secondary sources have been collected.

Long-term Meteorological data of the last 30 years have been collected from the nearest BMD stations (Dhaka) and analyzed to get the overall micro-climatic conditions of the study area.



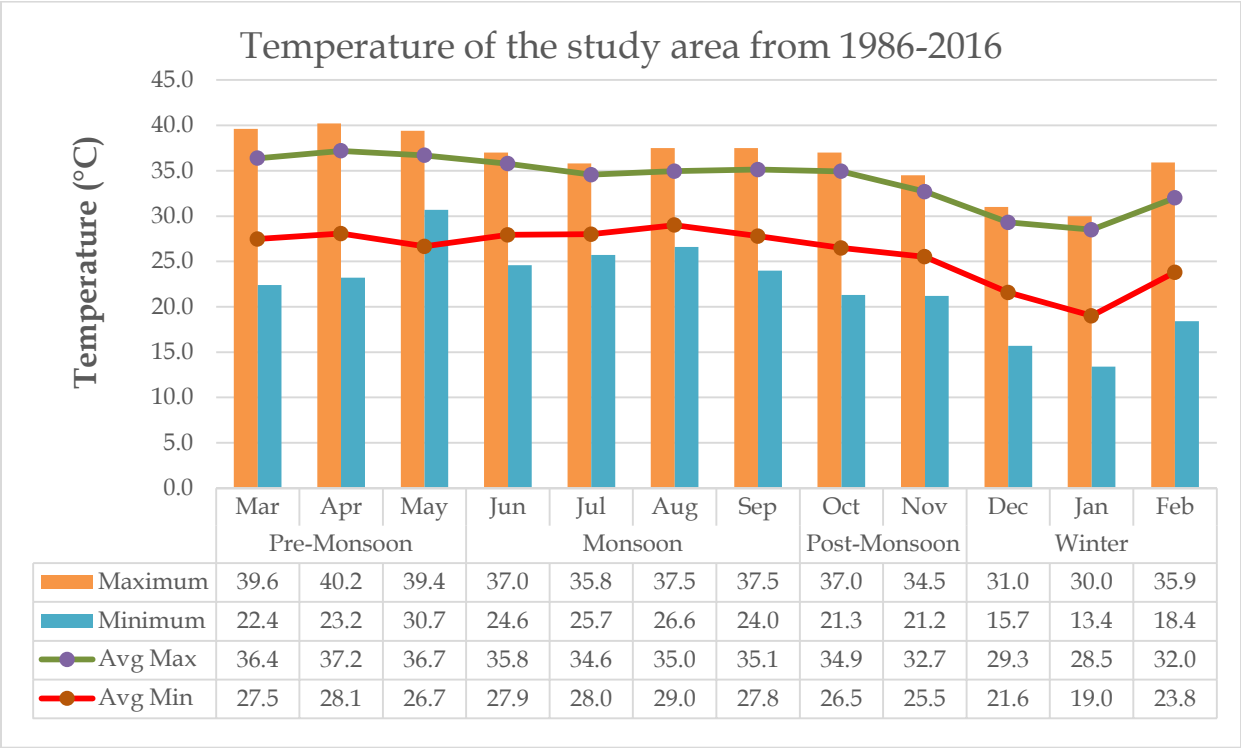
Source: Rashid, Haroun Er, 1991

Figure 4-2: Climate Region Map of Bangladesh

4.3.1 Temperature

The maximum, minimum and average temperatures recorded at the Dhaka weather station are presented below in ***Figure 4-3***.

The data analysis of the last 30 years (1986-2016) indicatesthat monthly maximum temperature varies from 30.0°C to 40.2°C whereas monthly minimum temperature varies from 13.4°C to 26.6°C. The lowest average temperature recorded in the past 30 years was in January 1991 (19.0°C). The highest temperature reached 40.2°C in April 2014. Throughout the year the highest temperatures are generally recorded from March to October, and the lowest temperatures from December to January.



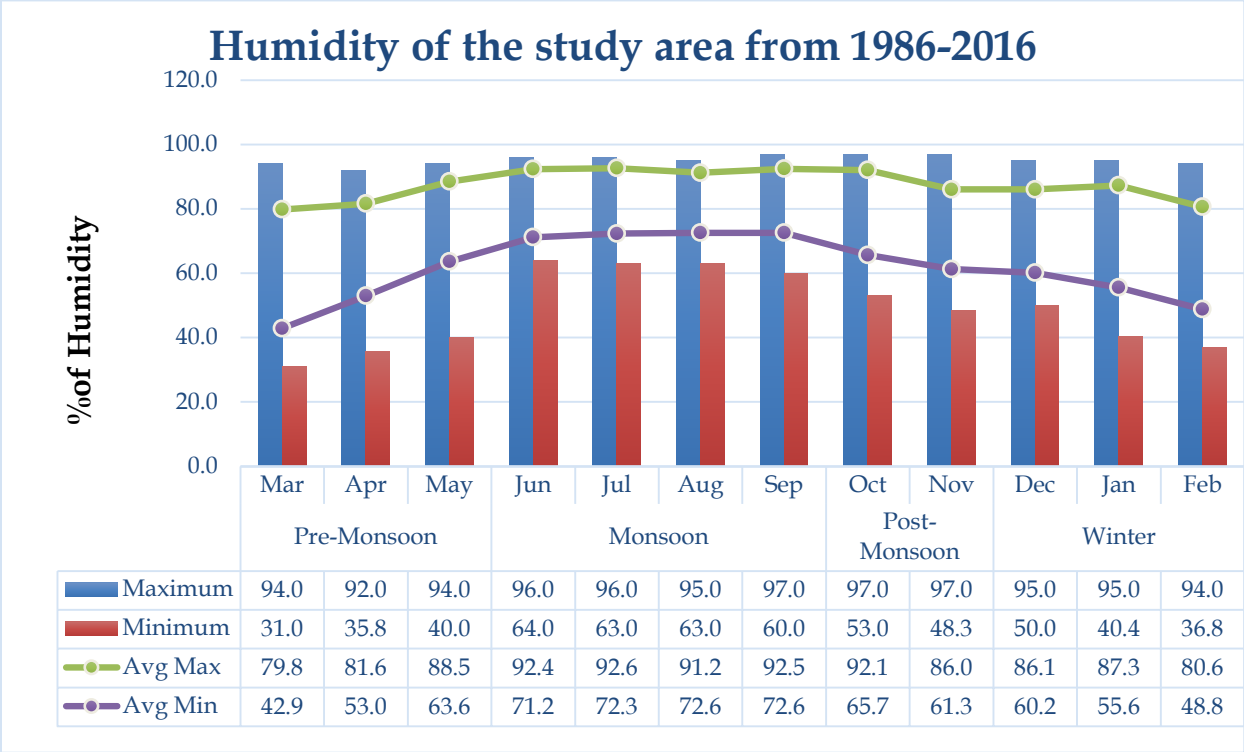
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
	Pre-Monsoon			Monsoon				Post-Monsoon		Winter		
Maximum	39.6	40.2	39.4	37.0	35.8	37.5	37.5	37.0	34.5	31.0	30.0	35.9
Minimum	22.4	23.2	30.7	24.6	25.7	26.6	24.0	21.3	21.2	15.7	13.4	18.4
Avg Max	36.4	37.2	36.7	35.8	34.6	35.0	35.1	34.9	32.7	29.3	28.5	32.0
Avg Min	27.5	28.1	26.7	27.9	28.0	29.0	27.8	26.5	25.5	21.6	19.0	23.8

Source: Bangladesh Meteorological Department, Dhaka

Figure 4-3: Monthly Maximum, Minimum and Average Temperatures (1986-2016) registered at the Dhaka Weather Station

4.3.2 Humidity

Due to the heavy rainfall and high air temperature, the humidity levels in Bangladesh remains high. Analyzing the meteorological data, it has been found that during the pre-monsoon period the humidity level remained at its lowest point. Within the study area, February is the driest month with an average minimum of around 49% humidity. However, humidity increases to maximum in the monsoon period. The average maximum humidity ranges from 94% to 97%, whereas the minimum average ranges from 31% to 64%. The monthly maximum, and maximum averages and minimum, minimum average of the last 30 years (1986-2016) of registered Dhaka weather station are shown in the ***Figure 4-4***.

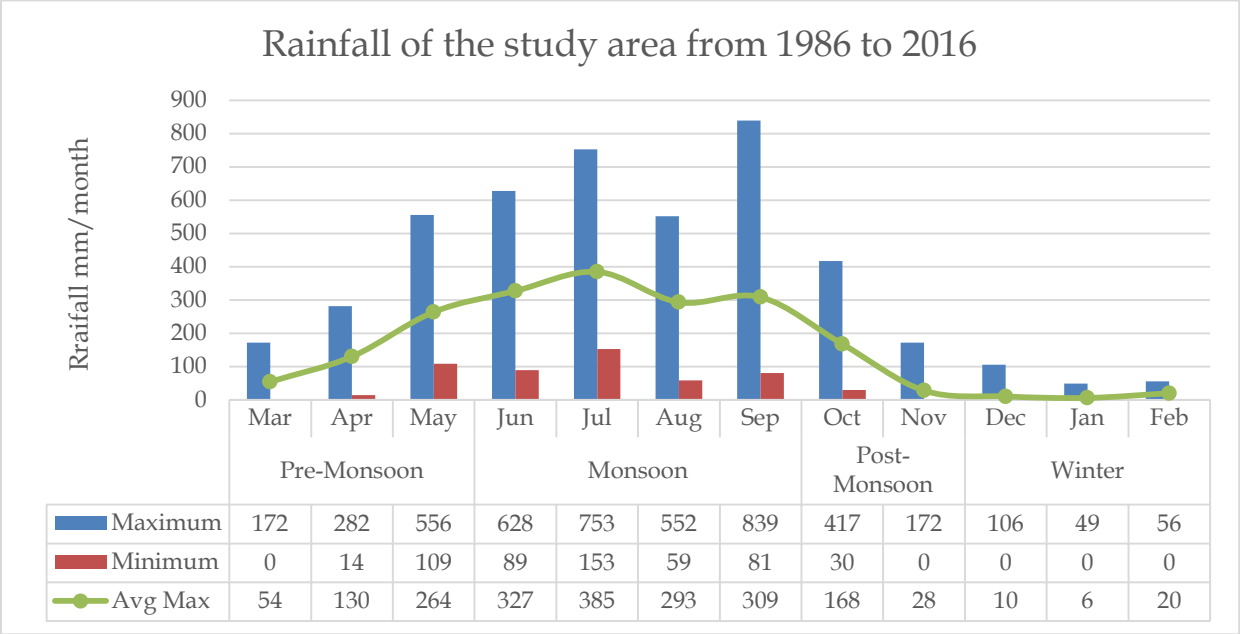


Source: Bangladesh Meteorological Department, Dhaka

Figure 4-4: Monthly Maximum, Minimum and Average Humidity (1984-2014) registered at the Dhaka Weather Station

4.3.3 Rainfall

About 80% of the rainfall occurs during the six monsoon months (May to October) with June and July getting the maximum average rainfall. Minimum rains are reported during the months of November to February whereas the average showering occurs in March, April and November. The meteorological data of the last 30 years from the Dhaka meteorological station shows that the annual average of total rainfall recorded as 1,994.6 mm/year. According to the analysis of the historical data, the monthly average of total rainfall occurs in July at 1,049 mm whereas monthly minimum rainfall is recorded during the winter season. The monthly maximum, minimum and average rainfall data of the last 30 years (1986-2016) registered at the Dhaka weather station is shown in the ***Figure 4-5.***



Source: Bangladesh Meteorological Department, Dhaka

Figure 4-5: Monthly Maximum, Minimum and Average Rainfall (1986-2016) registered at the Dhaka Weather Station

4.3.4 Evaporation

Evapo-transpiration reaches its maximum level in April when temperature, sunshine and wind are all at, or close to, their maximum levels for the year. Potential evapo-transpiration data for Dhaka stations presented in ***Table 4-2***. In Dhaka, evapo-transpiration varies from60 to 147 mm/day and yearly evapo-transpiration in Dhaka is 1245 mm/day.

Table 4-2: Monthly Potential Evapo-Transpiration Data of Dhaka Meteorological Station

Location	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Yearly
Dhaka	67	83	132	147	138	111	113	115	106	98	75	60	1245

Source: Bangladesh Meteorological Department, Dhaka

4.3.5 Wind Speed and Direction

Like the countries wind characteristics, the region characterized by Southerly wind from the Bay of Bengal during monsoon and Northwesterly wind from Himalaya during winter. As per BMD, windiest month is May with average wind speed of 2.6 knot and least windy month is October with average wind speed of 0.6 knot. Average monthly wind speed data of the Dhaka meteorological station given in ***Table 4-3***.

Table 4-3: Average Monthly Wind Speed Data of Dhaka Meteorological Station

Location	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Yearly
Dhaka	1.2	2	1.6	2	2.6	2	2	1.2	2	0.6	1	0.9	1.6

Source: Bangladesh Meteorological Department, Dhaka

4.3.6 Sun Shine Hours

The monthly average sunshine hour in Dhaka varies from 3.7 to 8.3 hour/day in a year. Highest average sunshine hours recorded in month of March. In general, maximum average sunshine hour data of 12 hour in a day found in March, April & May.

4.4 Air Quality and Noise

4.4.1 Ambient Air Quality

The objective of the ambient air quality-monitoring program was to establish the baseline ambient air quality in the study area. The profile of the study area is mainly Semi urban, which has a mix of scattered settlements, Industries and agriculture areas. Major possible source of air pollution in this area is industrial activities. Other activities, which add to the air pollution, are vehicular movement, dredging and filling activities, agricultural activities, and domestic emissions.

The air quality monitoring locations selected based on the locations of settlements and receptors within the study area. Logistical factors such as consent of villagers, mainly the house owners, power connection, accessibility, security, etc. have also been taken into account in finalising the monitoring stations.

Methodology of Air Quality Monitoring

The existing ambient air quality of the study area monitored at Four (4) locations during the monitoring period (September& October 2017). The monitoring parameters included Particulate Matter (SPM, PM_{10} and $PM_{2.5}$), Sulphur Dioxide (SO_2), Oxides of Nitrogen (NOx), and Carbon Monoxide (CO). SPM and CO monitored for 8 hours with the remaining parameters monitored on a 24-hourly basis during the study period.

Selection of sampling locations

The baseline status of the ambient air quality has been established through a scientifically designed ambient air quality-monitoring network. The ambient air quality monitoring locations ***(Figure 4-6)***are based on the following aspects covered in the field survey plan developed prior to the fieldwork:

- Meteorological conditions of the area are based on information provided by the BMD observatory at Dhaka;
- Topography of the study area; and
- Location of sensitive receptors such as major settlements;

The particulate and gaseous samples collected during the monitoring have been analysed as per the procedures specified in ***Table 4-4***. The geographical locations and setting of the ambient air quality monitoring locations has been presenting in ***Table 4-5***.

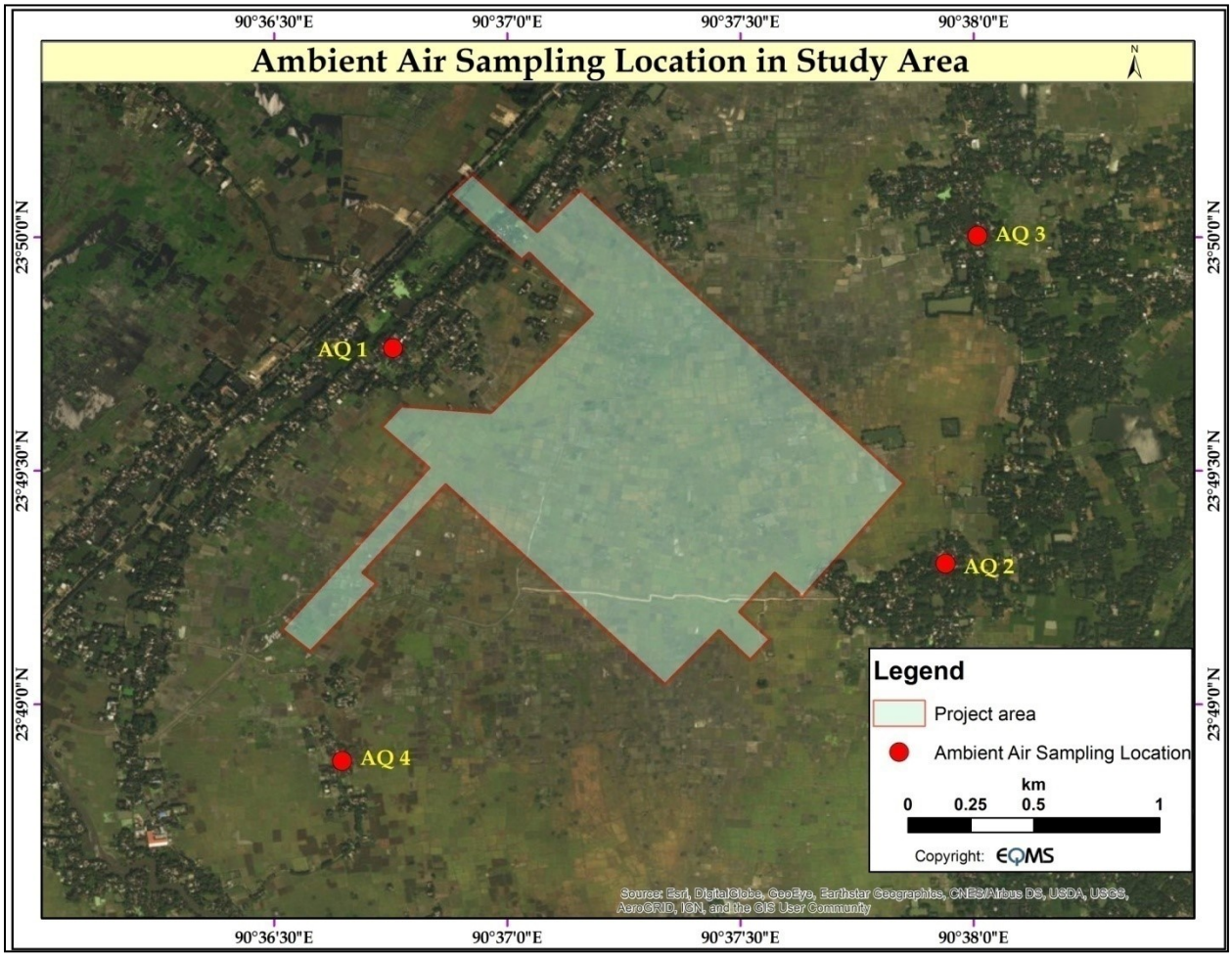
Table 4-4: Methodology for Analysis of Ambient Air Quality

Sl.	Parameter	Analysis procedure
1.	SPM	Gravimetric method
2.	PM10	Gravimetric method
3.	PM2.5	Gravimetric method
4.	SO_2	Colorimetric method at 560nm using spectrophotometer readings (West-Gaeke method)
5.	NOx	Colorimetric method at 540 nm using spectrophotometer readings (Jacob and Hochheiser method)
6.	CO	Digital CO meter

Table 4-5: Ambient Air Quality Sampling Locations

Sl.	Sampling Station	Station Code	Geographic Location	Location Setting
1.	In front of Nurul Haque House;Vill: Maizpara, Union: Satgram, Upazila: Araihazar	AQ1	23°49'45.8"N 90°36'45.3"E	Rural
2.	In front of Panchbaria Boro bari;Vill: Panchbaria, Union: Duptara,Upazila: Araihazar	AQ2	23°49'18.1"N 90°37'56.4"E	Rural
3.	In front of Tekpara govt. primary school; Vill: Tekpara, Union: Satgram, Upazila: Araihazar	AQ3	23°50'00.4"N 90°38'00.5"E	Rural
4.	In front of Rahim sekh house;Vill: Shingrati, Union: Duptara,Upazila: Araihazar	AQ4	23°48'52.59"N 90°36'38.57"E	Rural

Air Quality Monitoring Pictures



Source: Esri, Digital Globe, Geo Eye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, Aero GRID, IGN, and the GIS User Community

Figure 4-6: Air Quality Monitoring Locations

Ambient Air Quality in the Study Area

The monitored ambient air qualities are summarized in ***Table 4-6***.

Table 4-6: Ambient Air Quality in the Study Area

Sl.	Sampling Station Code	Ambient air pollution concentration					
		$PM_{2.5}$	PM_{10}	SPM	SO_2	NOx	CO
	Unit	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	ppm
1.	AQ1	46.6	105.2	152.1	8.4	27.5	2
2.	AQ2	27.8	83.6	120.3	5.3	17.8	0.25
3.	AQ3	32.8	92.4	135.5	6.8	20.1	1
4.	AQ4	25.3	78.3	109.4	4.2	14.3	0.23
Duration (hours)		24	24	8	24	24	8
Weather Condition		Sunny					

Sl.	Sampling Station Code	Ambient air pollution concentration					
		$PM_{2.5}$	PM_{10}	SPM	SO_2	NOx	CO
	Unit	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	ppm
Bangladesh Standard (*according to Environmental Conservation Rules' 1997 and subsequent amendment in 2005*)		65	150	200	365	65	9
IFC EHS Guideline (2007)		75 (24 hr) 35 (year)	150 (24 hr) 70 (year)	-	500(10 min) 125 (24 hr)	200 (1 hr) 40 (year)	-
Method of analysis		Gravimetric	Gravimetric	Gravimetric	West-Geake	Jacob and Hochheiser	Indicator tube

Note:
** CO concentrations and standards are 8-hourly only.*
*** The Bangladesh National Ambient Air Quality Standards have been taken from the Environmental Conservation Rules, 1997 which was amended on 19thJuly 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 EHS Guidelines (2007)*

Analysis and Discussion of Result

PM2.5

The 24-hourly average PM2.5 concentration in ambient air in the study area was recorded in the range of 25.3µg/m³ – 46.6µg/m³. All the monitoring locations result was within the 24-hourly National Ambient Air Quality Standard (NAAQS) for PM2.5 in Bangladesh.

PM10

The 24-hourly average PM10 concentration in ambient air in the study area was recorded in the range of 78.3µg/m³–105.2µg/m³. During the monitoring period, the maximum PM10 concentration was reported from project site as 105.2µg/m³. PM10 level (average) at all monitoring locations were reported below the NAAQS.

SPM

The 24-hourly average SPM concentration in ambient air in the study area was recorded in the range of 109.4µg/m³–152.1µg/m³. During the monitoring period, the maximum SPM concentration was reported from project area as 152.1µg/m³. SPM level of the four locations were reported below the National Ambient Air Quality Standards of Bangladesh.

SO_2

The 24-hourly average SO_2 concentration was recorded in the range of 4.2µg/m³– 8.4µg/m³. During the monitoring period, the maximum SO_2 concentration was reported at project site as 8.4µg/m³. SO_2 concentrations at all the monitoring locations were reported well below 365µg/m³, which is National Ambient Air Quality Standard (NAAQS) for SO_2 in Bangladesh.

NOx

The 24-hourly average NOx concentration was recorded in the range of 14.3µg/m^3– 27.5µg/m^3. There are no stipulated standards for 24-hourly NOx concentration in Bangladesh. The annual Bangladesh standard for NOx is 65 µg/m^3 and present concentrations at all the locations are well below this value.

CO

The 8-hourly CO concentration was recorded at AQ1, AQ2, AQ3 and AQ4 below 2ppm. CO concentrations were reported low at all the monitoring locations while comparing with the Bangladesh Standards (9ppm).

4.4.2 Ambient Noise Levels

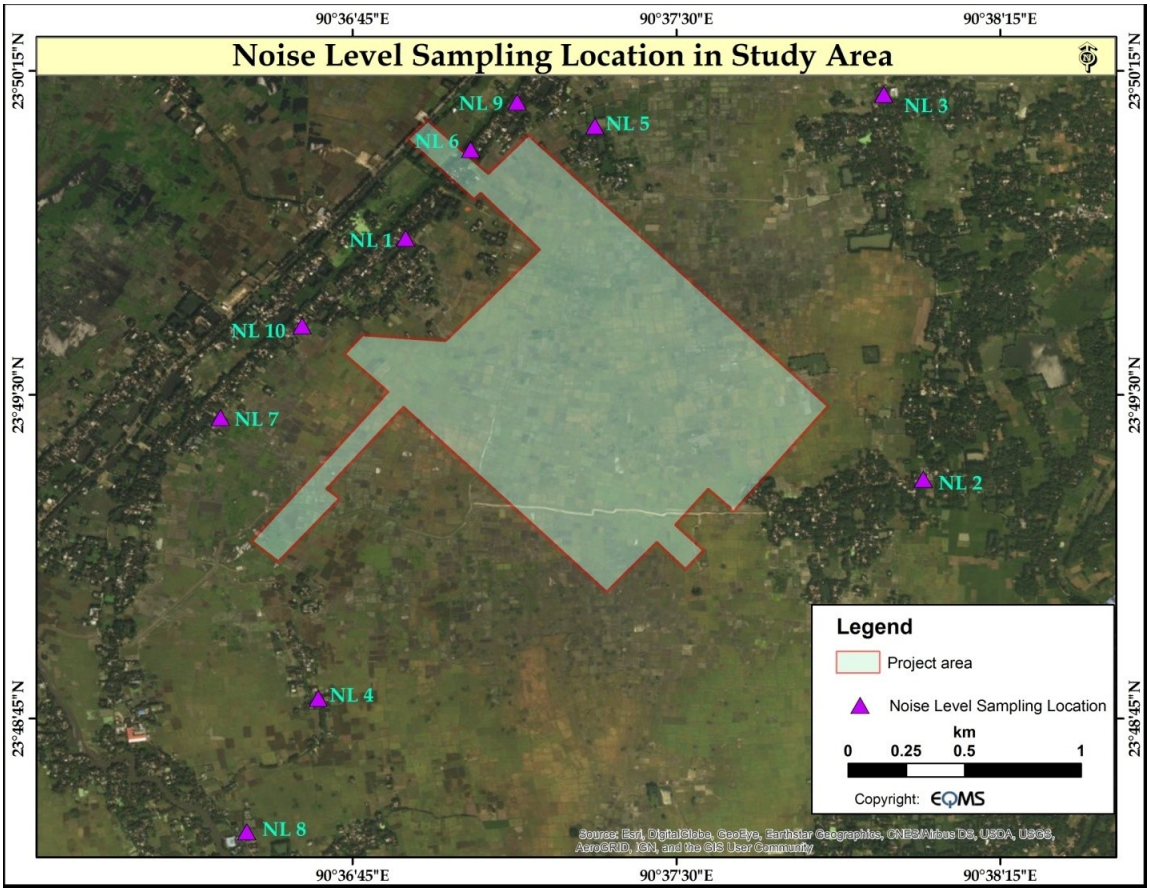
Noise levels were recorded at ten (10) locations in the study area during the monitoring period. Noise levels were recorded in the form of sound pressure levels with the help of a digital sound level meter. The details of noise monitoring locations are shown in ***Table 4-7***. The purpose of ambient noise level measurement was to determine sound intensity at the monitoring locations. These locations were chosen in such a way that a representative data could be record all over the block. The sound level recorded in form of A-weighted equivalent continuous sound pressure level (Leq) values with the use of A-weighting filters in the noise-measuring instrument.

Table 4-7: Details of Ambient Noise Monitoring Locations

Sl.	Location	Location Code	Geographic location	Location setting
1.	In front of Abdul Barez House; Vill: Maizpara, Union: Satgram	NL1	23°49'51.9"N 90°36'52.4"E	Residential
2.	In front of Danis Market; Vill: Panchbaria, Union: Duptara	NL2	23°49'18.2"N 90°38'04.5"E	Commercial
3.	In front of Israil House; Vill: Tekpara, Union: Satgram, Upazila: Araihajar	NL3	23°50'11.8"N 90°37'58.8"E	Residential
4.	In front of Arju mia house; Vill: Shingrati, Union: Duptara	NL4	23°48'47.6"N 90°36'40.0"E	Residential
5.	In front of Sonpara bonder Bari Jame Mosque; Vill: Sonpara, Union: Satgram	NL5	23°50'07.4"N 90°37'18.7"E	Silent
6.	In front of Sonpara govt. primary school; Vill: Sonpara, Union: Satgram	NL6	23°50'04.1"N 90°37'01.4"E	Silent
7.	In front of Naziruddin community clinic; Vill: Panchrukhi, Union: Satgram	NL7	23°49'26.8"N 90°36'26.6"E	Silent
8.	In front of Methila group;	NL8	23°48'28.9"N	Industrial

Sl.	Location	Location Code	Geographic location	Location setting
	Vill: Shingrati, Union: Duptara		90°36'30.3"E	
9.	In front of Rafiq molla house; Vill: Sonpara, Union: Satgram,	NL9	23°50'10.8"N 90°37'07.9"E	Residential
10.	In front of Nurul hoque house; Vill: Panchrukhi, Union: Satgram,	NL10	23°49'39.6"N 90°36'38.0"E	Residential

Noise Level Monitoring Pictures



Source: Esri, Digital Globe, Geo Eye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, Aero GRID, IGN, and the GIS User Community

Figure 4-7: Noise Monitoring Locations

Recorded noise level has been in ***Table 4-8***.

Table 4-8: Noise Level Parameter in and Around the Proposed Site

Location	Noise level (dB(A))				Applicable standard (dB(A))*		IFC EHS Guideline (2007)		Location setting
	$L_{eq\ (day)}$	$L_{eq\ (night)}$	L_{max}	L_{min}	Day	Night	Day	Night	
NL1	54	44.5	72	43.3	55	45	55	45	Residential
NL2	63.8	59.9	70.1	58.7	70	60	70	70	Commercial
NL3	62.6	47.5	72	44.2	55	45	55	45	Residential
NL4	54.5	44.3	75.7	43.1	55	45	55	45	Residential
NL5	49.2	39.8	70.4	39.4	50	40	55	45	Silent
NL6	55.3	43.8	76.6	39.6	50	40	55	45	Silent
NL7	63.5	57.4	84.8	56.5	50	40	55	45	Silent
NL8	65.9	60.5	78	57	75	70	70	70	Industrial
NL9	54.6	44.9	81.7	42.6	55	45	55	45	Residential
NL10	52.2	44.6	71.7	43.4	55	45	55	45	Residential

*Environmental Conservation Rules, 1997 (subsequent amendment in 2006)

Table 4-8summarizes the measured ambient noise levels at each monitoring location. The noise level at some locations within the study area was well within the standard limit of ECR'97 (subsequent amendment in 2006). The project area falls into residential area according to the Bangladesh Environmental Quality Standard ECR'97 categorization.

4.5 Water Resources

4.5.1 Surface Water System

The nearby surface water source of the proposed site for the Economic Zone is Dhawrakhali canal. Major water body within 10 km study area is Shitalakhya River and Meghna River. Other water bodies in the 10 km radius area are some canals and ponds.

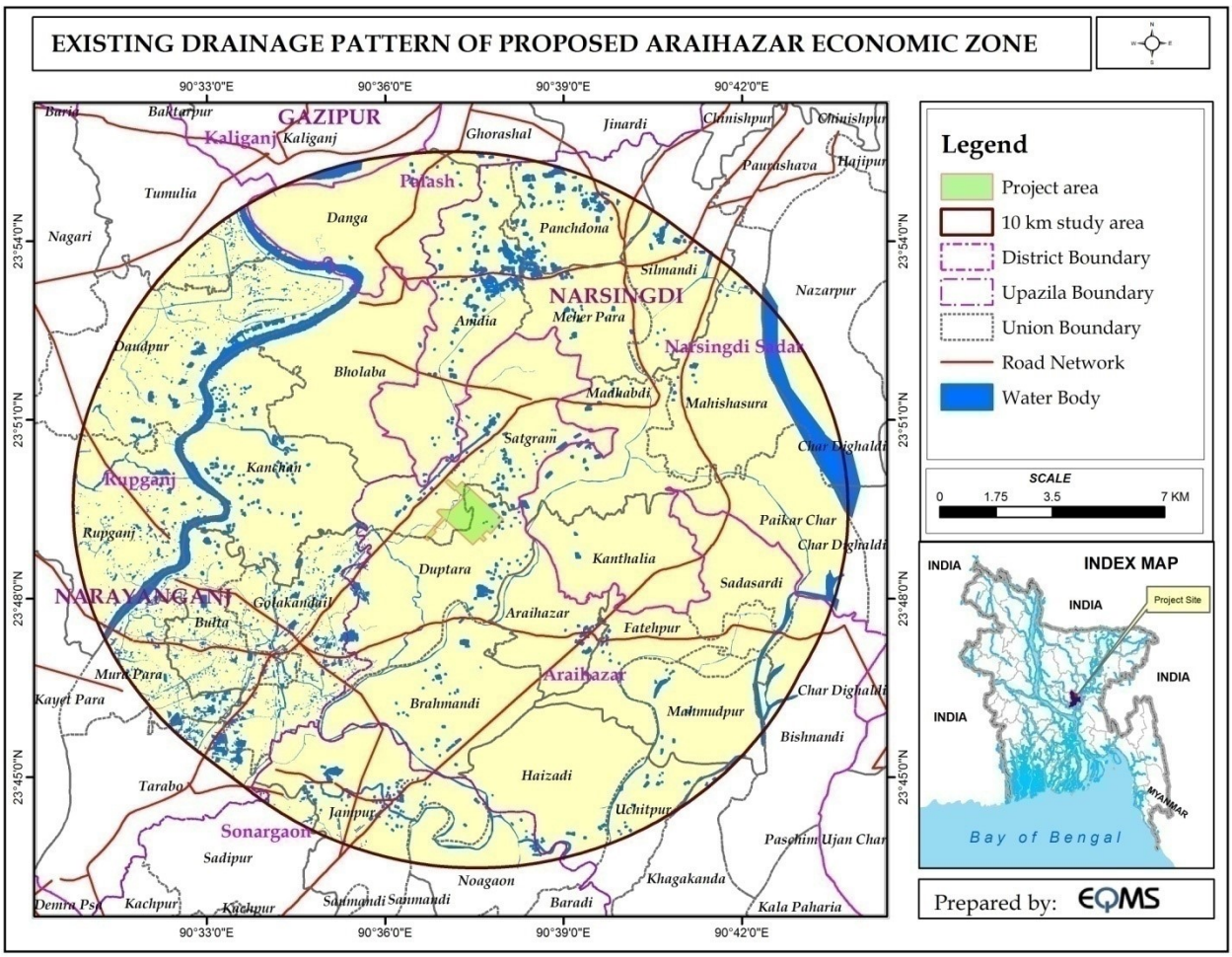
Dhawrakhali canal flows at the middle of the project site which width is approximately 5-7meters. It's downstream connected with Brahmaputra River which width is 24-27 meters. The Brahmaputra River falls in the confluence of the Meghna, Shitalakhya and Buriganga River after running approximately 44.30 kilometers from the meeting point of Dhawrakhali Canal and Brahmaputra River. The Haria and Bishnondi water intake point of Dhaka WASA is approximately 14 and 28 kilometers upstream of Meghna River from the meeting point of Brahmaputra and Meghna River. The following Figure 4-9 is showing the Brahmaputra River network and water intake point of DWASA in Meghna River.

After consultation with local fishermen the survey team try to identify the fishing condition of these khals which were enriching in fish. Now the water becomes polluted for discharging untreated water from various kinds of factories.

The Shitalakhya River originates from the Old Brahmaputra River and is part of the Old Bhahmmapura-Lakhya-Meghna river system. The Shitalakhya flows down toward the south and joins the lower Daleswari near Narayanganj, whereupon the combined tributary meets the Meghna River. The Shitalakhya River is a well-defined channel, which traverses the erosion-resistant soils of the Madhupur Tract without meanders and braiding. The length of the river from its off take to the point of confluence with the Dhaleswari is about 112 km and its peak discharge during high flood ranges between 1,800 and 2,700 m^3/s. At Narayanganj, the recorded water level peaked at 6.93 mPWD during the 1988 flood which is more than 1.0m higher than the natural ground level.In the past, the famous muslin industry of the country flourished along the Shitalakhya. At present, a number of heavy industries including the Adamjee jute mills, stand on the banks of Shitalakshya. There are three thermal powerhouses located at Palash, north of Ghorashal, and one at Siddhirganj, on the bank of the river. The important river port of Narayanganj, which is situated on its bank. The river was once famous for its clear and cool water. At present Industrial affluent dumped into the river, resulting in high levels of pollution is a cause for concern. Numerous launches move out along the river to different parts of Bangladesh. The government has approved construction of an AK khan container terminal on the river Shitalakhya with foreign investment. The river goes under tidal effect for about five months of the year but never overflows its banks.

The Meghna River is one of the most important rivers in Bangladesh, one of the three that forms the Ganges Delta, the largest on earth fanning out to the Bay of Bengal. Meghna River is a major water bodies of the Padma River (Ganges [Ganga] River) delta, in Bangladesh. The name is properly applied to a channel of the Old Brahmaputra downstream from Bhairab Bazar, after it has received the Surma (Barak) River. Flowing almost due south, the Meghna receives the combined waters of the Padma and Jamuna (the name of the Brahmaputra in Bangladesh) rivers near Chandpur. After a course of about 164 miles (264 km) it enters the Bay of Bengal by four principal mouths—Tetulia, Shahbazpur, Hatia, and Bamni. Major tributaries are the Dhaleswari, the Gumti (the name of the Gomati in Bangladesh), and the Feni. A river of great depth and velocity, the Meghna is sometimes split up into several channels and sandbanks of its own formation. It is navigable, but dangerous, all year. At spring tide, the sea rushes upriver in a bore that may reach nearly 20 feet (6 meters).

Project site is located on a naturally depressed area, which remains submerged during monsoon and dry in winter. Drainage pattern in 10 km area is given in ***Figure 4-8***.



Source: Google Earth

Figure 4-8: Drainage Pattern within the 10 km Study Area

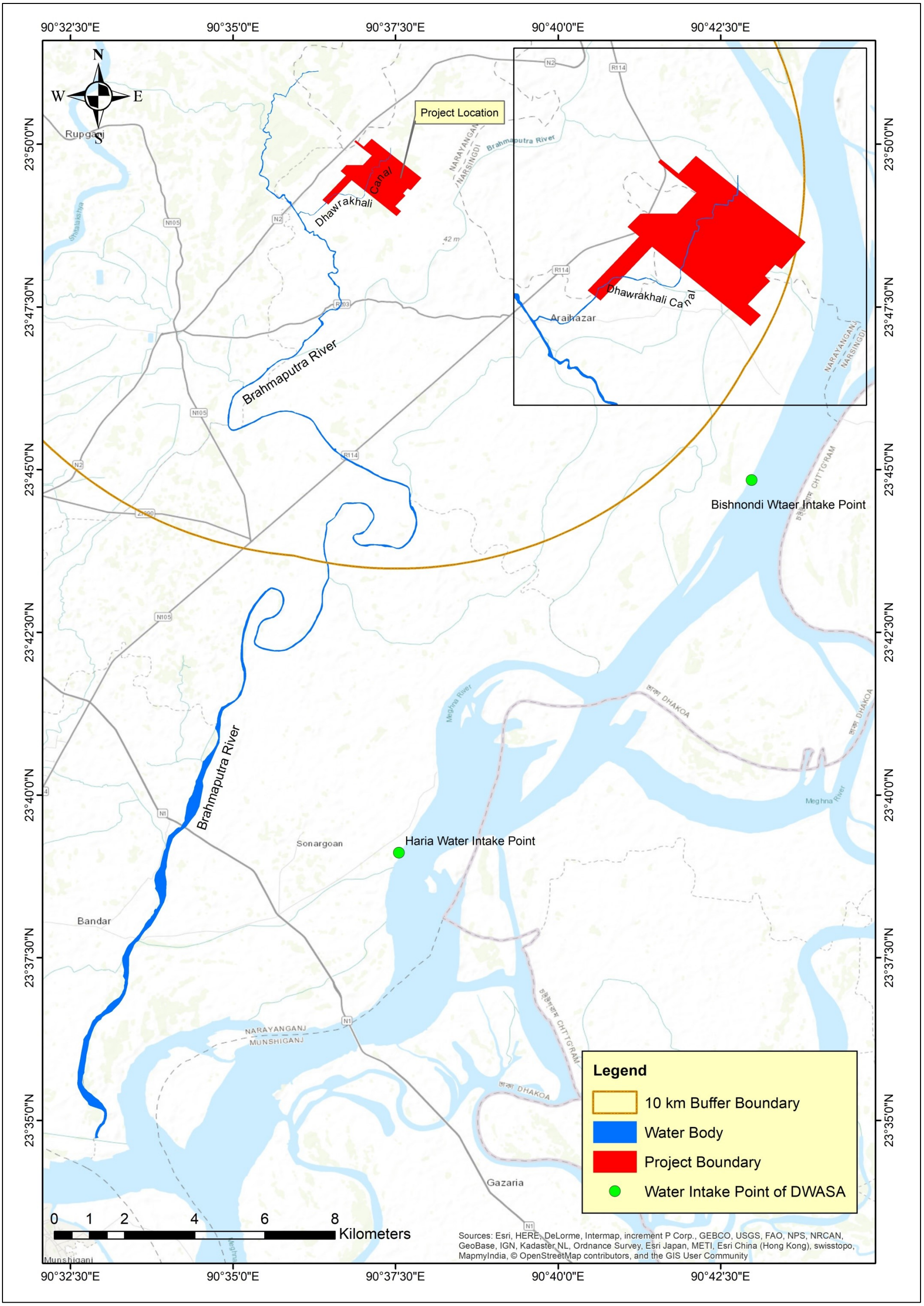


Figure 4-9: River Network and DWASA Water Intake Point Location

4.5.1.1 Surface Water Quality

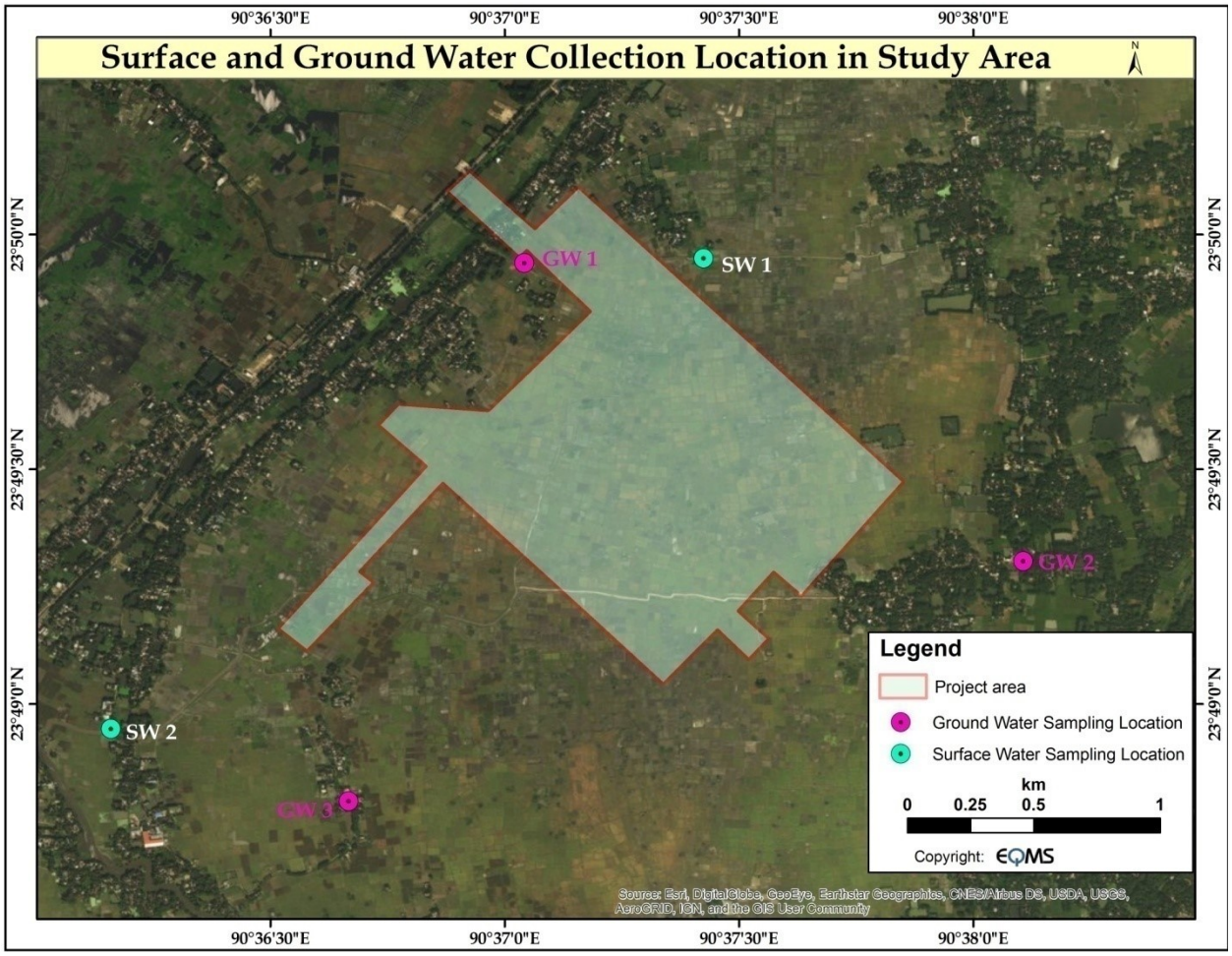
Water sampling and analysis undertaken to understand the overall baseline water quality characteristics of the surface water in the study area. Surface water samples taken from representative selected surface water body's sources representing different parts of the study area.

The surface water sampling collected from the Dhawrakhali canal to the project area. Surface water sampling locations were selected to obtain a representative water sample from various zones within the study area. Two (2) samples of surface water were collected from the canal. Detail of the sampling location provided in ***Table 4-9***.

Table 4-9: Details of Surface Water Sampling Locations

Sl.	Sampling location	Sampling Code	Geographic location	Type of Source
1.	Dhawrakhali Khal (Up-stream) Village: Tekpara	SW1	23°49'57.01"N 90°37'25.47"E	Canal
2.	Dhawrakhali Khal (Down-stream); Village: Panchrukhi	SW2	23°48'56.8"N 90°36'09.5"E	Canal

Surface & Ground Water Collection Pictures



Source: Esri, Digital Globe, Geo Eye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, Aero GRID, IGN, and the GIS User Community

Figure 4-10: Surface Water & Ground Water Sample Collection Locations

The samples were analyzed for parameters covering Bacteriological and physico-chemical characteristics which include certain heavy metals and trace elements.

Water samples were collected as grab water samples in a pre-washed 5-litre plastic jerry can and 250 ml sterilized clean PET bottle for complete physio-chemical and bacteriological tests respectively.

The samples were analyzed as per standard procedures/methods 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 4-10***.

Table 4-10: Methods for Water Analysis

Sl.	Parameter	Test method (APHA)
1.	Temperature (°C)	Digital thermometer

Sl.	Parameter	Test method (APHA)
2.	TDS (mg/l)	Digital TDS meter
3.	EC (µmhos/*cm*)	Digital EC meter
4.	DO (mg/l)	Digital DO meter
5.	pH	Digital pH meter
6.	Biochemical Oxygen Demand (BOD)	5 days incubation
7.	Chemical Oxygen Demand (COD)	CRM
8.	Chloride	Titrimetic
9.	Hardness	Titrimetic
10.	Iron (Fe)	AAS
11.	Manganese (Mn)	AAS
12.	Sulphate	UVS
13.	Total Suspended Solid (TSS)	Gravity Multimeter
14.	Turbidity	Turbidity Meter

N.B: AAS-Atomic Absorption Spectrophotometer, UVS-UV-Visible Spectrophotometer, CRM-Closed ReflexMethods, MFM-Membrane Filtration Method

The quality of surface water was compared with the standards for Inland Surface Water, Environment Conservation Rules (ECR), and 1997-Schedule 3). The standards have been presented along with the monitoring results of surface water for comparison.

The surface water quality compared with the Bangladesh ECR standard for best practice based classification criteria. ***Table 4-11*** shows the analysis results. Some of the water analysis parameters discussed below in detail:

A certain quantity of surface water was collected from upstream and downstream areas of the Dhawrakhali Canal. The surface water quality of Dhawrakhali canal is acceptable in the monsoon season. However, in the dry season the water became polluted because of untreated water discharge from Dyeing industry. The concentration level of BOD, COD and TSS are above the Bangladesh Standard for both SW1 & SW2. In addition, the concentration level of chloride and hard particles in the water is shown in the table below to be clearly published Bangladesh Standard.

Table 4-11: Surface Water Quality Analysis

Characteristics	Unit	Concentration Present		WHO	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
Temperature	^{o}C	29.0	28.6	-	-	-	-	-	-	-
BOD	mg/L	6	2	-	2 or less	3 or less	3 or less	6 of less	10 or less	10 or less
COD	mg/L	24	8	-			-			
EC	mS	0.19	0.15	(2,000 by EPA)	-	-	-	-	-	-
DO	mg/L	6.62	6.19	-	6 or above	5 of more	6 or more	5 or more	5 or more	5 or more
pH	-	7.21	6.82	9.2	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5
TDS	ppt	0.09	0.08	1500	-	-	-	-	-	-
Chloride	mg/L	22	19	250.0			-			
Hardness	mg/L	85	75	500			-			
Iron (Fe)	mg/L	0.54	0.25	0.3			-			
Manganese (Mn)	mg/L	0.03	0.04	0.1			-			
Sulphate	mg/L	1	0	400			-			
Total	mg/L	14	13	-			-			

Characteristics	Unit	Concentration Present		WHO	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
Suspended Solid (TSS)										
Turbidity	NTU	7.2	4.6	5>			-			

(Source: Laboratory Analysis, DPHE and EQMS laboratory)

* Bangladesh Environment Conservation Rules, 1997- Schedule 3 (Standards for inland surface water)

4.5.2 Tropical Cyclones and Tidal Flooding

4.5.2.1 Tropical Cyclones

Bangladesh very often becomes the landing ground of cyclones formed in the Bay of Bengal. This is because of the funnel shaped coast of the Bay of Bengal, Most of the damage occurs in the coastal regions of Khulna, Patuakhali, Barisal, Noakhali and Chittagong and the offshore islands of Bhola, Hatiya, Sandwip, Manpura, Kutubdia, Maheshkhali, Nijhum Dwip, Urir Char and other newly formed islands. The coastal zone of Bangladesh is disaster prone.

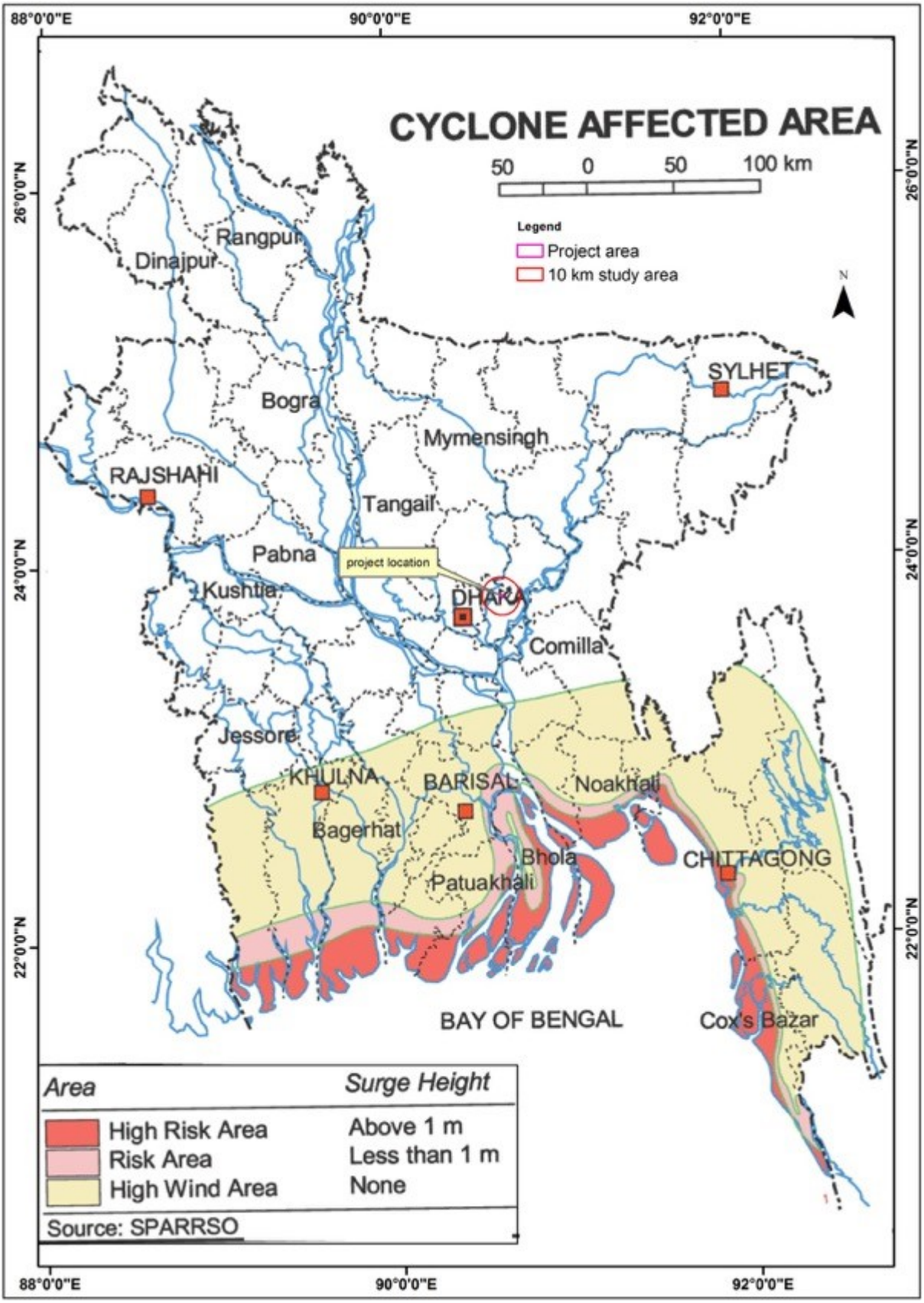
Devastating cyclones hit the coastal areas of Bangladesh almost every year usually accompanied by high-speed winds, sometimes reaching 250 km/hr or more and 3-10m high waves, causing extensive damage to life, property and livestock. Because of the funnel shaped coast, Bangladesh repeatedly becomes the landing ground of cyclones formed in the Bay of Bengal. These cyclones occur in two seasons, April-May and October-November – i.e. before and after the monsoon.

Cyclones in Bangladesh presently classified according to their intensity and the following nomenclature is in use:

- Depression (winds up to 62 km/hr);
- Cyclonic storm (winds from 63 to 87 km/hr);
- Severe cyclonic storm (winds from 88 to 118 km/hr); and
- Very severe cyclonic storm of hurricane intensity (winds above 118 km/hr).

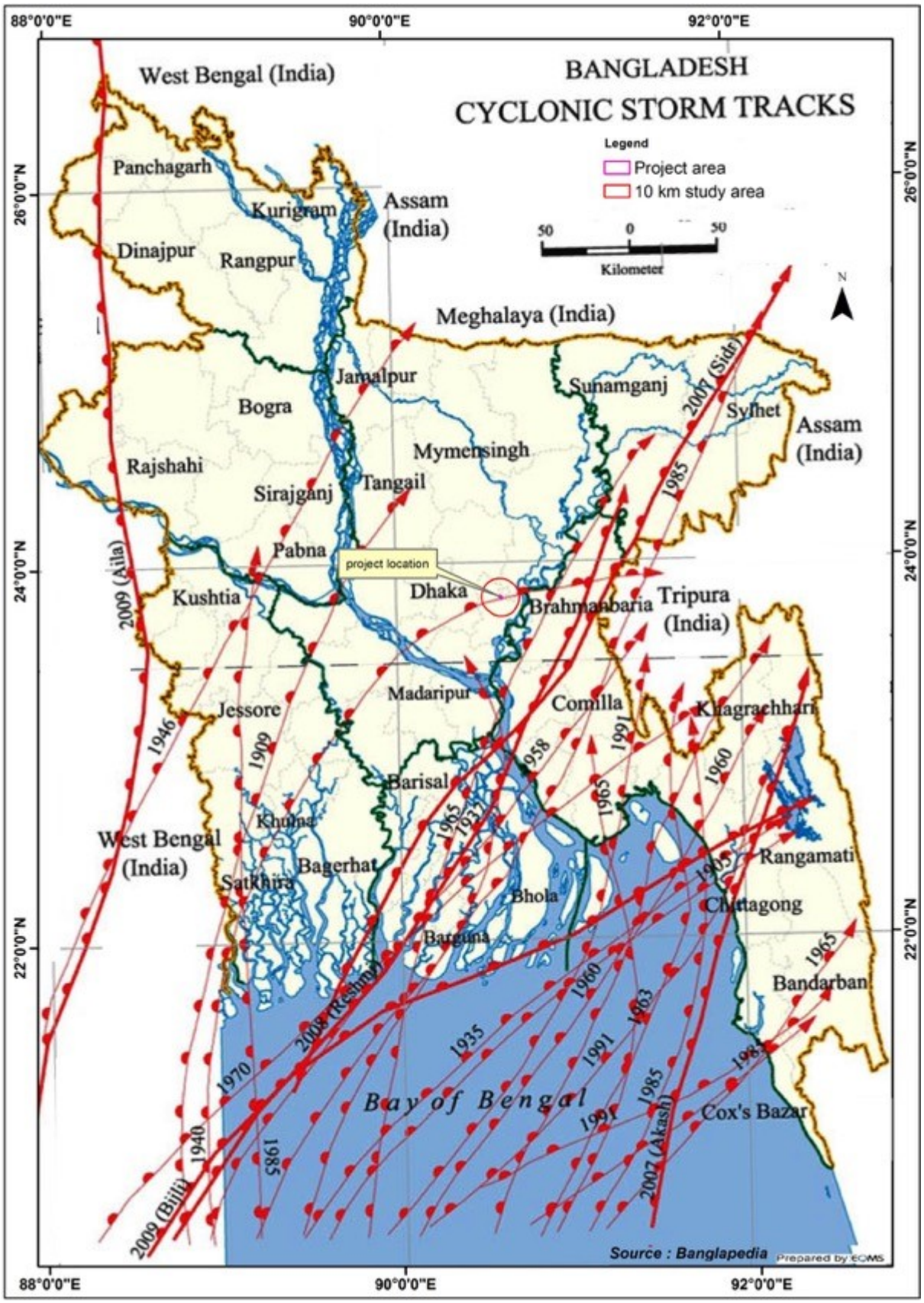
Project site is located in far away from the coastal areas of Bangladesh. Araihazar upazila of Narayanganj district where the project site is located not falls in the cyclone affected areas of Bangladesh ***(Figure 4-11).***

Numbers of cyclones have struck Bangladesh in past and has cause severe damages at few times. Cyclone affected area and track map of Bangladesh is given in ***Figure 4-11&Figure 4-12***.



Source: SPARRSO

Figure 4-11: Cyclone Affected Areas of Bangladesh



Source: Banglapedia

Figure 4-12: Cyclonic Storm Track in Bangladesh

4.5.2.2 Tornado

It is the pre-monsoon period when most of the abnormal rainfall or drought conditions frequently occur in different parts of Bangladesh. In addition, there are severe local seasonal storms, popularly known as nor'westers (kalbaishakhi). Severe nor'westers is generally associated with tornadoes. Tornadoes embedded within a mother thundercloud, and moves along the direction of the squall of the mother storm. The frequency of devastating nor'westers usually reaches the maximum in April, while a few occur in May, and the minimum in March. Nor'westers and tornadoes are more frequent in the afternoon. Nor'westers may occur in late February due to early withdrawal of winter from Bangladesh. The occasional occurrence of nor'westers in early June is due to the delay in the onset of the southwest monsoon over the region (Karmakar, 1989). List of the nor'westers and tornadoes is given in ***Table 4-12***.

Table 4-12: List of Tornadoes had hit the Bangladesh

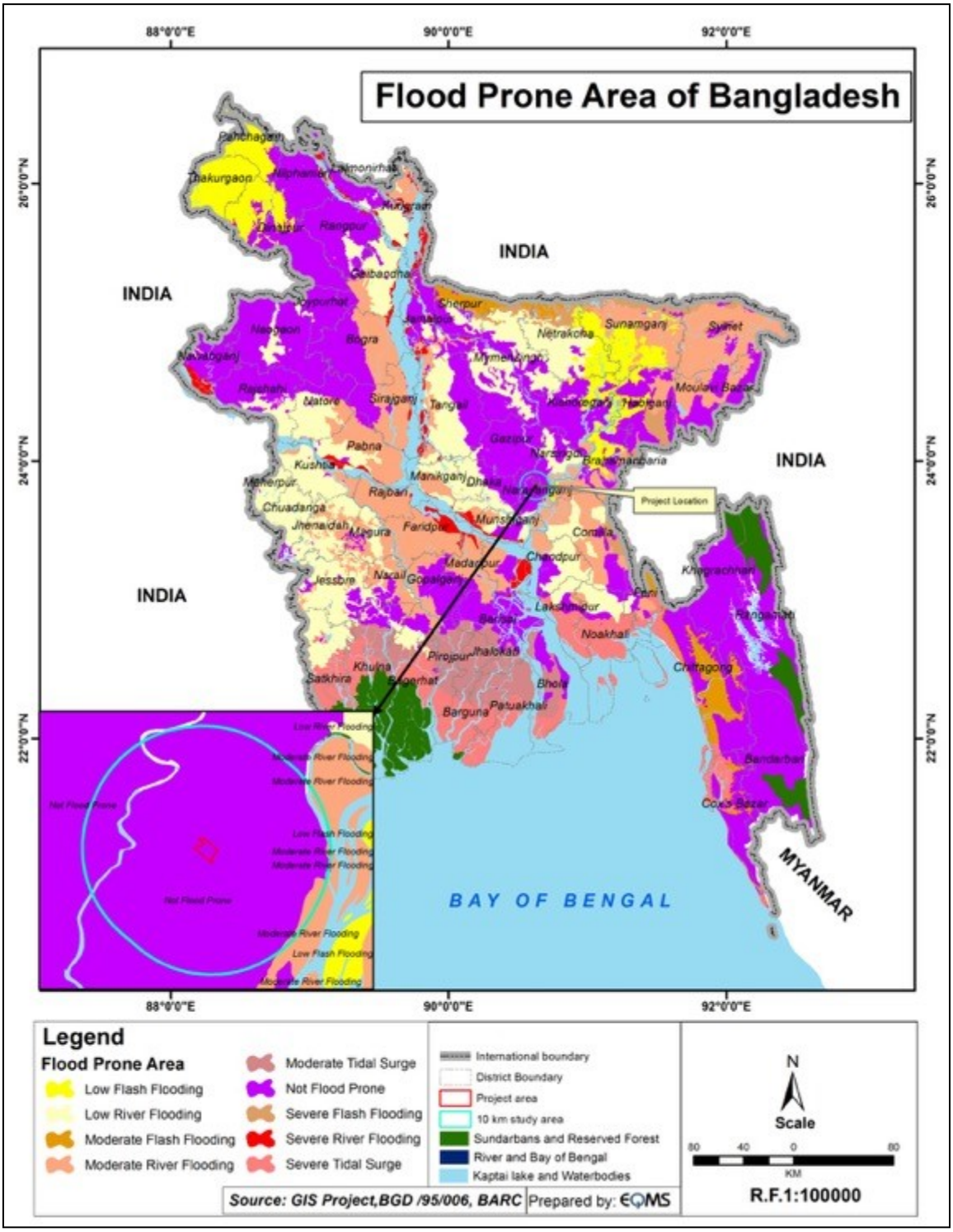
Date	Location
14th April, 1969	Demra (Dhaka)
17th April, 1973	Manikganj (Dhaka)
10th April, 1974	Faridpur
11th April, 1974	Bogra
9th May, 1976	Narayanganj
1st April, 1977	Faridpur
26th April, 1989	Saturia (Manikganj)
14th May, 1993	Southern Bangladesh
13th May, 1996	Tangail
4th May, 2003	Brahmanbaria
21st March, 2005	Gaibandha

Source: Bangladesh Disaster Knowledge Network

4.5.2.3 Tidal Flooding

Floods are the most significant natural hazard in the country causing extensive damage to human life and property. The country lies on the downstream part of three major river basins: Brahmaputra, Ganges and Meghna and thus is frequently flooded. There have been many destructive floods in Bangladesh, including very severe floods of 1987, 1988 and 1998. The 1988 flood set a new record for flooded area, while 1998 flood was unprecedented with its long duration. The flood damage potential in Bangladesh is increasing due to the possible causes of climate change, urban concentration in the three river basins, encroaching of settlements into flood prone areas, and overreliance on the safety provided by flood control works such as levees, reservoirs. There are two types of floods which occur in Bangladesh: annual floods (barsha) that inundate up to 20% of the land area; and low frequency floods of high magnitude that inundate more than 35% of the area (bonna). The major floods that occurred in 1954, 1955, 1974, 1984, 1987, 1988, 1993, 1998, 1999, 2000, 2007 and 2017 have

been very destructive and caused serious threat to lives and economy. In the context of human exposure in flood hazard zones, nearly 19,279,960 people are present in these zones and Bangladesh ranks 1st among 162 nations. Similarly, the modeled amount of GDP in seismically hazardous zones puts Bangladesh 3rd among 162 countries. The project site falls under normal flood prone area. Moreover, with in 10 km radius area major portion are free from river flooding. Flood hazard map of the Bangladesh is shown in ***Figure 4-13***.



Source: GIS Project, BGD/95/006, BARC

Figure 4-13: Flood Prone Areas of Bangladesh

In order to confirm the real site flood levels of Araihazar, hearing surveys have been conducting for residents and upazilas of Project sites. The main target high water levels are obtained from hearing surveys of local residents (patriarchs) who experienced the 1988 and1998 floods, then converted to the altitude of digital mapping. According to the results of these surveys, the past average flood water level of Araihazar was + 6.3 m (***Table 4-13***). The past flood water levels of Araihazar was affected by the high water level of the nearby rivers, and can be treated as a static water surface for simplicity's sake.

Table 4-13: Flooding Trace Survey of Araihazar

Survey Point No.	Trace water level high (MSL±0.00 m)
Fmh 1	+6.0
Fmh 2	+6.5
Fmh 3	+6.5
Fmh 4	+5.8
Fmh 5	-
Fmh 6	+6.3
Fmh 7	-
Fmh 8	+6.3
Average water level	**+6.3**

Source: JICA Feasibility study

The highest water levels and relevant return periods of the three nearest stations are shown in ***Table 4-14***. The highest water level of Araihazar EZ site was calculatedbased on an irregular triangular network (TIN) by the weighted average method. The water levelof a 100-year return period is 7.21 m.

Table 4-14: Maximum Water Level at Nearby Water Level Stations and Estimated Maximum Water Level of Araihazar EZ Site

Vicinity water level station and EZ candidate site	Return period and relevant maximum water level (m)			
	10year	50year	100year	200year
SW 177	6.82	7.57	7.85	8.10
SW 179	6.08	6.60	6.79	6.97
SW 179	5.79	6.31	6.51	6.69
Araihazar EZ Site	**6.34**	**6.97**	**7.21**	**7.42**

Source: Feasibility study

4.5.3 Salinity

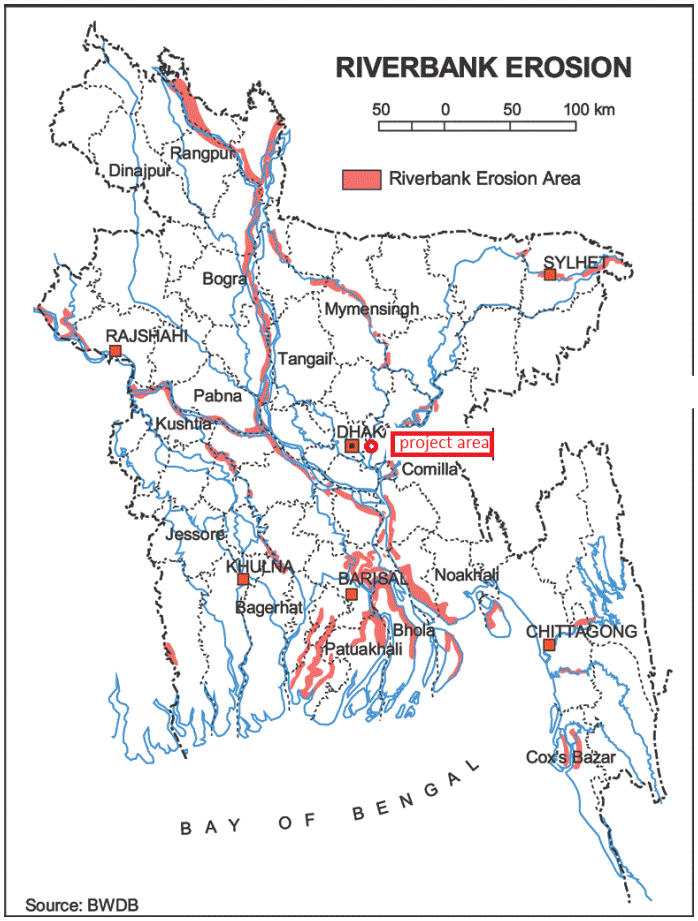
Major water bodies within 10 km study area are Shitalakhya River and Meghna River. All Rivers carry fresh water in monsoon season. However, in the dry season Shitalakhya River has water becomes polluted because of excess discharge of industrial chemicals.

4.5.4 Drainage Congestion and Water Logging

The Araihazar EZ site is flat agricultural land (paddy field) with an elevation of MSL + 2.5 m, and submerged in the rainy season. Small water channels a few meters lower than the surrounding agricultural ground elevation exist. The channels have been using for transportation of agricultural products and fertilizers by small boat. Water logging observed at site during monsoon season. According to the information collected through focus group discussions (FGD), the area affected in normal floods. However, during heavy rainfall and monsoon season the river water enter in the low laying area causes water stagnation in the area for some time. Rainwater inside the EZ site flows from the northeast to the southwest and drains into the southwestern side of the river, connecting to the Meghna River. The elevation of the candidate site is lower than past flood levels of surrounding large rivers such as the Meghna River and the Shitalakshya River. Hence, it is necessary to ensure surface water diversion around the candidate site after site formation.

4.5.5 Erosion and Sedimentation

There is no major river within 5km radius study area. The closest river is Shitalakhya River, which is 5.5 km far from the Araihajar Economic Zone area. Shitalakhya River is not erosion prone River. The Shitalakhya River flows from North to Southwestern and located5.5 km North Eastern side from the project site. No riverbank erosion observed in the river site area. Map showing areas prone to riverbank erosion given below in ***Figure 4-14***.

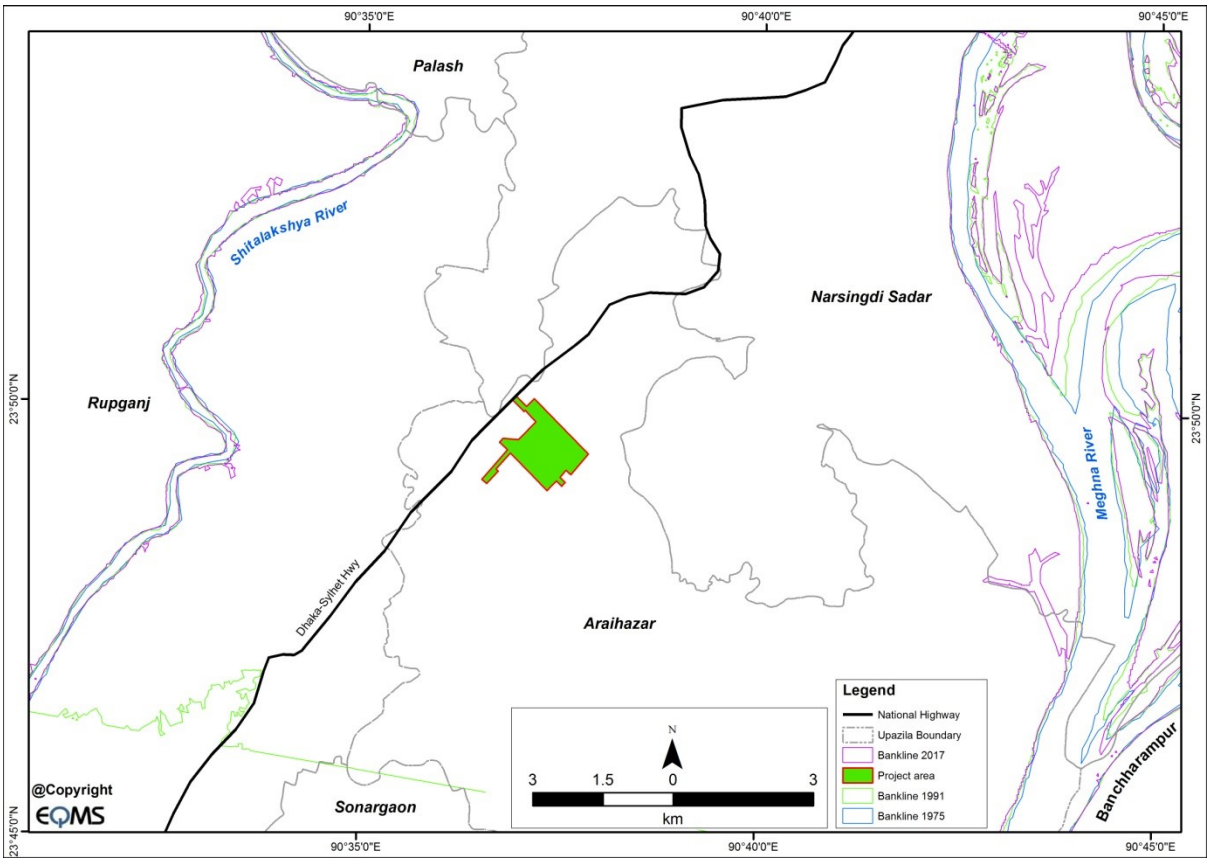


Source: BWDB

Figure 4-14: Map showing riverbank erosion of Bangladesh

4.5.6 River Morphology

River bank erosion has long been a dominant environmental problem affecting many people of Bangladesh. It has so many adverse effects on the lives and livelihood of the people of this disaster prone country. It dislocates thousands of peoples each year adding to the 50% of the rural population who are already landless due to riverbank erosion (BBS, 1982, Halli, 1991). River bank erosion is a complex process in which many factors play a role. Important factors are flow, channel geometry and bed topography, vegetation and groundwater level and their variation with time and space, sediment transport and bank material properties (River survey project, 1996). Erosion by rivers is mainly hydrologic and causes destruction. Islam, Okubo and Muramoto (1994) noted that in Bangladesh the rivers cause erosion due to their unstable characters as they flow through the alluvial soils of recent deposits. ***Figure 4-15***shows the river morphology study of Shitalakhya & Meghna River from 1975 to 2017. The project site is situated quite save position and no major change of river flow direction is found in the below figure.



Source: Google Earth

Figure 4-15: Historical River Bank Erosion Scenario of Shitalakhya & MeghnaRiver from the Proposed Project Site

4.5.7 Navigation

Navigability of rivers in Bangladesh has been deteriorating steadily over the years. The withdrawal of water beyond the border and within Bangladesh for irrigation and other purposes has resulted in decreased navigability of rivers during dry season resulting in gradual channel decline.

The river network connects almost all the country's major cities, towns and commercial centers. Moreover, being cheap, safe and environmentally friendly, inland water transportation is often the only mode that serves the poor, proving especially useful during periods of widespread flooding.

Currently, container feeder service is available from Chittagong Port to Port Klang (daily); Port of Singapore (daily); and Colombo Port (every 2-3 days) for connecting the mother vessels serving international destinations. More than 5 feeder vessel operators with vessels capacity of 1,000 -1,500boxes (containers) have deputed their feeder vessels in this circuit. The transit time is about 3-4 days from /to Chittagong Port to the hub ports. All international Shipping Lines have their presence in Bangladesh and some even operate their own feeder vessels.

Due to the steady growth in traffic volume, Chittagong Port performs well on the financial front. It is financing its third Port development project at Paira Bandar with its own resources.

The Prime Minister inaugurated the third port, Payra Seaport, on 19th November 2013. It is on Rabnabad channel - which is 31 Km from the sea boundary, 316 Km from Chittagong, 130 Km from Mongla port and 340 Km from the capital. This port shall have Draft of 8 -10 m when in operation.

In addition to the Pangaon ICT, the Government of Bangladesh granted approval to establish a container port on the bank of the Meghna River in Narayanganj District to the Ananda Group in November 2013. It will be the fifth inland container terminal (ICT) in the private sector. Approvals for establishing ICTs have already been granted to the Rupayan Group, Kumudini Welfare Trust, AK Khan and Company and Cemcor. Meanwhile, the Ministry of Shipping, GoB, is finalizing a draft of guidelines for establish in ICTs under private sector investment. A deep-sea port is also proposed to be constructed at Sonadia, Cox Bazar.

Bangladesh inland waterway transport is divided into four levels. The Dhaka-Chittagong route (Pangaon ICT, 160 nautical miles: about 290 km), including a part of a coastal shipping route, is classified as a first-level waterway with 3.6~3.9 m water depth. Bangladesh Inland Water Transport Authority (BIWTA) manages the navigability of these inland water routes by conducting waterway depth surveys, maintenance dredging, and so on. The number of registered ships using inland waterways was 9852 as of the end of 2014. As for vessel type, there were 3988 sand barges, 2755 cargo ships, and 928 dredging vessels. The number of container ships for inland waterways and coastal shipping appears to be small.

According to calculated results in 2014, the handling volume of sea shipping in Pangaon ICT (Inland Container Terminal) is only 1,300 TEU per year. However, its handling capacity is 150,000 TEU per year.

On the other hand, Summit ICT harbor, which is located on the downstream side of the Pangaon ICT, is waiting for approval of its operation permit. Summit Inc. utilizes Pangaon ICT facility and barge to start the water transport business to the Chittagong port while

waiting for the pending approval of their ICT facilities. The container handling volume was 1,300 TEU in about one month, from the end of September to October 2015.

4.5.8 Ground Water System

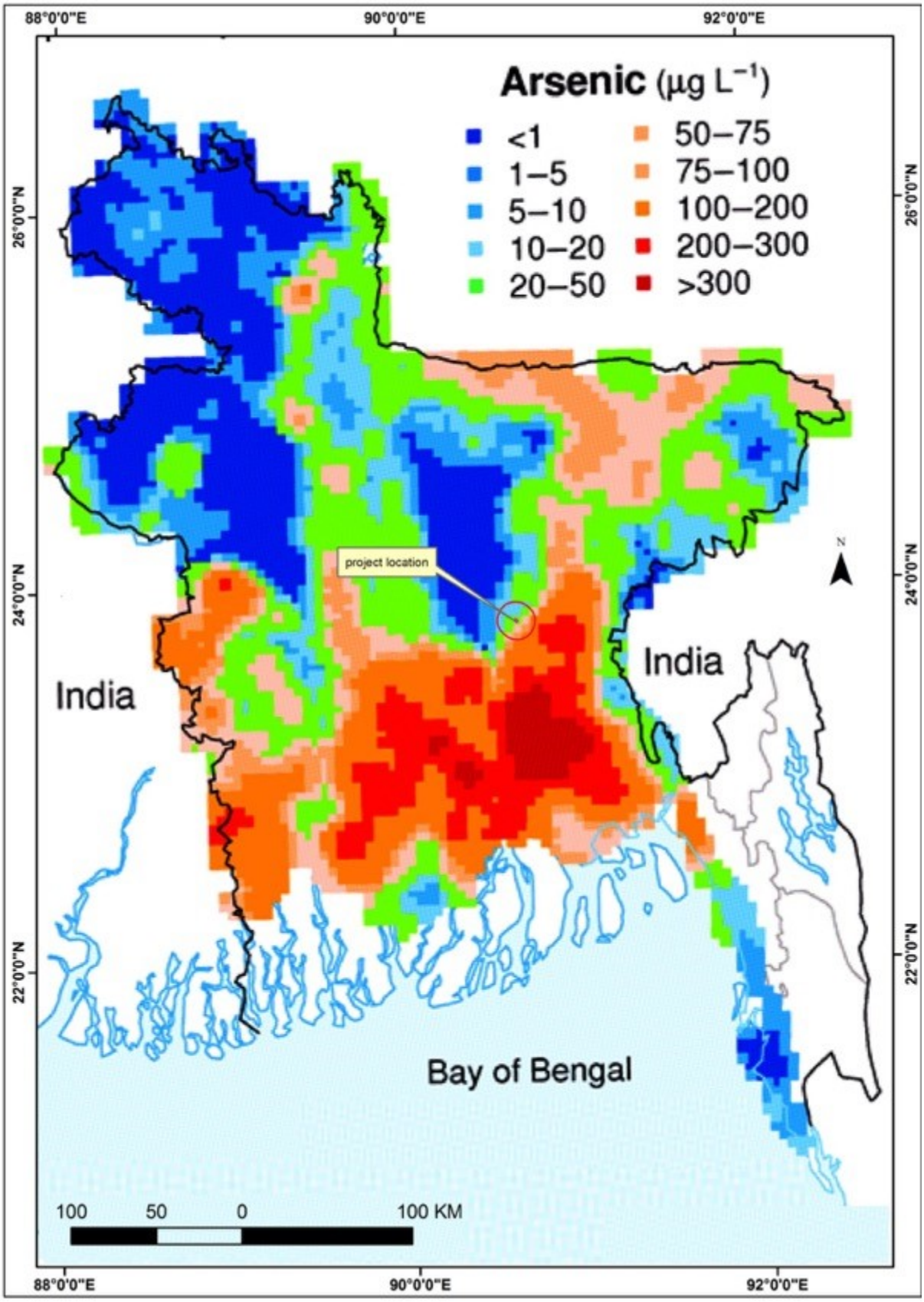
There are three main aquifers in the central region of Bangladesh, where the proposed project is located:

- An upper (composite) aquifer, reaching depths of 50m which is covered with an upper silty clay layer of less than 20m;
- A middle (main) aquifer of fine to heavy sands, which is generally 10-60m deep, and in most areas is hydrologically connected with the composite aquifer above; and
- A deep aquifer of medium, medium-to-fine or medium-to-coarse sand, which is generally found at depths below 100 m

In Dhaka region, 80% of the domestic water supply is obtained from the middle aquifer, extracted by tube-wells throughout the city. Groundwater is the main source of water for drinking and irrigation in Bangladesh and most of cases people relies on groundwater for industrial purposes. Due to the dependency on groundwater and excessive withdrawal, the level of ground water table is decreasing day by day in the central region especially in Dhaka region. On the other hand, the groundwater of coastal region has seriously affected by salinity. Also the ground water is affected by arsenic contamination and at some places it found many times higher than the threshold limit (WHO standards) (See the following table).

However, fortunately, Araihazar EZ site not affected by salinity and there is little possibility of salinity intrusion in the near future. Ground water is the main source of domestic, irrigation and industrial water supply in the project area.

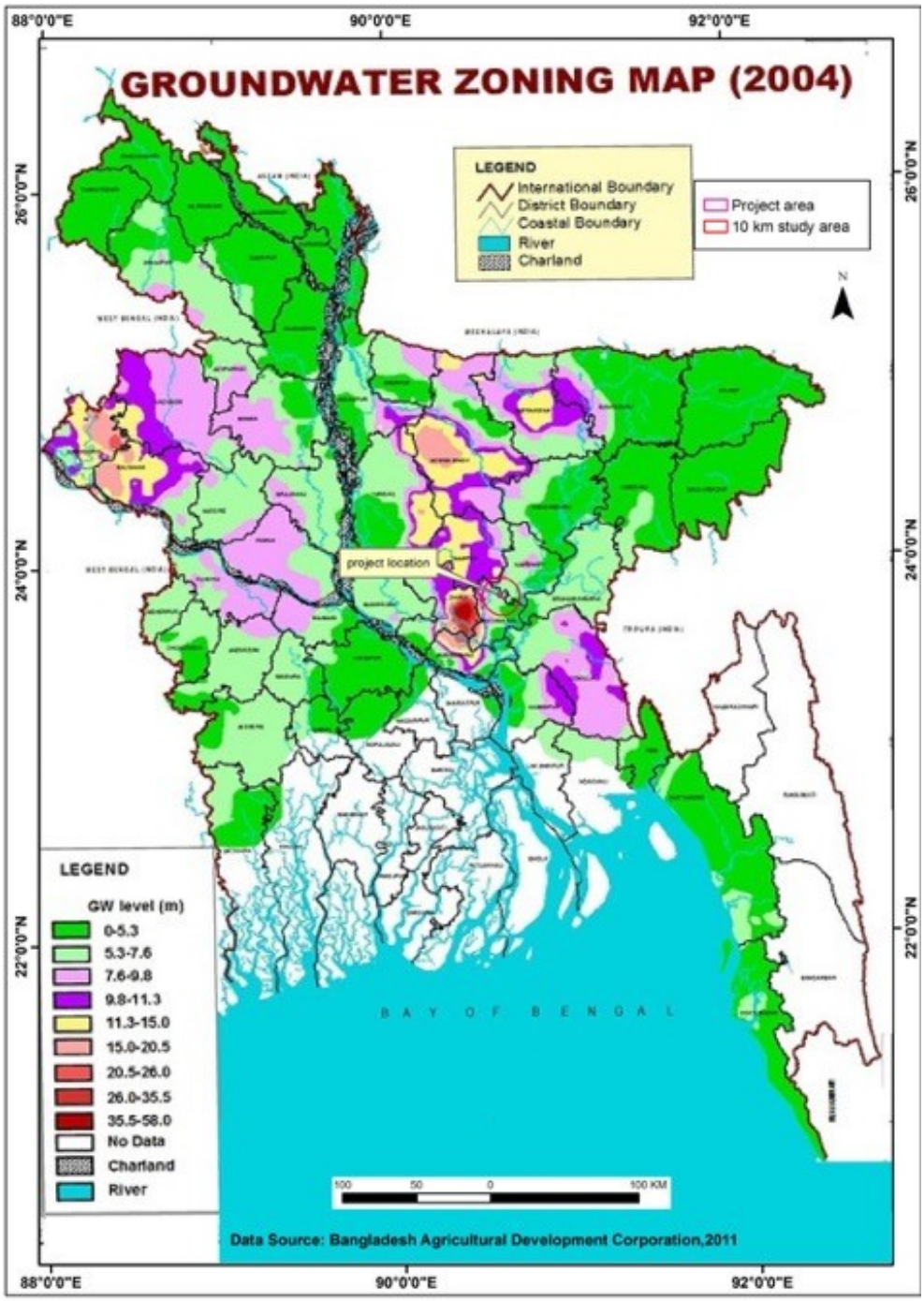
The JICA survey team (Survey 2000) was conducted on 55 TWs altogether, 38 STWs (69.1%) and 17 DTWs (30.9%); 26 (47.3%) in Duptara Union and 29 (52.7%) in Satgram Union.Most of the area is relatively safe with only two TWs in Duptara Union having arsenic exceeding the Bangladeshi standard for drinking water of 50ppb. The water of 23 TWs (79.3%) out of 29 in Satgram Union was within the Bangladeshi standard of 0.3-1 ppm whereas only 14 TWs (53.8%) out of 26 in Duptara Union contained iron within the Bangladeshi standard. And High conductivity value was found in two TWs in Duptara Union at 2005µs/cm (DTW of 645ft) and 3050µs/cm (STW of 170ft), indicating high salinity.



Source: AAN

Figure 4-16: Distribution of Arsenic (As) in Groundwater

Figure 4-17is showing the Ground Water Zoning Map, which indicated that the project site is located at the area of ground water level 0-5.3, 5.3- 7.5m. This area also receives sufficient amount of rainfall and there is a good availability of ground water that being used by hand pumps for drinking and domestic purposes. The homesteads are using hand deep tube well to meet their domestic demand. Potable ground water is available at an average depth of 110mto 220m. During site visit, it is observe that sufficient quantity of water was coming out from the HTW. However, after discussion with the local people it is learnt that there is no specific complaint about non- availability of ground water.



Source: Bangladesh Agriculture Development Corporation, 2011

Figure 4-17: Ground Water Zoning Map of Bangladesh

4.5.8.1 Ground Water Quality

The water sampling and analysis was undertaken to understand the overall baseline water quality of the groundwater in the study area. Ground water samples taken from representative selected groundwater sources representing different parts of the study area.

The groundwater sampling locations were selected to obtain a representative water sample from various zones within the study area. The samples were collected from existing tube wells (hand-tube wells being use by the villagers). A total Three (3) ground water samples were collected from different locations of study area. Details of the sampling locations provided in ***Table 4-15*** and depicted in ***Source:*** Esri, Digital Globe, Geo Eye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, Aero GRID, IGN, and the GIS User Community

Figure 4-10.

Table 4-15: Details of Ground Water Sampling Locations

Sl.	Sampling location	Sampling Code	Geographic location	Type of Source
3.	In front of Bacchu mia House, Vill: Sonpara, Union: Satgram,Upazila: Araihajar	GW1	23°49'56.5"N 90°37'02.6"E	Tube well
4.	In front of Bacchu mia House, Vill: Sonpara, Union: Satgram, Upazila: Araihajar	GW2	23°49'18.2"N 90°38'06.5"E	Tube well
5.	In front of Arju mia Sentu House, Vill: Shingrati, Union: Duptara,Upazila: Araihajar	GW3	23°48'47.6"N 90°36'40.0"E	Tube well

The samples analyzed for parameters covering Bacteriological and physico-chemical characteristics, which included certain heavy metals and trace elements.

Water samples were collected as grab water sample in a pre-washed 5-litre plastic jerry can and 250 ml sterilized clean PET bottle for complete physio-chemical and bacteriological tests respectively.

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 4-16***.

Table 4-16: Methods for Water Analysis

Sl.	Parameter	Test method (APHA)
1.	Temperature (˚C)	Digital thermometer
2.	TDS (mg/l)	Digital TDS meter
3.	EC (µmhos/*cm*)	Digital EC meter
4.	DO (mg/l)	Digital DO meter
5.	pH	Digital pH meter
6.	Arsenic (As)	AAS
7.	Calcium (Ca)	AAS
8.	Chemical Oxygen Demand (COD)	CRM

Sl.	Parameter	Test method (APHA)
9.	Chloride	Titrimetic
10.	Coliform (Faecal)	MFM
11.	Coliform (Total)	MFM
12.	Fluoride	UVS
13.	Iron (Fe)	AAS
14.	Lead (Pb)	AAS
15.	Manganese (Mn)	AAS
16.	Phosphate	UVS
17.	Sulphate	UVS
18.	Total Suspended Solid (TSS)	Gravity Multimeter
19.	Turbidity	Turbidity Meter

N.B: AAS-Atomic Absorption Spectrophotometer, UVS-UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, MFM-Membrane Filtration Method

The quality of groundwater was compared with the Drinking Water Standard E.C.R.-Schedule-3, 1997. The standards have been presenting along with the monitoring of results of groundwater for comparison.

In 1993, the Department of Public Health Engineering (DPHE) first detected arsenic in hand tube wells (HTWs) and arsenic contamination has become one of the most pressing environmental issues in Bangladesh. The World Health Organization has defined the tolerance limit of arsenic for drinking water as 0.01mg/L, while the Bangladesh standard for arsenic in drinking water is 0.05mg/L. The arsenic content of the project site is 0.02 mg/l, which is within the Bangladesh Standards (0.05mg/l).

In September 2017, the survey team collected groundwater samples from tube wells in and around the project area. The result of the groundwater field samples and the GoB standards for potable water (ECR, 1997) is shown below in ***Table 4-17***. The concentration levels of EC and Manganese (Mn) of tube well found above the standard set by the DOE, GoB for drinking water. But the levels of pH, TDS, As, Ca, COD, Chloride, Fluoride, Fe, Pb, Phosphate, Sulphate, TSS and turbidity were found to be within the limit set by the DOE, GoB for drinking water. The average depths of deep tube wells for drinking water are at least 600-700 feet. After consultation with the DPHE officer of Araihazar, The survey team found the concentration level of Iron and Arsenic become higher when the tube wells depth reaches below the 600 feet. According to the overall water quality data, practically good quality and quantity of ground water is available in and around the project site.

Table 4-17: Ground Water Quality Analysis Result

Sl.	Parameters	Unit	Sampling code			Bangladesh Standard	WHO
			GW1	GW2	GW3		
1.	Temperature (˚C)	^{0}C	27.1	27.0	27.4	20-30 ˚C	-
2.	EC	mS	0.56	0.84	0.52	0.05 mg/l	(2,000 by

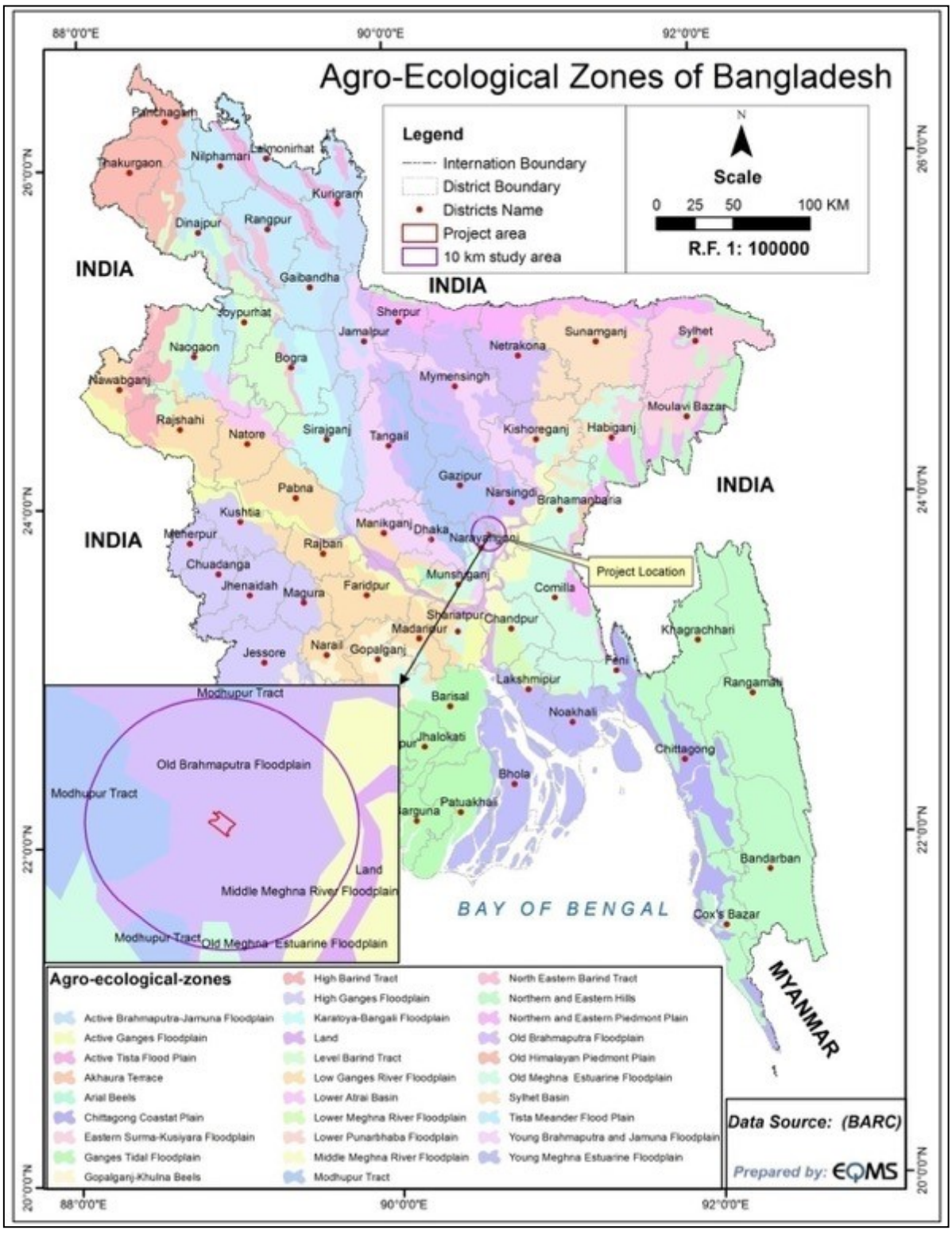
Sl.	Parameters	Unit	Sampling code			Bangladesh Standard	WHO
			GW1	GW2	GW3		
							EPA)
3.	pH	-	6.64	6.71	6.92	6.5-8.5	9.2
4.	DO	mg/L	6.88	6.23	6.38	6	-
5.	TDS	ppt	0.28	0.42	0.26	-	1500
6.	Arsenic (As)	mg/L	0.002	0.002	0.002	0.05 mg/l	0.05
7.	Calcium (Ca)	mg/L	39	15	33	75	200.0
8.	Chemical Oxygen Demand (COD)	mg/L	4	4	4	4.0	-
9.	Chloride	mg/L	37	152	62	150-600	250.0
10.	Coliform (Faecal)	N/100ml	0	0	0	0	0
11.	Coliform (Total)	N/100ml	0	0	0	0	0
12.	Fluoride	mg/L	0.028	0.027	0.025	1.0	1.5
13.	Iron (Fe)	mg/L	0.26	0.06	0.57	0.3-1	0.3
14.	Lead (Pb)	mg/L	0.009	0.001	0.001	0.05	0.01
15.	Manganese (Mn)	mg/L	0.06	0.28	0.12	0.1	0.1
16.	Phosphate	mg/L	0.089	0.18	0.19	6.0	-
17.	Sulphate	mg/L	1	3	1	400	400
18.	Total Suspended Solid (TSS)	mg/L	2	3	5	10	-
19.	Turbidity	NTU	0.70	6.4	4.5	10	5>

Source: Laboratory Analysis, DPHE and EQMS laboratory

4.6 Land Resources

4.6.1 Agro ecological Regions

The 10 km study area covers four distinct agro-ecological zones; they are the Old Brahmaputra Floodplain, Modhupur Tract, Middle Meghna River Floodplain and Old Meghna Estuarine Floodplain. The project site falls under Old Brahmaputra Floodplain zone. Agro-ecological zones of Bangladesh have shown in ***Figure 4-18***. Details of these agro ecological zones has discussed in ***Table 4-18***.



Source: BARC

Figure 4-18: Agro-ecological Zones of Bangladesh

Table 4-18: Details of Agro-ecological zones of Bangladesh within 10km study area

Characteristics	Old Brahmaputra Floodplain	Modhupur Track	Middle Meghna River Floodplain	Old Meghna Estuarine floodplain
Physiography	Most areas have broad ridges and basins. The differences in elevation between ridge top and basin centre usually 2-5 meters.	Level upland area with well-drained red brown soil. Closely dissected upland areas with deep well drained red soils on level upland soils and deep broad valleys with grey and dark grey heavy clay. Closely dissected areas with shallow, moderately to poorly drained brown soils. Planed areas with deep and shallow poorly grey silty soils alley with dark grey heavy clays planed areas with shallow poorly drained grey	The region includes island-former Brahmaputra char-within the Meghna river. It comprises various kinds of relief. The Meghna riverbanks are mainly stable. However, bank erosion occurs on a small scale locally.	Smooth, almost level, floodplain ridges and shallow basin
Soil Type	Dark grey floodplain soil generally predominates. Reaction of the cultivated layer is usually medium to very strongly acidic. Organic matter in the cultivated layer range from about 1-1.5 percent in the ridge soil to 2-5 percent in basin soil	Soils are clayey (87%), loamy (13%) and sandy (<1%) organic matter content is low (<1.5%) and pH ranging from 4.5 to 7.8	Three main kinds of soil occurs a) Grey loams and clays on ridge and basin site in area of Meghna alluvium. b) Grey loamy ridge soil and dark grey basin soils in old Brahmaputra alluvium. c) Grey sands to loamy sands in Old Brahmaputra char. Organic matter content is low	Silty soils predominate but silty clay and clay also found. Organic matter contents in the cultivated layer range from 1-2.5 percent in ridges and 2-5% in depression. Moisture holding capacity is high.
Water	A limited amount of surface	Only limited amount of	Ample surface water exists in	Surface water that could be

Characteristics	Old Brahmaputra Floodplain	Modhupur Track	Middle Meghna River Floodplain	Old Meghna Estuarine floodplain
resources	water is available for irrigation mainly in the Old Brahmaputra and Shitalakhya river.	surface water are available in rivers and bils and this is almost fully exploited. Ground water is apparently is generally available, Artesian water occurs in a few valleys near Bhaluka in the north and east	the Meghna channels to irrigate the whole region and groundwater probably is readily available for use by tube wells if needed to supplementation surface water supplies.	used for irrigation is widely available from the Meghna, Sitalakhya, Dhaleswari or Ganges distributaries. Ground water apparently is readily available for use by tube well.
Present land use	Permeable soils on high ridges: aus, jute, groundnut, sugarcane; with irrigation wheat, potato, tobacoo, rabi vegetables and spices Medium lowland and low land basin: Mainly mixed aus and aman or jute and broadcast aman on lowland. With irrigation, mainly HYV boro	Jackfruits are found on field boundaries, rainfed aus followed by mashkalai or mustard, other crops are sugarcane, kharif groundnut, with irrigation wheat, potato, rabi vegetables; sal forests are present. HYV boro, HYV aman on irrigated land. Pineapple is also widely grown in Madhupurarea.	Mainly deep water aman, or mixed aus and aman. Local boro paddy in flooded area and HYV boro in higher margin of basin. Rabi crops are chilli, mustard, wheat, kheshari etc	On highland and medium highlands- aus, T.aman, HYV boro rice, mustard and rabi crops are grown. On medium lowland-mixed aus and aman, jute, wheat, mustard, potato, chilli, kaon, sesame, kheshari etc. are grown. In the lowland-Local variety of boro are widely grown.
Major Cropping Pattern	Mustard-Aus/Jute-Fallow Vegetable(R) – B.aus – Fallow Sugarcane Boro-Fallow-T.aman Fallow-Jute-T.aman	Mustard/Vegetable(R)/groundnut in Aus/Jute-Fallow Boro-Fallow-T.aman Fallow- B.aus-T.aman Sugarcane Pineapple	Veg(R)/Wheat/Potato/mustard/pulse B.aus/Jute-T.aman Chillies-B.aus/Jute-Fallow Mustard-Boro-Fallow Boro-Fallow-Fallow	Mustard/wheat/grasspea/potato/Cucurbits- B.aus-T.aman Boro-Fallow-T.amam Sugarcane B.aus-Fallow Mustard-Jute-Fallow

Source: BARC

4.6.2 Land Types

The suitability analysis of agricultural land use for all the unions of Araihazar Upazila has carried out based on the attributes and field data. It shows that most of the unions are suitable for agriculture crop cultivation due to favorable land types and other characteristics. Local people have consulted to know whether the present land use in the area have been in conformity with the suitability of land. Land type &land suitability analysis of all the unions of Araihazar Upazila shown in ***Table 4-19***.

Project site is located at Sonapara village, under Satgram & Duptara union of Araihazar upazila. Total area of the Satgram union is 1963.97acre. The major land type of the Satgram union is High land (15%), Medium highland (22%) followed by Medium low land (45%) & Low land (17%).

Table 4-19: Union wise Land type & land Suitability Analysis of Araihazar Upazila

Union	Area (ha)	Land Type (%)	Land Suitability
Satgram*	1963.97	HL-16, MHL-22, MLL-45, LL-17	Mostly $S_1$and S_2
Duptara*	1672.88	HL-11, MHL-12, MLL-66, LL-6, VLL-5	Mostly $S_1$and S_2
Araihazar Paurashava	796.36	HL-13, MHL-38, MLL-25, LL-13, VLL-11	Mostly $S_1$and S_2
Bishnandi	1785.83	HL-4, MHL-29, MLL-41, LL-26	Mostly $S_2$and S_3
Brahmandi	1632.79	HL-20, MHL-56, MLL-18, LL-6	Mostly $S_1$and S_2
Fatehpur	709.31	HL-40, MHL-43, MLL-15, LL-2	Mostly $S_1$and S_2
Haizadi	1713.36	HL-10, MHL-14, MLL-73, LL-2 VLL-1	Mostly $S_1$and S_2
Kalapaharia	3464.37	HL-2, MHL-8, MLL-67, LL-12, VLL-11	Mostly $S_2$and S_3
Khagakand	1285.83	HL-6, MHL-60, MLL-20, LL-14	Mostly $S_1$and S_2
Mahmudpur	967.21	HL-10, MHL-12, MLL-70, LL-5 VLL-3	Mostly $S_1$and S_2
Uchitpur	978.54	HL-15, MHL-19, MLL-52, LL-14	Mostly $S_1$and S_2
Gopaldi Paurashava	1145.34	HL-6, MHL-22, MLL-59, LL-12 VLL-1	Mostly $S_1$and S_2

Source: National Land Zoning Report, Araihazar Upazila, December 2016

S_1- Highly suitable, S_2- Suitable, S_3- Moderately suitable and S_4- Not suitable

HL=High land, MHL= Medium high land, MLL= Medium low land and LL= Low land

*Project site located in this union

4.6.3 Soil Texture

The 10 km study area covers three distinct soil type; they are the Gray Flood plain soil, Non-Calcareous Dark Grey Floodplain soils and Red Brown terrace soils. Project site soil covers Grey Floodplain Soils& Non-Calcareous Dark Grey Floodplain. Project area is shown in the soils of Bangladesh Map***(Figure 4-19)***.

Grey floodplain soil contains lime in part or all of the upper 125 cm of the profile. The top soil usually is grey or olive-grey when dry, but may be darker and bluish or greenish grey when wet and reduced in the monsoon season. The subsoil usually is grey with yellow-brown or brown mottles and broken or continuous grey coating. The structure usually is prismatic in coarse soils. The soil texture of the project site located union is sandy loam to loam.

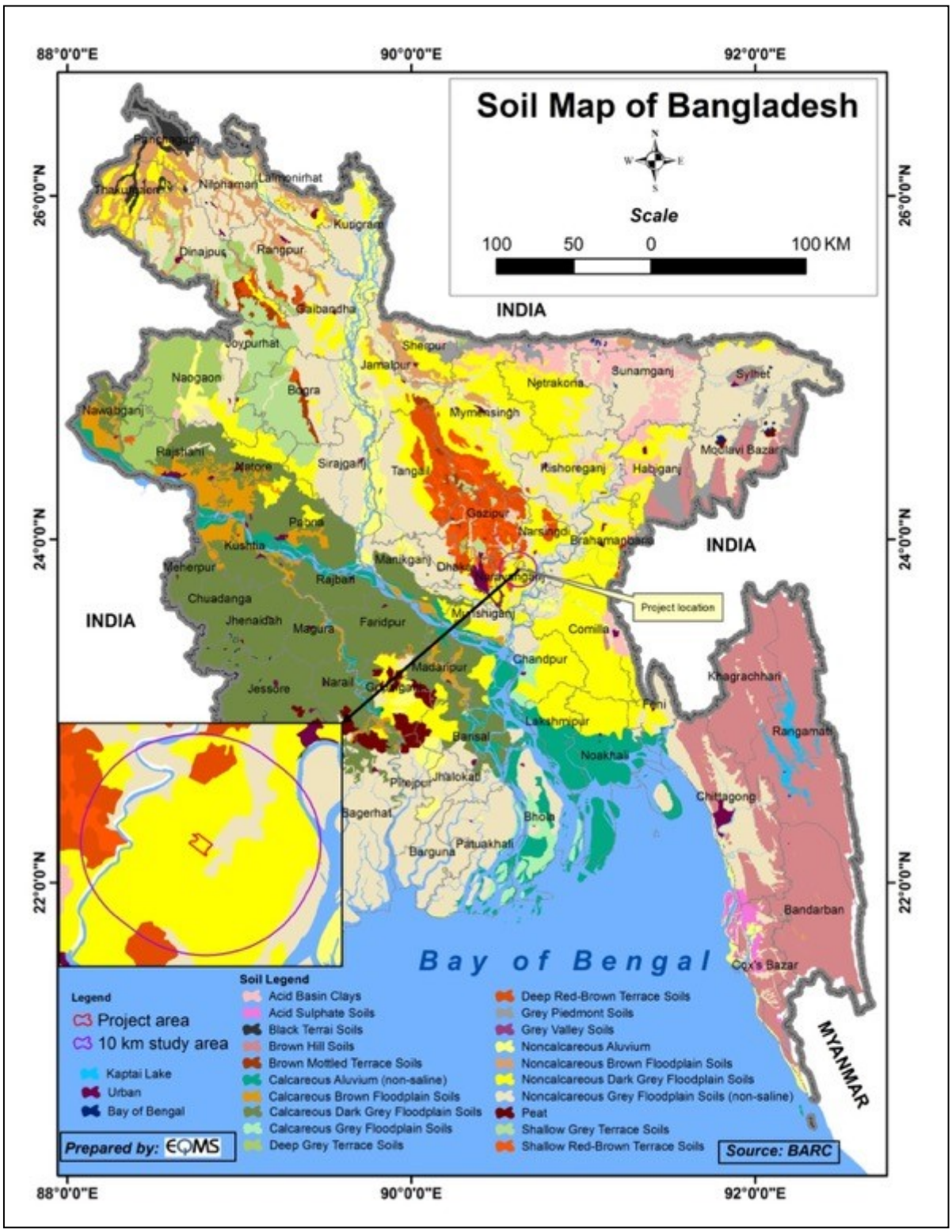
Non-calcareous Dark Grey Floodplain soils they have a cambic B-horizon, non-calcareous dark grey topsoil and subsoil. They occur extensively on the Old Brahmaputra and old Meghna estuarine floodplain. Silt loam and silty clay loam are predominant on the Meghna estuarine floodplain and in the Tista meander floodplain, whereas silty clays and heavy clays are extensive on the Old Brahmaputra floodplain. The majority of these soils are Eutric Gleysols.

The landscape is complex and seasonally flooded. General soil color of Araihazar Upazila is grey to dark grey. The top soil has occupied by silt loams to silty clay loams; loam to clay loam. Araihazar, organic matter contents low in the high land, but moderate in the lower parts. General fertility status is moderate. The top soil pH level ranges from 5.0-6.9. Union wise soil texture of the Araihazar upazila has shown in ***Table 4-20***.

Table 4-20: Union wise Soil Texture Analysis of Araihazar Upazila

Union	Area (ha)	pH	Top Soil Texture	Land Suitability
Satgram*	1963.97	6.0-6.9	Loam to Clay Loam	Mostly $S_1$and S_2
Duptara*	1672.88	6.0-6.9	Loam to Clay Loam	Mostly $S_1$and S_2
Araihazar Paurashava	796.36	6.0-6.9	Loam	Mostly $S_1$and S_2
Bishnandi	1785.83	5.0-6.9	Loam to Clay Loam	Mostly $S_2$and S_3
Brahmandi	1632.79	6.0-6.9	Loam to Clay Loam	Mostly $S_1$and S_2
Fatehpur	709.31	5.5-5.7	Loam	Mostly $S_1$and S_2
Haizadi	1713.36	5.5-5.7	Loam to Clay Loam	Mostly $S_1$and S_2
Kalapaharia	3464.37	5.0-6.9	Loam to Clay Loam	Mostly $S_2$and S_3
Khagakand	1285.83	6.0-6.9	Loam to Clay Loam	Mostly $S_1$and S_2
Mahmudpur	967.21	5.5-5.7	Loam to Clay Loam	Mostly $S_1$and S_2
Uchitpur	978.54	5.0-6.9	Loam to Clay Loam	Mostly $S_1$and S_2
Gopaldi Paurashava	1145.34	6.0-6.9	Loam to Clay Loam	Mostly $S_1$and S_2

Source: National Land Zoning Report, Araihazar Upazila, December 2016
S_1- Highly suitable, S_2- Suitable, S_3- Moderately suitable and S_4- Not suitable.
*Project site located in this union



Source: BARC

Figure 4-19: Soils of Bangladesh

4.6.3.1 Soil Quality

Sampling Methodology and Locations

The soil sampling strategy was designed to assess the existing soil quality over the study area. Two soil samples were collected from the study area. The details of the soil sampling

locations are presented in ***Table 4-21***and ***Figure 4-20.*** A composite sampling technique has used for soil sampling from each location.

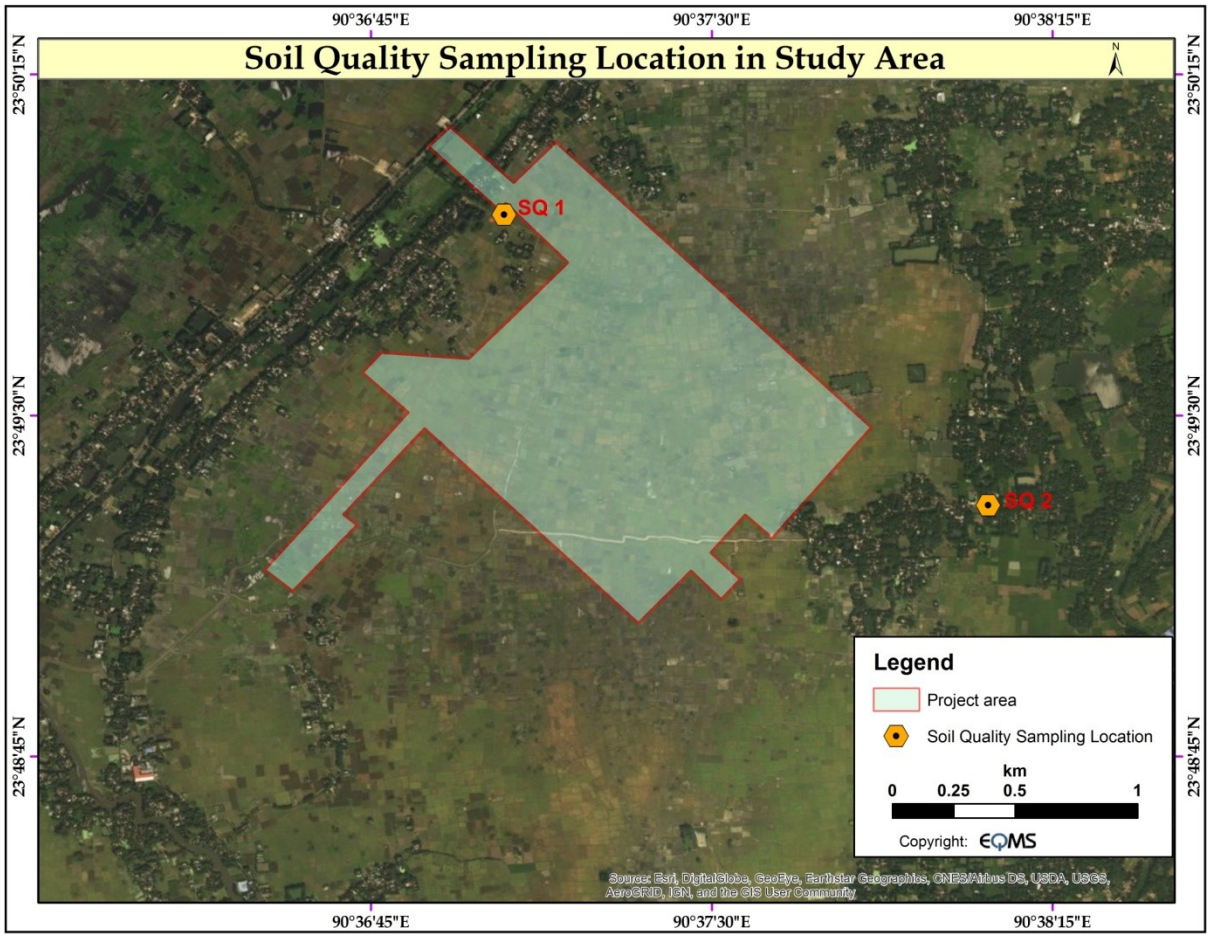
Table 4-21: Location of Soil Samples

Sl.	Sampling Station	Station Code	Geographic Location	Location Setting
1.	Project Site; Vill: Sonpara, Union: Satgram, Upazila: Araihazar	SQ1	23°49'56.5"N 90°37'02.6"E	Project area
2.	Vill: Tekpara, Union: Satgram, Upazila: Araihazar	SQ2	23°49'18.2"N 90°38'06.5"E	Land

Soil samples were collected using tools from a depth of 45 cm from the top soil surface. At each location, soil samples were collected from two spots and homogenized. The homogenized samples were collected following a quartering technique and then packed in polythene plastic jars and sealed. The sealed samples were sent to the laboratory for analysis.

The soil samples were analysed for physical and chemical characteristics including minerals, heavy metals and trace elements.

Soil Sample Collection Pictures



Source: Esri, Digital Globe, Geo Eye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, Aero GRID, IGN, and the GIS User Community

Figure 4-20: Soil Sampling Location Map

Analysis Results and Discussions

The analysis results of physico-chemical parameters of samples are presented in ***Table 4-22.***

Table 4-22: Soil Quality Results in the Proposed AEZ Site

Parameters	Unit	Soil Quality	Soil Quality
Sample Code		**SQ1**	**SQ2**
pH	-	5.7	6.2
Manganese	(µg/g or ppm)	5.40	15.00
Copper	(µg/g or ppm)	6.02	1.40
Iron	(µg/g or ppm)	138.60	99.40
Zinc	(µg/g or ppm)	1.00	0.86
Lead	(µg/g or ppm)	36.50	25.37

Source: Laboratory analysis, SRDI

Physical characteristics of soil

The particle size distribution of the soil samples shows major percentage of Sand, followed by silt and clay in most of the samples. The texture shows soil samples of the study area are of a loam type.

pH level of soil

The pH of the soil samples from the site was found to be neutral as per the standard soil classification given in ***Table 4-23***. As per laboratory analysis, SQ1 is moderately acidic and SQ2 is slightly acidic.

Table 4-23: Standard pH level of soil

pH	Classification
<4.5	Extremely acidic
4.51-5	Very strong acidic
5.01-5.5	Strongly acidic
5.51-6	Moderately acidic
6.1-6.5	Slightly acidic
6.51-7.3	Neutral
7.31-7.8	Slightly alkaline
7.81-8.5	Moderately alkaline
8.51-9.00	Strongly alkaline
>9	Very strongly alkaline

Metals in soil

Iron, Copper, Zinc, Lead and Manganese has detected in the soil sample.

In the Environmental Conservation Rules (ECR), 1997 has no soil quality standard. So, the soil quality in the study area was compared with the heavy metal content standard of USEPA office of solid waste and emergency response, hazardous waste land treatment ***(Table 4-24)***.

Table 4-24: Heavy Metal Contents of the Natural Soil

Element	Symbol	Common Range (ppm or mg/kg)	Average Concentration (ppm or mg/kg)
Manganese	Mn	200-3000	600
Copper	Cu	2-100	30
Lead	Pb	2-200	10
Zinc	Zn	100-300	50

Source: USEPA office of solid waste and emergency response, hazardous waste land treatment, SW-874 (April 1983, page 273)

Both baseline soil qualities have observed to be well below the threshold limit compared with the USEPA standard of heavy metal content in soil.

4.6.4 Land Use

Predominant land use of the Satgram union area is agriculture followed by settlement and water body. Recommended land zoning of this area is agriculture increasing industrial and commercial zone. A detailed land use pattern of the Araihazar union is shown in***Table 4-25***.

Table 4-25: Union wise Present Land Use Information and Identified Land Zoning of Araihazar Upazila

Union	Present Land Use (%)	Recommended Land Zoning
Bishnandi	Agriculture=46, Fallow/Chance Crop=1, Area Under Development=1, Road=1, Settlement=17, Water Bodies=34	Agriculture- Charand Meghna River Zones
Brahmandi	Agriculture=64, Industrial Area=1, Road=2, Settlement=29, Water Bodies=4	Agriculture Industrial and Commercial Zones
Duptara*	Agriculture=68, IndustrialArea=1, Road=1, Settlement=24, Water Bodies=6	Agriculture Industrial and Commercial Zones
Fatehpur	Agriculture=58, Road=2, Settlement=33, Urban=1, Water Bodies=6	Agriculture Industrial and Commercial Zones
Haizadi	Agriculture=74, Road=1, Settlement=21, Water Bodies=4	Agriculture Zone
Kalapaharia	Agriculture=56, Settlement=9, Water Bodies=35	Agriculture- Char and Meghna River Zone
Khagakand	Agriculture=49, Road=1, Settlement=16 Water Bodies=34	Agriculture- Char and Meghna River Zone
Mahmudpur	Agriculture=49, Road=1, Settlement=16 Water Bodies=34	Agriculture- Charand Meghna River Zone
Satgram*	Agriculture=76, Industrial Area=1, Road=1 Settlement=18, Water Bodies=4	Agriculture Industrial and Commercial Zones
Uchitpur	Agriculture=73, Road=1, Settlement=20 Water Bodies=6	Agriculture Zone
Araihazar Paurashava	Agriculture=55, Industrial Area=1, Brick Field=1, Road=2, Settlement=37, Urban=1 Water Bodies=3	Paurashava area
Gopaldi Paurashava	Agriculture=58, Industrial Area=3, Road=1 Settlement=32, Water Bodies=6	Paurashava area
Satgram (Part)	Industrial Area (Economic Zone)	Araihazar Economic Zone
Duptara (Part)		

Source: National Land Zoning Report, Araihazar Upazila, December 2016

*Project site located in this union

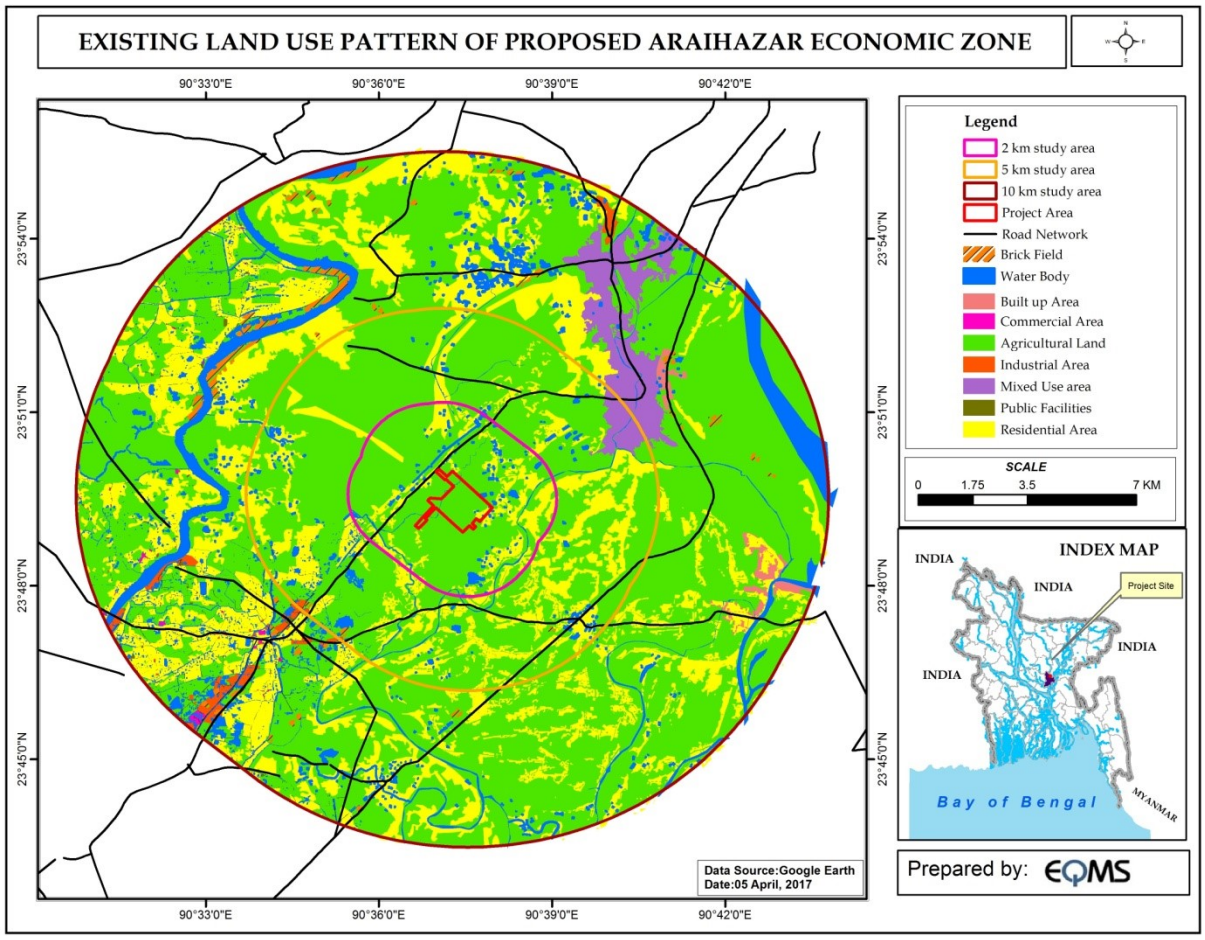
Land use/cover inventories are an essential component in land resource evaluation and environmental studies due to the changing nature of land use patterns. The land use study for the proposed project and its 10 km buffer has been undertaken with the following objectives:

- To study the land use/cover in the 10 km radius areas of the proposed Araihazar EZ project site and provide inputs for environmental planning of the proposed plant by analyzing the existing land use/land cover scenario; and
- To establish the existing base line scenario using a GIS database for incorporation of thematic information on the different physical features including water bodies, settlements, transport networks and administrative boundaries etc.

The evaluation of the existing environmental status of the study area has considered 0-10 km. This revealed that the land use/land cover consists mainly of Agricultural land, residential area, settlements with homestead vegetation and water bodies. ***Table 4-26***shows the existing land use composition around 10 km of the project study area. ***Figure 4-21***is showing the land use pattern within 10 km of the study area.

Table 4-26: Existing Land use Composition around 10 km of the Project Area

Land use Category	Area in Acres	Percentage (%)
Commercial	87.16	0.09
Agricultural land	62,250.19	66.21
Industrial	542.23	0.58
Water	6,605.07	7.03
Public	79.29	0.08
Residential	19,259.53	20.48
Mixed area	1,575.87	1.68
Brick Field	859.05	0.914
Roads	427.89	0.46
Built Up area	2,332.45	2.48
Total		**100.0**



Source: Google Earth

Figure 4-21: Land use/Land Cover Map for 10 km Study Area

4.7 Agriculture Resources

The agro-ecological unit of the project is Old Brahmaputra Floodplain zone. Most of the areas of this Upazila have developed by the Brahmaputra and Meghna river floodplain where land has constantly formed by transforming sediments deposited by the Meghna and Brahmaputra rivers that are seasonally flooded. The top soil has occupied by silt loams to silty clay loams; loam to clay loam. Araihazar, organic matter contents low in the high land, but moderate in the lower parts. General fertility status is moderate. The top soil pH level ranges from 5.0-6.9.

4.7.1 Farming Practice

Land type is the dominant factor guiding choice of crops and cropping patterns of Araihazar Upazila. Selection of crop largely depends on topographic position of land. Data collected during field study shows that Araihazar Upazila comprises predominantly with medium high land (53%) followed by medium low land (17%), high land (14%)and low land (10%) and very low land (6%). Land that has above normal flooding level can provide wide range of opportunities for growing crops. High land and medium high land are suitable for diversified crop cultivation including Boro, T. aman, mustard, potato, vegetables, chili, spice, jute, sweet potato, sesame, pulses and wheat. Medium lowland to low land area are suitable for yielding crops in Rabi season. (Source: Land Zoning Report, Araihazar Upazila)

4.7.2 Cropping Pattern and Intensity

Major portion of the land within study area is under agriculture. Crop land areas are occupied with paddy cultivation in Araihazar Upazila during the most part of the year. Other crops like mustard, potato, vegetable, chili, spice, jute, sweet potato, sesame, pulses and wheat are also included in cropping pattern of this Upazila. Different crops like chili, onion, groundnut, B.aman, Boro, aus, mustard, small cucumber and vegetables are instilled and adapted in char cropping pattern for the maximum utilization of land. Out of the total cultivable land in Araihazar single cropped area covers 19%, double cropped area 61%, triple cropped area 20% and multi cropped area less than 1%. Cropping intensity of this Upazila is about 201%. Cropping pattern and intensity of the study area is provided in ***Table 4-27***.

Table 4-27: Present Cropping Pattern

Upazila	Net Cultivable Area (NCA)	Major Cropping Pattern	Percentage (%)	Area(in ha)	Cropping Intensity (%)
Araihazar	11,256 ha	Boro- Fallow-B.aman	32	3602	201
		Boro-Fallow-Fallow	12	1351	
		Spices- Fallow -B.aman	12	1351	
		Boro-Dhaincha-T.aman	8	900	
		Vegetables-Vegetables-Vegetables	8	900	
		Potato-Fallow-Fallow	6	675	
		Pulse- Fallow -B.aman	5	563	
		Boro-Aus-Fallow	5	563	
		Boro-Fallow-T.aman	5	563	
		Others	7	788	
		Total	**100**	**11,256**	

Source: National Land Zoning Report, Araihazar Upazila, December 2016 (Page-37)

4.7.3 Cropped Area

Multiplicity of cropping systems has been one of the main features of the upazila. Farmers are harnessing their life style by producing various crops round the year. At the same time, the pressure of population on land and other natural resources along with rapid urbanization and/or industrialization is a major factor for changing land-use patterns rapidly which has adverse effect upon upazila's agricultural land. These changes are again causing reduction of agricultural production and the loss of biodiversity. In addition, the availability of land per capita is decreasing and thereby people are becoming landless and marginalized.

Overexploitation, mismanagement and changes in land use pattern are taking place at an unprecedented rate. However, there has been a positive change in adaption modern technologies like high-yielding varieties of rice and other crops, irrigation and mechanized

cultivation in this area. It is recognize that a change has taken place in production of different crops including fruit and vegetable in this region. The cropped area and cropping intensity of Araihazar upazila has given in ***Table 4-28***.

Table 4-28: Cropped area and cropping intensity of Araihazar upazila

Union	Crop Land Category								
	Single		Double		Triple		Multi		Cropping Intensity (%)
	Area (in ha)	Area (%)	Area (in ha)	Area (%)	Area (in ha)	Area (%)	Area (in ha)	Area (%)	
Araihazar	61	14	218	50	153	35	4	1	223
Bishnandi	321	38	448	53	76	9	0	0	171
Brahmandi	63	6	778	74	210	20	0	0	214
Duptara*	126	11	756	66	264	23	0	0	212
Fatehpur	50	12	203	49	161	39	0	0	227
Haizadi	191	15	867	68	217	17	0	0	202
Kalapaharia	683	35	1053	54	215	11	0	0	176
Khagakand	83	13	496	78	57	9	0	0	196
Mahmudpur	72	11	424	65	157	24	0	0	213
Sadasardi	85	13	389	59	184	28	0	0	215
Satgram*	237	16	888	60	355	24	0	0	208
Uchitpur	149	21	405	57	156	22	0	0	201
Total	**2,121**	**19**	**6,925**	**61**	**2,205**	**20**	**4**	**0**	**201**

Source: National Land Zoning Report, Araihazar Upazila, December 2016 (Page-34)
*Project site located in this union

4.7.4 Crop Production

Araihazar Upazila of Narayanganj district is very close to Dhaka city. Agriculture is still a promising sector creating enormous food production, generating employment opportunities and potential for the development of rural livelihood. However, the agricultural production system has aggravated by climate change, increasing population pressure, rapid urbanization, industrialization and infrastructural development that already depleted cultivable agricultural land resources. At present, the land of Araihazar Upazila are occupied with heavily industrialization and successively decreasing the land for agricultural production that making the farmers very tense to produce more food from this scanty land resource. To cope up with this present situation, farmers are using their land very intensively with the traditional diversified crop cultivation that reflects the present cropping practices in different unions. Blessed by the Meghna and Brahmaputra river basin Araihazar Upazila was prominent for cultivating different crops but present scenarios has changed due to land degradation. About 28.48% people of this Upazila are now engaged in agriculture. Wide range of rabi and kharif crops such as paddy, mustard, potato, vegetable, chili, spice, jute, sweet potato, sesame, pulses, wheat etc. grow here. Well-grown fruits are mango,

jackfruit, litchi, black berry; papaya etc. It is reported that sometimes-natural disasters like flood, drought, tornado, hailstorm damage crop production.

However, shifting agricultural land to non-agricultural purposes is a common phenomenon in this Upazila. Protecting agricultural land, minimizing land degradation and introducing modern technology are the basic needs to cope-up with the increasing demand of food for the growing population of this Upazila.

4.7.5 Crop Damage

Major causes for crop damage are given below:

- Scarcity of surface water for irrigation and higher cost of LLPs and DTWs in the local markets are the major problems for intensive irrigation in the area. But there is an ample opportunity to expand the irrigated area in future by promoting surface water irrigation, infrastructural development and ensuring timely availability of necessary inputs like seeds, fertilizers and pesticide/insecticides as reported by the local people.
- The most alarming situation found in the area was that the valuable agriculture land had been decreasing rapidly due to unplanned construction of houses, markets, industries and other infrastructural development in the area.
- During field survey, it has found that most of the old canals of the study areas had been close due to human interventions like construction of houses, markets and other infrastructures that were creating barriers to natural flow of water and ultimately had created drainage congestion in the area.
- In the medium high land areas, drainage congestion during rainy season hampering timely cultivation of T.aman (HYV) crop and damages summer vegetables. Seed beds of T. aman
- (HYV) crop were damaging in almost every year due to drainage congestion created when there is heavy rainfall during the months of June-August.
- Deficiencies of essential plant nutrients, drought in dry season, risk of early flood caused by heavy rainfall, shortage of crops storage facilities, marketing etc. are other common problems restricting crop cultivation in the study areas.

4.7.6 Main Constraints of Crop Production

Major problems here in crop cultivation are as follows: (i) Flood (ii) Drought (iii) hail storm (iv)Siltation (v)Water logging (vi) Soil fertility losses (vii) Pest and disease (viii) Shortage of mechanical tools and equipment (ix) Post-harvest loss of rabi crops (x) Tornado (xi) Lack of improved varieties and quality planting materials (xii) Artificial fertilizer crisis (xiii) Electricity power failure (xiv)Shortage of irrigation (xv) Temperature fluctuation (xvi) Changes in rainfall pattern (xvii) Top-soil cutting (xviii) Agriculture labor crisis and high wage rate (xix) Poor use of organic matter and soil nutrients deficiency (xx) Decrease of agricultural land.

Impact of the above problems on crop cultivation and society are: (i) Damaged standing crop due to seasonal flood(ii) Increase insect and pest infestation (iii) Essential plant nutrients deficiency (iv)Rapid depletion of crop production resources (v) Change in rivers

and canals morphology (vi)Unfavorable human habitat and health hazards (vii) Seasonal un-employment (viii) Land degradation(ix) Unmanageable post-harvest loss of fruits and vegetable and (x) Negative impact on employment and food security.

4.8 Livestock and Poultry

Livestock is an integral component of the complex farming system in Bangladesh as it not only a source of meat protein but also a major source of farm power services as well as employment. The livestock sub-sector provides full time employment for 20% of the total population and part-time employment for another 50%. The poultry meat alone contributes a substantial 37% of the total meat production in Bangladesh (Begum et al 2011). The GDP contribution of this sub-sector has been a modest 2.6% annually in the 1990s (IMF 2005) which was lower than the previous estimates of 5% of total and 10% of agricultural GDP during the 1970s and 1980s (FAO 1990; Planning Commission 1990).Livestock population in Bangladesh is currently estimated to comprise 25.7 million cattle, 0.83 million buffaloes, 14.8 million goats, 1.9 million sheep, 118.7 million chicken and 34.1 million ducks. The density of livestock population per acre of cultivable land is 7.37 (Banglapedia). The number of holding reporting selected livestock and poultry species 2008 in Araihazar Upazila has given in ***Table 4-29***.

Table 4-29: Number of holding reporting selected livestock and poultry species 2008 in Araihazar Uapzila

Cow and buffalo	Holding number	11,377
	Number of animal	23,471
Goat	Holding number	12,942
	Number of animal	28,180
Sheep	Holding number	2,031
	Number of animal	5,712
Hen and cock	Holding number	31,941
	Number of animal	161,578
Duck	Holding number	14,628
	Number of animal	66,353
Others	Holding number	1,971
	Number of animal	15,115

Source: Bangladesh Bureau of Statistics (BBS), District Statistics 2011 Narayanganj

4.8.1 Feed and Fodder Shortage

The owners of the livestock population are facing problems in respect of availability of fodder and feeds during the month from March to December due to shortage of grazing fields. In dry and Kharif-I seasons, the lands are generally submerged with water in the study areas. During Kharif-II season, the fields have covered with T. Aman (Local). Rice straw is the main fodder for cattle. Bran of wheat and rice, oil cakes, powder of cereal crops etc. are the other common fodders, but the availability of these feed in these areas is rare. 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 has provided. However, at times kitchen wastes become feed to the poultry.

4.8.2 Livestock/Poultry Diseases

Parasites and diseases cause serious losses in draft power and in the livestock and poultry production. Compounding factors make the control of health problems difficult and they include:

- General low level of nutrition
- Large livestock population
- Warm humid climate
- Congestion of animals during annual flooding
- Difficult communications impede implementing control programs

The Government has estimated that losses due to internal parasites are far greater than losses caused by diseases but both are serious. Adequate levels of nutrition would significantly reduce production losses caused by parasites.

The most frequently reported diseases among cattle and buffaloes are Anthrax, black quarter and foot and mouth disease. The got/cyst in head is common disease of goat. Newcastle disease, fowl pox, fowl cholera and duck plague are common among poultry. 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. 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 cause the diseases to the poultry birds.

The Directorate of Livestock Services (DSL) laboratories produce vaccines and serra for control. There is some shortage in capacity of the laboratories to meet all the needs. However, this is a serious problem due to an inadequate or ineffective system of distribution to the farm level.

4.9 Fisheries

4.9.1 Introduction

In Bangladesh, fish provides 60 percent of the national animal protein and this sub-sector contributes about 5 percent to the national GDP and approximately 9 percent to the total foreign exchange earnings. Nearly, 1.2 million people directly employed in this sub-sector and another 11 million are indirectly engaged in activities related to this sub-sector.

Fisheries status of the study area is good in wet season but moderate in dry season because of polluting water of Dhawrakhali canal and Brahmaputra River. Like other fisheries sector of the of country fisheries of the study area is not a major source of income, employment and livelihood support of the local people. (Source: Land Zoning Report, Araihazar Upazila)

4.9.2 Problem and Issues

In the study, area has lots of problem, which were restricting expansion, and developments of both capture and culture fisheries in the area. The details of problems in capture and culture fisheries have provided below

- Industrial and municipal waste are creating serious water pollution and hampering the growth of the aquatic flora and fauna etc
- Indiscriminate use of destructive fishing gears like current jal (monofilament twin net).
- The fish species diversity and stocks were under threats of depletion due to indiscriminate and uncontrolled harvesting.
- Indiscriminate harvesting of brood/mother fish during breeding season
- Deposition of silt in river mouths limits migration of fish to upstream.
- Extensive use of pesticides and agro-chemicals ultimately hamper spawning and damage fish habitats.
- The demand for agricultural production, particularly cereals, encourage attempts to dry out the wetland with a reduction in the capture area particularly beel and its fisheries resources.
- Erratic rainfall, prolong flooding, six month dry season and sandy soil is a major problems for full time aquaculture practices.
- Blockade of rivers and canals by flood protection embankments has seriously affected natural abundance of fish in open water by disrupting breeding migration.

4.9.3 Habitat Description

Araihazar Upazila has a total wetland area 3540.42 hectare of which 2503.44 hectare is under open water capture fisheries and 1036.98 hectare is under culture fisheries. Land distribution including wetland, wetland distribution between capture and culture fisheries and union wise wetland distribution with Paurashava has shown below. Bishnandi, Mahmudpur and Araihazar union shows good potential for fisheries production of Araihazar Upazila, which covers 36.83%, 18.48% and 13.87% respectively.

Table 4-30: Wetland Distribution of Araihazar Upazila (Hectare)

Union	Union Area	Culture Fisheries		Total Culture	Total Capture (In dry season)	Total Wetland
		Pond Culture	Other Fish Culture			
Araihazar	796.36	99.4	0.00	99.4	11.06	110.46 13.87%
Bishnandi	1785.83	50	0.00	50	597.01	647.01 36.83%
Brahmandi	1632.79	80.95	0.00	80.95	34.29	115.24 7.05%
Duptara	1672.87	110.36	0.00	110.36	44	154.36 9.23%

Union	Union Area	Culture Fisheries		Total Culture	Total Capture (In dry season)	Total Wetland
		Pond Culture	Other Fish Culture			
Fatehpur	709.31	49	0.00	49	27.02	76.02 10.72%
Haizadi	1713.36	130.12	0.00	130.12	24.67	154.79 9.03%
Kala Paharia	3464.37	5	0.00	5	1158.83	1163.83 33.59%
Khagakanda	1285.83	30	0.00	30	437.31	467.31 36.34%
Mahmudpur	967.21	124	0.00	124	54.74	178.74 18.48%
Sadasardi	1145.34	75.6	0.00	75.6	39.39	114.99 10.04%
Satgram*	1963.97	165.26	0.00	165.26	19.64	184.9 9.41%
Uchitpur	978.54	117.29	0.00	117.29	55.48	172.77 17.66%
Total	**18115.79**	**1036.98**	**0.0**	**1036.98**	**2503.44**	**3540.42 19.54%**

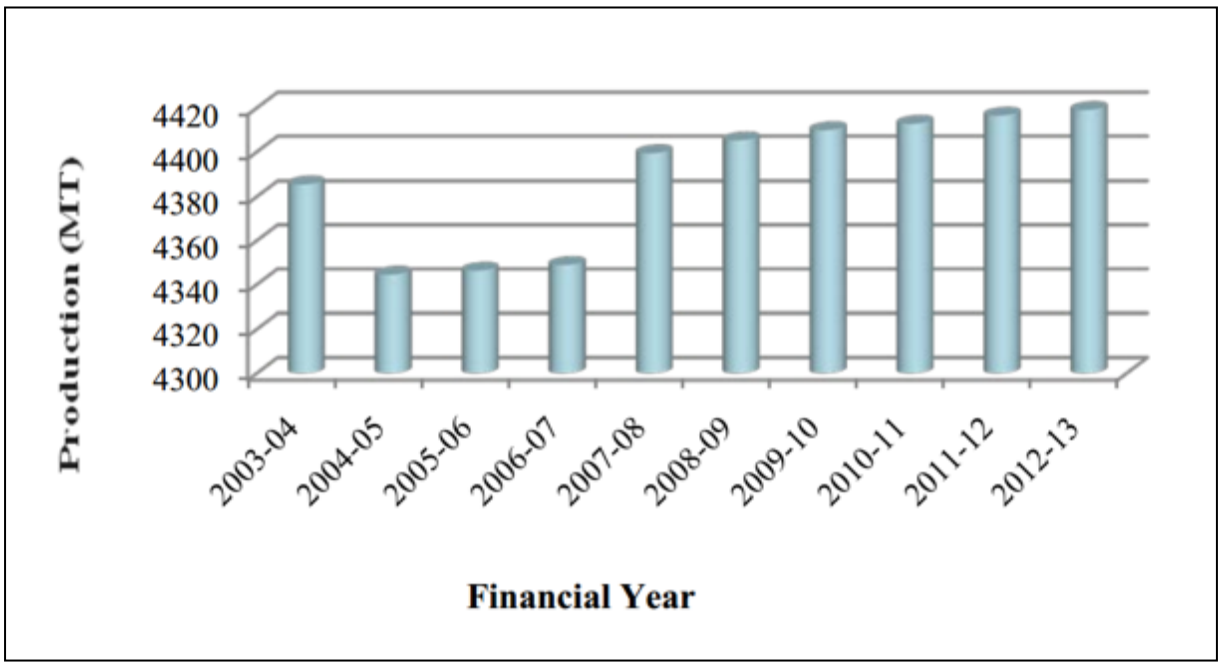
Note: Area in hectare
*Project site located in this union
Source: www.landzoning.gov.bd

Out of total area 18115.79 hectare, only 19.54% of the area represents wetland that covers 71%capture and 29% culture fisheries respectively. Generally, it varies in dry & wet season. When dry season, it is alarming in situation and wet season it inundates up to 5% of total land surface. Progressive river siltation is causing frequent floods in the rainy season due to reduce water-holding capacity. On the other hand, these water bodies are also dry up quickly in the dry season.

4.9.4 Fish Production and Effort

Freshwater culture fisheries of Araihazar Upazila represent the mainstay of pond aquaculture, nursery etc. Total areas of capture and culture fisheries in Araihazar Upazila are 2282.51 ha and 96.75 ha respectively. According to present field survey in 2012-13, the average fish production of Araihazar Upazila capture fisheries are 0.30 kg/ha and culture fisheries are 3.73 kg/ha.

The fisheries production of Araihazar Upazila shows an increasing trend. It was 4385 MT in 2003-2004 that was gradually increasing to 4419 MT in 2012-2013. On the other hand, the national fisheries production in 2003-2004 was 21.21 lakh MT that was gradually increasing to34.10 lakh MT in 2012-13. Fisheries production in Araihazar Upazila was increasing by 0.78% in last 10 years (2003-2012), where national production increased by 60.77 % (2003-2012) only.



Source: Land zoning report of Araihajar Upazila (www.landzoning.gov.bd)

Figure 4-22: Fisheries Production of Last 10 Years in Araihazar Upazila

Productivity status of Araihazar Upazila is the lower of national production due to less application of scientific technical knowledge about stock enhancement, seed production and pond management system. Basic inputs like fish seeds, fish feeds and other on-farm inputs are not available to most pond owners. For unfavorable physico-chemical and biological condition of different ecosystem (river, beel, paddy field, floodplain, boropit, aquaculture pond etc) and intensive stocking of fingerlings with free of cost in open water bodies (river, canal, beel etc.) by Department of Fisheries (DoF) play important role for further increase of fisheries productivity of Araihazar Upazila.

4.9.5 Fish Migration

Reportedly, feeding and spawning migration of riverine resident fish species occur through open and regulated khals to some extent during the period of late June to August in the study area. Perennial khals along with other seasonal internal khals are used as feeding and shelter ground of most of the open water fishes. Many fish species like migrate horizontally to these water bodies as part of their life cycle. Peripheral rivers along with internal river and khals of the study area silted up naturally and due to structures on the khals cause the reduction the length of successive migration routes. Longitudinal migration of fish species has therefore obstructed.

4.9.6 Fish Biodiversity

Araihazar Upazila has potential of inland open water fisheries resources that consist of the seasonal water bodies, rivers, natural depressions or beels and reservoir. There are about 2600 beneficiaries involve in fisheries activities of the upazila. Annual flooding in the rainy season inundates up to 5% of the total land surface. Despite the existence of huge resources, the inland capture fisheries have replaced as top fish producing sources over the years by aquaculture due to decline and degradation of resources. However, over a few years aquatic

biodiversity especially fish species and other aquatic organism in inland open water have declined due to natural and anthropological causes. The priority given to improved biological management that will restrict the degradation of resources and production.

Major native capture species are:Ilish (*Tenualosha ilisha*), rui(*Labeo ruhita*), catla (*Catla catla*), puti (*Puntius puntio*),Beda (*Nandus nandus*), koi(*Anabas testudineous*), mrigel(*Cirrhinus cirrhosus*), boal(*Wallago attu*), taki (*Channa punctatus*), mola(*Amblypharyngodon mola*),guchi (*Macrognathus puncalus*),baim (*Mastacembelus armatus*),shoal (*Chana striatus*), tengra(*Mystus vittatus*), Gozar (*Channa marulius*), kholisha (*Colisha fasciata*), etc.

Fresh water aquaculture is an important component of Araihazar Upazila fisheries. Currently aquaculture has been practicing in a total area of 1036.98 ha which cover about 29% of totalinland water of Araihazar Upazila culture fisheries comprises of pond aquaculture, fish culture in seasonal water bodies, canal, khal, boropit, fish culture in paddy field etc. Major native culture speciesare: rui (*Labeo rohita*), catla (*Catla catla*), bata (*Labeo bata*), mrigel (*Cirrhina mrigala*), tilapia(*Oreochromis nilotica*), grass carp(*Ctenopharyngodon idella*), silver carp (*Hypopthalmichthys nobilis*),tilapia (*Oreochromis mossambicus*), magur (*Clarias batrachus*), koi (*Anabas testudineus*), shing(*Heteropneustes fossilis*), sarputi (*Puntius sarana*), Pungus (*Pungasius suchi*)etc.

4.9.7 Fisheries Management

There is no community based fisherman association in the study areas. Fishing right on existing fish habitats is insignificant particularly on common resources. Department of Fisheries (DoF) has limited activity (observe fishing ban, technology transfer on pond aquaculture practices through training etc.) for fisheries resource conservation and management in the study areas. Regarding fisheries, land zoning can help for protection of fish habitat, nursery areas, and as well as habitat restoration of the fisheries ecosystem, they do not usually address fisheries operations such as controls on harvesting (e.g., sizes, seasons, gear type etc). Because these control functions typically involve only the fisheries sector, they can be handled separately. As mentioned, land zoning usually addresses multi-sector concerns. However, the land zoning format can assist fisheries harvest management and such controls as closed areas and maintenance of traditional fishing practices. Land zoning can support fisheries management particularly in developing countries beset with overfishing problems and multiple resources use conflicts. Some NGOs are working, but they have much more microcredit function rather than extension services and aquaculture training. Enforcement off fisheries regulation is very weak.

4.10 Ecological Resources

4.10.1 Bio-ecological Zone

IUCN has classified Bangladesh into 25 Bio-ecological Zones in the context of physiographic and biological diversity. The survey area covers three distinct Bio-ecological zones; they are the Brahmaputra-Jamuna Floodplain (Bio-Ecological Zone 4c), Madhpur Sal Tract (Bio-ecological Zone 3) and Major Rivers (Bio-Ecological Zone 11). The Project site falls under Brahmaputra-Jamuna Floodplain (Bio-Ecological Zone 4c) Zone. Details of the Bio-ecological

zone within the study area are described below. (Source: Bio-ecological zones of Bangladesh, 2002, IUCN).

Source: IUCN

Figure 4-23: Bio-ecological zones of the study area

Bio-ecological zone (4c)
Brahmaputra-Jamuna Floodplain

Location	23° 37′-26°38′ N and 89° 37′-91°00′E
Relevant adm hq	Sherpur, Jamlpur, Tamgail, Mymensingh, Kisoreganj, Narsighdi, Dhaka
Physiography	Old Brahmaputra floodplain and Young Brahmaputra floodplain
Soil	Non-calcareous gray floodplain soils; Non-calcareous dark grey floodplains soils.
Rainfall	20230-3300 mm.
Temperature	Maximum 34°C, Minimum 11°C
Floodindg depth	H-MH, MH-H, MH-L
Land Use	Rabi-Aus-T.aman(2a); Boro-Fallow-T.aman(4a), Boro-Fallow-Fallow(9)

Floral Diversity

Tree

Kanthal (*Artocarpus heterophyllus*), Aam (*Mangifera indica*), Rendi koroi (*Samanea saman*);

Herbs and Shrubs

Danda Kalash (*Leucus aspera*), Koroi (*Pongamia pinnata*), Jarul (*Lagerstrocmia specoisa*), Motkila (*Glycosmis arborea*);

Trees near water

Pitali (*Trewia nodiflora*), Koroi (*Pongamia pinnata*), Jarul (*Lagerstroemia speciosa*), Debdaru (*Polyalthia longifolia*);

Aquatic Plants

Kachuripana (*Eichornia crassipes*), Shada shapla (*Nymphea nouchali*), Keshordam (*Ludwigia adscendense*);

Faunal diversity

Mammals

Rhessus macaque (*Macaca mulatta*), Three-stripped palm squirrel (*Funambulus palmarum*), Jackal (*Canis aureus*);

Reptiles

Yellow monitor (*Varanus flavescens*), Bengal monitor (*Varanus bengalensis),* Common Vine Snake (*Ahaetulla nasuus*);

Amphibians

Tree frog (*Polypedates leucomystax*), Cricket frog (*Limnonects limnocharis*);

Bio-ecological zone (3)
Madhpur Sal Tract

Location	23° 50′-24°50′ N and 89° 54′-90°50′E
Relevant adm hq	Tangail, Mymensingh, Gazipur
Physiography	Madhpur tract
Soil	Deep red-brown terrace soils
Rainfall	2030-2290 mm
Temperature	Maximum 34°c, Minimum 11°C.
Floodindg depth	H
Land Use	Desiduous forest (14c)

Floral diversity

Trees

Sal (*Shorea robusta*), Ban chalta (*Dilleniapentagyna*), Chitrika/Neul (*Bursera serrata*), Ban karpash (*Thespesia lampus*), Bhela (*Semicarpus anacardium);*

Shrubs

Kamela (*Mallotus phillipinensis*), Kestoma/Keura (*Glochidion multiloculare*), Assar (*Grewia microcos*), Mankanta(*Randia dumetorum*);

Herbs

Shamdaln(*Elephantopus scaber*), Shothi (*Curcuma zeodaria), Boreriahispida;*

Climbers

Kamkui/kantkui (*Bridelia retusa*), Goalia lata (*Spatholobus roxburghii*), Ban ritha /Kuchui (*Acasia concinna*), Anantamuli (*Hemidesmus indicus*);

Orchids

Geodorum densiflorum;

Faunal diversity

Mammals

Capped langur (*Trachypithecus pileatus)*, Wild boar(*Sus scrofa)*, Asiatic brush-tailed porcupine (*Atherurus macrorus*), Jackal (*Canis aureus*), Jungle cat (*Felis chaus);*

Birds

Indian pitta (*Pitta brachyuran)*, Dollar bird (*Eurystomus orientalis)*, Blue-tailed bee-eater (*Merops orientalis*), Dusky eagle owl (*Bubo coromandus)*, Green-billed malkoha(*Phaenicophaeus tristis)*, Lesser coucal (*Centropus bengalensis*), Yellow-footed green pigeon (*Treron phoenicoptera*);

Reptiles

Indian black turtle (*Melanochelys trijuga*), Monoccllate cobra (*Naja kaouthia*), Cantor's kukri snake (*Oligodoti ajdurus)*;

Amphibians

Kaloula/Painted bull lrog (*Kaloula pulchra*), Ornate miciohylid (Microhyla omata), Taipeh frog (*Runa taipehensis*),Balloon frog (*Upvrodon globulosus*);

Bio-ecological Zone (11)

Major Rivers

Location	22° 55′-26°15′ N and 88° 10′-90°37′E
Relevant adm hq	Rajshahi, Kushtia, Faridpur, Shariatpur, Chandpur, Narayangonj, Manikganj,Tangail, Sirajgonj. Kurigram, Rangpur
Physiography	Young Brahmaputra floodplain, Gangea river floodplain
Soil	Calcareous alluvium (non-saline); Noncalcareous alluvium
Rainfall	1270-2290 mm
Temperature	Maximum 37°C , Minimum 9° C
Floodindg depth	MH and ML
Land Use	Rabi-Aus-T.aman(2a);Rabi-Mixed B. aus & aman(7a); Rabi-B.aus-Fallow (le)

Floral diversity

Plants

Binna ghash (*Vetiveria zizanioides*), Kash (*Saccharum spontaneium*), Ghagra (*Xanthium indicum*), Ban palang (*Rumex maritimus*);

Faunal diversity

Mammals

Ganges river dolphin (*Platanista gangetica*), Bengal fox (*Vulpes bengalensis*), Greater bandicot rat

(*Bandfcota indica*);

Birds

River lapwing (*Vanellus duvaucelii*), Black-bellied tern (*Sterna acuticauda*), Sand lark (*Calandrellaraytal*), Spot-billed duck (*Anas poecilorhyncha*, Small pratincole (*Glareola lactea*);

Reptiles

Bibron's softshell turtle (*Pelochelys bibroni*), Gangetic gharial (*Gavialis gangeticus*), Ganges softshell turtle (*Aspideretes gangeticus*), Median roofed turtle (*Kachuga tentoria*);

Amphibians

Jerdon's bull frog (*Hoplobatrachus crassus*), Skipper frog (*Euphlyctis cyanophyctis*);

4.10.2 Common flora and fauna

4.10.2.1 Introduction

The biodiversity component of the study focused on a few groups of biological components. These were: flora, birds, reptiles, amphibians, mammals as well as the surrounding ecosystems. Most of the fieldwork within the project has been addressed with these groups although each group had different approaches and requirements. A multidisciplinary team related to ecology (terrestrial & aquatic) has been engaged in conduct the study. The study area (10 Km buffer area from project site) occupied various types of ecosystems such as rural settlements, roadside vegetation, croplands, woodland vegetation and wetlands.

The high-resolution satellite images of the study area were studied to identify ecologically significant areas and different wildlife habitats. Based on the information from the aerial maps and available project site map, field survey was undertaken to list the available habitat types along with flora and fauna known to inhabit the area. The surveys included transects within the study area covering all major habitat types. During transect survey other members of the team having expertise on respective fields accompanied the ecologist. Secondary ecological data of the study area have been explored from different publications and reports like IUCN, Bangladesh National Herbarium, Birdlife International and Wildlife Trust of Bangladesh (WTB).

4.10.2.2 Aquatic Flora

The plant species usually submerged or partially submerged/floating in the water recorded from the study area are mosquito ferns(*Azollasp*), kachuripana (*Eichornia crassipes)*, tropical white morning-glory (*Ipomea alba)*, esthwaite waterweed(*Hydrilla verticillata)*, taro(*Calocasia esculenta),* globe yellowcress*(Rorippa indica)*, procumbent yellow-sorrel (*Oxalis corniculata)*,four-leaf clover(*Marselia sp*), lamb's quarters *(Chenopodiumalbum)*, goose weed (*Sphenoclea zeylanica)* and hornworts (*Ceratophyllumsp*),white water-lily (*Nymphaea nouchali),* red water-lily *(Nymphaea rubra).*

None of the species observed are of conservational significance.

4.10.2.3 Terrestrial Flora

A. Grassland

A total 17 species belonging to 14 genera of 10 families were recorded from the study area listed in ***Table 4-31***. Four (4) species of grasses were identified among themBarajavani (*Fimbristylis milliacea)* and Mutha (*Fuirena ciliaris)* were found most commonly occurring. Herbs were represented by 5 species dominated by Kapalphutki (*Cardiospermum halicacabum*), Jhaljamani*(Cocculus hirsutus),* Marmarialata *(Cissus repens)*and Banorkalai (*Atylosia scrabaeoides*)list of grassland flora of the study area.

Table 4-31: A checklist of grassland floral species in the study area

SI	Scientific name	Family	Common Name (Bengali name)	Status of distribution	Type
1	*Coccinia grandis.*	Cucurbitaceae	Telakucha	common	Wild
2	*Ampelocissus latifolia.*	Vitaceae	Angurlata	common	Wild
3	*Atylosia scrabaeoides.*	Fabaceae	Banorkalai	common	Wild
4	*Canavalia gladiate.*	Fabaceae	Mousim, Makhansim	common	Cultivated
5	*Cardiospermum halicacabum*	Sapindaceae	Kapalphutki	common	Wild
6	*Centrosema pubescens*	Fabaceae	Gandhya Sim	common	Wild
7	*Cissus repens.*	Vitaceae	Marmarialata	common	Wild
8	*Cocculus hirsutus.*	Menispermaceae	Doipata, Jhaljamani	common	Wild
9	*Dioscorea belophylla.*	Fabaceae	Sora Alu	common	Wild
10	*Ichnocarpus frutescens.*	Apocynaceae	Dudhilata	common	Cultivated
11	*Ipomoea aquatica*	Convolvulaceae	Panikalmi	common	Wild
12	*Ricinus communis*	Euphorbiacreae	Venna, Reri	common	Wild
13	*Xanthosoma sagittifolium*	Araceae	Dud Kachu	Common	wild
14	*Senna tora.*	Caesalpiniaceae	Kalkasunda	Common	wild
15	*Fimbristylis dichotoma subsp. podocarpa Koyama*	Cyperaceae	Nirbishi	Common	wild
16	*Fimbristylis milliacea.*	Cyperaceae	Barajavani	Common	wild
17	*Fuirena ciliaris.*	Cyperaceae	Mutha	Common	wild

B. Common plant of the study area

A total of 53 species, 48 genera belongs to 31 families were represented by terrestrial flora. Mahogani (*Swietenia mahagoni)* tree species is endangered as per classification. Coconut (*Cocos nucifera),* Eucalyptus*(Eucalyptus citriodora),* Mango *(Mangifera indica),*Guava *(Psidium guajava), Ricinus cummunis,* Litchi (*Lichi chinensis),*Kul-boroi*(Ziziphus mauritiana),*Pepe *(Carica papaya),*Sajna*(Moringa oleifera),*Jambura*(Citrus aurantifolia),* Mahogani *(Sweitenia mahagoni),*Banana (*Musa sapientum),*Kachkola(*Musa paradisiac),*Kathal*(Atrocarpus heterophyllus)*andAcasia *(Acacia nilotica)*were recorded most commonly occurring trees.

Table 4-32: A checklist of common plant species in the study area

SI	Scientific Name	Family	Common Name	Habit	Status of distribution	Type
1.	*Polyalthia longifolia*	Annonaceae	Debdaru	T	sporadic	Cultivated
2.	*Gmelina arborea L.*	Verbenaceae	Gamari	T	sporadic	Cultivated
3.	*Eucalyptus citriodora Hook*	Myrtaceae	Eucalyptus	T	sporadic	Cultivated
4.	*Erythrina ovalifolia Roxb.*	Caesalpiniaceae	Mander, Patiyamander	T	sporadic	Wild
5.	*Dillenia indica L.*	Dilleniaceae	Chalta	T	sporadic	Wild
6.	*Areca catechu L.*	Mimosaceae	Supari, Gua	T	sporadic	Cultivated
7.	*Hibiscus rosa-sinensis*	Malvaceae	Joba	S	sporadic	Cultivated
8.	*Cestrum nocturnum L.*	Solanaceae	Hasnahena	S	sporadic	Cultivated
9.	*Corchorus aestuans L.*	Tiliaceae	Banpat	H	sporadic	Wild
10.	*Mimusops elengi.*	Sapotaceae	Bakul	T	rare	Cultivated
11.	*Delonix regia.*	Caesalpiniaceae	Krisnochura	T	rare	Cultivated
12.	*Lawsonia inermis.*	Lythraceae	Mehede	S	rare	Cultivated
13.	*Gardenia coronaria.*	Rubiaceae	Gandhyaraj	S	rare	Cultivated
14.	*Paederia foetida*	Rubiaceae	Gandhyabhaduli	C	rare	Cultivated
15.	*Ziziphus Mauritian*	Rhamnaceae	Kul, Boroi	T	common	Cultivated
16.	*Terminalia arjuna*	Combretaceae	Arjun	T	common	Cultivated
17.	*Tamarindus indica.*	Caesalpiniaceae	Tetul	T	common	Cultivated
18.	*Syzygium cumini (L.) Skeels*	Myrtaceae	Jam	T	common	Cultivated
19.	*Coccinia grandis*	Cucurbitaceae	Telakucha	C	common	Wild
20.	*Lablab purpureus*	Fabaceae	Shim	C	common	Cultivated
21.	*Lageneria siceraria*	Cucurbitaceae	Kadu	C	common	Cultivated
22.	*Alocasia indica*	Araceae	Mankachu	H	common	Wild
23.	*Colocasia esculenta*	Araceae	Bankachu	H	common	Wild
24.	*Cynodon dactylon*	Poaceae	Durba	H	common	Wild
25.	*Musa paradisica*	Mussaceae	Kachkola	H	common	Cultivated
26.	*Carica papaya*	Caricaceae	Pape	S	common	Cultivated
27.	*Sesbania canabina*	Fabaceae	Dhoincha	S	common	Cultivated
28.	*Phyllanthus acidus*	Euphorbiaceae	Arboroi	ST	common	Cultivated
29.	*Psidium guajava*	Myrtaceae	Peyara	ST	common	Cultivated
30.	*Aegle marmelos*	Rutaceae	Bel	T	common	Cultivated

SI	Scientific Name	Family	Common Name	Habit	Status of distribution	Type
31.	*Albizia procera*	Mimosaceae	Silkoroi	T	common	Cultivated
32.	*Annona squamosa*	Annonaceae	Ata	T	common	Cultivated
33.	*Aphanamixis polystachya*	Meliaceae	Roina	T	common	Wild
34.	*Artocarpus heterophyllus*	Moraceae	Kathal	T	common	Cultivated
35.	*Azadirachta indica*	Meliaceae	Neem	T	common	Cultivated
36.	*Bambusa balcooa*	Poaceae	Barakbans	T	common	Cultivated
37.	*Barringtonia acutangula*	Lecythidaceae	Hijal	T	common	Cultivated
38.	*Bombax ceiba*	Bombaceae	Shimul Tula	T	common	Wild
39.	*Borassus flabellifer*	Palmae	Tal	T	common	Wild
40.	*Citrus grandis*	Rutaceae	Jambura	T	common	Cultivated
41.	*Cocos nucifera*	Arecaceae	Narikel	T	common	Cultivated
42.	*Feronia lemonia*	Rutaceae	Kadbel	T	common	Cultivated
43.	*Litchi chinensis*	Sapindaceae	Lichu	T	common	Cultivated
44.	*Litsea monopetala*	Lauraceae	Menda	T	common	Wild
45.	*Moringa oleifera.*	Moringaceae	Sajna	T	common	Wild
46.	*Neolamarckia cadamba.*	Rubiaceae	Kadam	T	common	Wild
47.	*Phoenix sylvestris.*	Arecaceae	Khejur	T	common	Cultivated
48.	*Phyllanthus embelica.*	Euphorbiaceae	Amloki	T	common	Cultivated
49.	*Samanea saman.*	Mimosaceae	Rain Tree, Meghsirish	T	common	Cultivated
50.	*Streblus asper*	Moraceae	Sheora	T	common	Wild
51.	*Switenia mahogani*	Meliaceae	Mahogani	T	Common	cultivated
52.	*Acacia nilotica*	Fabaceae	Acasia	T	Common	Wild
53.	*Casia siamea*	Fabaceae	Cassia tree	T	Common	Wild

C. Agricultural land

Mono-cropping agricultural pattern of paddy is pre dominant in the area. IRRI and Agrani are cultivated in the agricultural lands. IRRI is cultivated in the late of December whereas Agrani is cultivated in the late of March. Rabi crops cultivated are those: mustard, chilly, onion, vegetables, ladies finger, long yard bean, tomato etc. In the rainy season the agricultural lands goes under water and generally, it remains in uncultivated for 6-8 months.

So, the whole land remains underwater until early winter.It is envisaged that agricultural land would be falling within the Araihazar EZ area.

4.10.2.4 Aquatic Fauna

A. Macro-invertebrate Fauna

Macro-invertebrate surveys were conducted in 22-23 October,2017 survey. Macro invertebrate species such as water spiders (*Argyroneta aquatic*), Common Apple snail (*Pila globosa*), Disk Snail (*Macrochlamys sequax*), River Snail (*Bellamya begalensis*), Brotia Snail (*Brotia costula*), Lymneid Snail (*Lymnaea luteola*), Fresh water Mussels species such as (*Lamellidens corrianus*), (*Lamellidens marginalis*), (*Lamellidens jenkinsianus*) were observed in the study area. None of the species observed are of conservational significance.

B. Fish

In order to get secondary information as well as various literatures review found some data / information on the specific floodplain of the project area. The Sonakahli and Dhawrakhali canal interconnected with each other while they are connected to Old-Brahmaputra River. 31 species of 25 genera belonging to 17 families are reported from the canal and river. Among of them 4 species are in endangered and 2 species are vulnerable and 3 are near threatened according to the Red list of IUCN (2015, Vol.3).

Table 4-33: A checklist of fish in the study area.

SL#	Local name	Common name	Scientific name	Family	IUCN Status
1.	Koi	Climbing perch	*Anabus testudines*	Anabantidae	LC
2.	Chela	Large Razorbelly Minnow	*Salmophasia bacaila*	Cyprinidae	LC
3.	Katol	Catla	*Catla catla*	Cyprinidae	LC
4.	Boal	Freshwater Shark	*Wallago attu*	Siluridae	VU
5.	Rui	Ruhu	*Labeo rohita*	Cyprinidae	LC
6.	Pangash	Yellowtail Catfsh	*Pangasius pangasius*	Pangasiidae	EN
7.	Tengra	Striped Dwarf Catfsh	*Mystus vittaus*	Bagridae	LC
8.	Shing	Stinging Catfsh	*Heteropneustes fossilis*	Heteropneustidae	LC
9.	Shol	Snakehead Murre	*Channa striatas*	Channidae	LC
10.	Taki	Spotted Snakehead	*Channa punctata*	Channidae	LC
11.	Bele	Bele	*Glossogobius giuris*	Gobiidae	LC
12.	Chital	Humped Featherback	*Chitala chitala*	Notopteridae	EN
13.	Gajar	Giant Snakehead	*Channa marulius*	Channidae	EN

SL#	Local name	Common name	Scientific name	Family	IUCN Status
14.	Pabda	Pabda catfish	*Ompok pabda*	Siluridae	EN
15.	Kakila	Silver Needle Fish	*Xenentodon cancila*	Belonidae	LC
16.	Mola	Mola Carplet	*Amblypharyngodon mola*	Cyprinidae	LC
17.	Chela	Large Razorbelly Minnow	*Salmophasia bacaila*	Cyprinidae	LC
18.	Bata	Bata Labeo	*Labeo bata*	Cyprinidae	LC
19.	Jat Punti	Spotfn Swamp Barb	*Puntius sophore*	Cyprinidae	LC
20.	Khailsha	Banded Gouram	*Trichogaster fasciata*	Osphronemidae	LC
21.	Gulsha Tengra	Bleeker's Mystus	*Mystus bleekeri*	Bagridae	LC
22.	Tengra	Striped Dwarf Catfsh	*Mystus vittatus*	Bagridae	LC
23.	Magur	Walking Catfsh	*Clarias batrachus*	Clariidae	LC
24.	Bacha	Batchwa Vacha	*Eutropiichthys vacha*	Schilbeidae	LC
25.	Potka	Ocellated Pufferfsh	*Tetraodon cutcutia*	Tetraodontidae	LC
26.	Choto Tengra	Tengara Catfsh	*Mystus tengara*	Bagridae	LC
27.	Mrigal	Mrigal Carp	*Cirrhinus cirrhosus*	Cyprinidae	NT
28.	Tatkini	Reba	*Cirrhinus reba*	Cyprinidae	NT
29.	Silver carp	Silver carp	*Hypophthalmichthys molitrix*	Cyprinidae	NT
30.	Grass carp	Grass carp	*Ctenopharyngodon idella*	Cyprinidae	DD
31.	Olive barb	Sar punti	*Systomus sarana*	Cyprinidae	LC

Data source: Study team using IUCN classification system

IUCN Status code: CR - Critically Endangered, EN - Endangered, VU - Vulnerable, LC - Least Concern, DD- Data Deficient, NT-Near Threatened

Fishing at Sonakahali canal

Fishing at Dhawrakhali canal

Small indigenous fish species were also available especially from the monsoon season to post monsoon season. Such fish are an important protein source for the poor people. During discussion with the local fishermen fishing community it was revealed that most of the subsistence and part-time fishermen depend on these small fishes not only as a protein source in their diet but also a major part of their income comes is derived from the sale of these fish.

4.10.2.5 Terrestrial Fauna

A. Mammals

Nine species of terrestrial mammals belonging to the 8 genera of 6 families were recorded to occur in wild in the Project. Golden Jackal (*Canis aureus*), Bengal Fox (*Vulpes bengalensis*) and Indian Gray Mongoose (*Herpestes edwardsii*) were seen visiting canal area, Sonpara during the field survey by the ecology team. Jungle Cat (*Felis chaus*) was reported to be seen by locals during field consultations in agricultural and homestead plantation areas. None of the species are reported to be listed in RED category of IUCN 2015 v2.However, Indian Gray Mongoose (*Herpestes edwardsii*), Jungle Cat (*Felis chaus*) and Asian House Shrew (*Suncus murinus*) are reported to be listed in Bangladesh Wildlife Prevention Order, 1973 as Sch-III which protects them from hunting, killing and capturing.

Table 4-34: A checklist of mammals found in the study area

SL#	Local Name	Common Name	Scientific Name	Family	IUCN Status*
1	Khet-indur	Lesser Bandicoot Rat	*Bandicota bengalensis*	Muridae	LC
2	Dhari Indur	Large Bandicoot Rat	*Bandicota indica*	Muridae	LC
3	Nengti Indur	House Mouse	*Mus musculus*	Muridae	LC
4	Chucho	House Shrew	*Suncus murinus*	Soricidae	LC
5	Chamchika	Indian Pipistrelle	*Pipistrellus coromandra*	Vespertilionidae	LC
6	Boro Beji	Common Mongoose	*Herpestes edwardsii*	Herpestidae	LC
7	Khek Shial	Bengal Fox	*Vulpes bengalensis*	Canidae	VU
8	Ban Biral	Jungle Cat	*Felis chaus*	Felidae	NT
9	Pati Shial	Golden Jackal	*Canis aureus*	Canidae	LC

Data source: Study team using IUCN classification system

IUCN Status code: CR - Critically Endangered, EN - Endangered, VU - Vulnerable, LC - Least Concern, NT-Near Threatened

B. Avifauna

A total of 45 species belonging to 37 genera of 27 families were observed to be in the study area during field survey by ecology team in 22-23 October, 2017. These species are present in variety of habitats from Grassland, homestead plantation, agriculture plantation and aquatic habitat. The list of species is included in***Table 4-35***. Out of these 45 species, Red Vented

Bulbul (*Pycnonotus cafer*), Black Drongo (*Dicrurus macrocercus*), Oriental Magpie Robin (*Copsychus saularis*), Spotted Dove (*Streptopelia chinensis*), Black Kite (*Milvus migrans*), Large Billed Crow (*Corvus macrorhynchos*), Rufous Treepie (*Dendrocitta vagabunda*), Indian Roller (*Coracias benghalensis*), Common Hoopee (*Upupa epops*), Black Rumped Flameback (*Dinopium benghalense*), White Throated Kingfisher (*Halcyon smyrnensis*), Pied Kingfisher (*Ceryle rudis*), Fulvus breasted Woodpecker (*Dendrocopos macei*), Shikra (*Accipiter badius*), White Wagtail *(Motacilla flava*), Red Wattled Lapwing (*Vanellus indicus*), Asian Koel (*Eudynamys scolopacea*), Rock Pigeon (*Columbam livia*), Common Myna (*Acridotheres tristis*), Jungle Myna (*Acridotheres grandis*) and Green Bee eater (*Merops orientalis*) are reported to be listed in Bangladesh Wildlife Prevention Order,1973 as Sch-III which protects them from hunting, killing and capture.

The proposed project site has many harbors species such as Red vented bulbul, Red Watted Lapwing, Black Kite, Black Drongo, Rock Pigeon, Long–tailed Shrike and Common Myna. These species are common in the area and sufficient habitats are available within area once the construction and operation activities are commenced. None of the species were listed as threatened as per IUCN classification.

Table 4-35: A checklist of birds in the study area

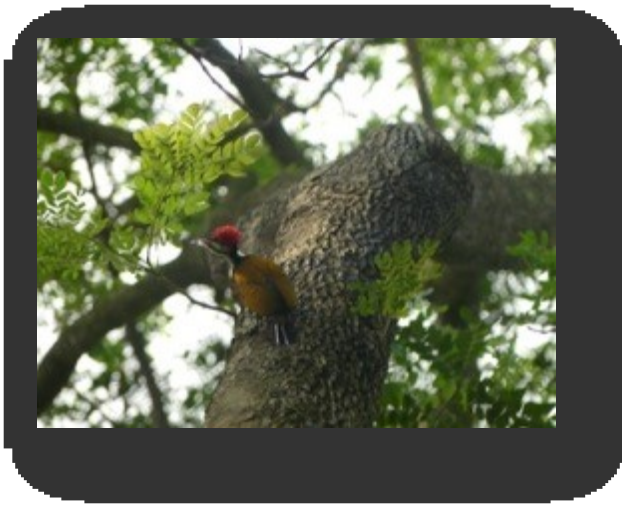
SI	Local name	Common name	Scientific name	Family	IUCN status*
1	Bangla Kaththokra	Lesser Goldenback	*Dinopium benghalense*	Alcedinidae	LC
2	Shobuj Tia	Rose-ringed Parakeet	*Psittacula krameri*	Psittacidae	LC
3	Halde Pakhi	Black-hooded Oriole	*Oriolus xanthornus*	Oriolidae	LC
4	Kala Fingey	Black Drongo	*Dicrurus macrocercus*	Dicruridae	LC
5	Pati Kak	House Crow	*Corvus splendens*	Corvidae	LC
6	Dar Kak	Jungle Crow	*Corvus levaillanti*	Corvidae	LC
7	Bangla Bulbul	Red-vented Bulbu	*Pycnonotus cafe*	Pycnonotidae	LC
8	Pati Tuntuni	Common Tailorbird	*Orthotomus sutorius*	Sylviidae	LC
9	Dhani Futki	Paddyfeld Warbler	*Acrocephalus agricola*	Sylviidae	LC
10	Gobrey Shalik	Pied Myna	*Sturnus contra*	Sturnidae	LC
11	Jhuti Shalik	Jungle Myna	*Acridotheres fuscus*	Sturnidae	LC
12	Bhat Shalik	Common Myna	*Acridotheres tristis*	Sturnidae	LC
13	Doel	Oriental Magpie Robin	*Copsychus saularis*	Muscicapidae	LC
14	Chorui	House Sparrow	*Passer domesticus*	Passeridae	LC
15	Gecho Chorui	Tree Sparrow	*Passer montanus*	Passeridae	LC
16	Dhani Tulika	Paddyfeld Pipit	*Anthus rufulus*	Motacillidae	LC

SI	Local name	Common name	Scientific name	Family	IUCN status*
17	Tila Ghughu	Eastern Spotted Dove	*Spilopelia chinensis*	Columbidae	LC
18	Nilmatha Hash	Mallard	*Anas platyrhynchos*	Anatidae	LC
19	Metey Rajhash,	Greylag goose	*Anser anser*	Anatidae	NT
20	Himaloee Kaththokra	Himalayan Flameback	*Dinopium shorii*	Picidae	DD
21	Bada Satarey	Marsh Babble	*Pellorneum palustre*	Timaliidae	DD
22	Holdebook Chotok	Yellow breasted Bunting	*Emberiza aureola*	Emberizidae	VU
23	Dhub Boga	Little Egret	*Egretta garzetta*	Ardeidae	LC
24	Boro Pankouri	Great Cormorant	*Phalacrocorax carbo*	Phalacrocoracidae	LC
25	Desi Pankouri	Indian Cormoran	*Phalacrocorax fuscicollis*	Ardeidae	LC
26	Chhoto pankouri	Little Cormorant	*Microcarbo niger*	Phalacrocoracidae	LC
27	Lal pa Dhenga	Black-winged Stilt	*Himantopus himantopus*	Recurvirostridae	LC
28	Proshanto Sonajiria	Pacifc Golden Plover	*Pluvialis fulva*	Charadriidae	LC
29	Utturey Titi	Northern Lapwing	*Vanellus vanellus*	Charadriidae	LC
30	Pati Batan	Common Sandpiper	*Actitis hypoleucos*	Scolopacidae	LC
31	Bon Batan	Wood Sandpiper	*Tringa glareola*	Scolopacidae	LC
32	Khoiramatha Gangchil	Brown-headed Gull	*Larus brunnicephalus*	Laridae	LC
33	Choto Panchi	Little Tern	*Sterna albifrons*	Laridae	LC
34	Katua Chil	Black-winged Kite	*Elanus caeruleus*	Accipitridae	LC
35	Teela Eagle	Crested Serpent Eagle	*Spilornis cheela*	Accipitridae	LC
36	Pati Shikre	Shikra	*Accipiter badius*	Accipitridae	LC
37	Bhubon Chil	Black Kite	*Milvus migrans*	Accipitridae	LC
38	Shobuj Shuichora	Green Bee-eater	*Merops orientalis*	Meropidae	LC
39	Nilkan Machranga	Blue-eared Kingfsher	*Alcedo meninting*	Alcedinidae	LC
40	Chhoto Maachranga	Common Kingfsher	*Alcedo atthis*	Alcedinidae	LC

SI	Local name	Common name	Scientific name	Family	IUCN status*
41	Lal Machranga	Ruddy Kingfshe	*Halcyon coromanda*	Alcedinidae	LC
42	Meghou Machranga	Stork-billed Kingfsher	*Pelargopsis capensis*	Halcyonida	LC
45	Dholagola Maachranga	White-throated Kingfsher	*Halcyon smyrnensis*	Halcyonidae	LC

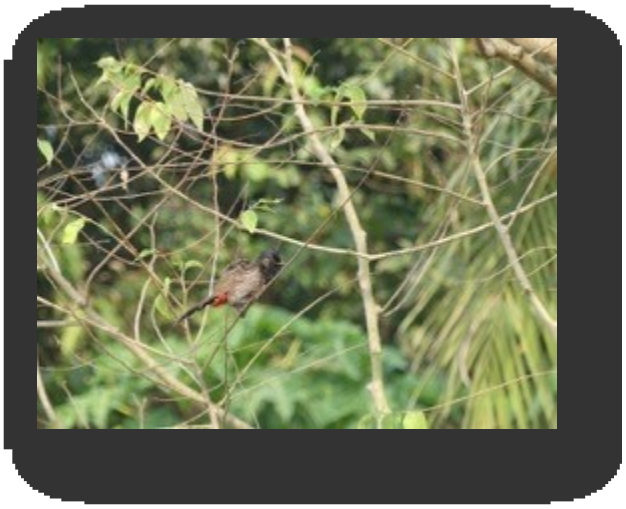
Data source: Study team using IUCN classification system

IUCN Status code: CR - Critically Endangered, EN - Endangered, VU - Vulnerable, LC - Least Concern, DD- Data Deficient, NT-Near Threatened



Lesser Goldenback

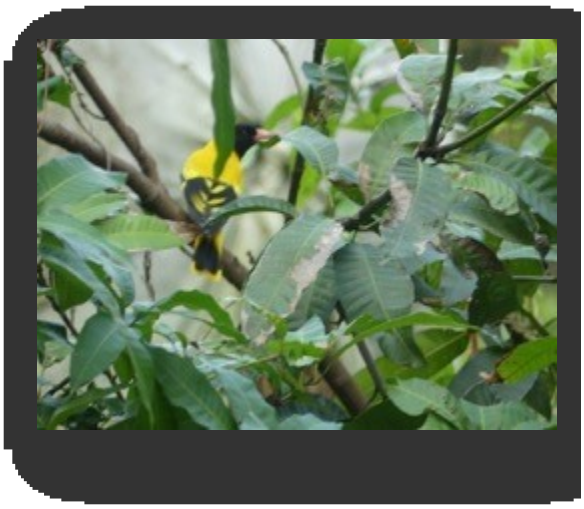
Black Drongo



Red-vented Bulbul

Spotted Dove

Pied Myna



Yellow breasted Bunting

C. Herpeto-fauna

Nineteen(19) species belonging to 17 genera of 14 families are reported from the area. Out of these House Lizard (*Hemidactylus flaviviridis),* Indian Rat Snake (*Ptyas mucosa*) and Checkered Keelback (*Xenochropis piscator*) were observed by ecology team during field survey in October 2017. Rests of the reptilian fauna were reported to be observed by locals during fieldconsultations in the villages of project area. Among the 9, Bengal Monitor (*Varanus benghalensis*) and Spotted Flapshell Turtle (*Lissemys punctata*) are reported to be listed in Bangladesh Wildlife Prevention Order,1973 as Sch-III which protects them from hunting, killing and capturing.

Table 4-36: A checklist of herpetofauna in the study area

SL#	Local name	Common name	Scientific name	Family	IUCN Status
1	Dhora Shap	Checkered Keelback	*Xenochrophis piscator*	Natricidae	LC
2	Shangkhini	Banded Krait	*Bungarus fasciatus*	Elapidae	LC
3	Paina Shap	Common Smooth-scaled Water Snake	*Enhydris enhydris*	Homalopsidae	LC
4	Baro Dumukha Shap	Diard's Blindsnake	*Argyrophis diardii*	Typhlopidae	LC
5	Laodoga Shap	Vine Snake	*Ahaetulla nasuta*	Colubridae	LC
6	Darash Shap	Indian Rat Snake	*Ptyas mucosa*	Colubridae	LC
7	Gui shap	Bengal Monitor	*Varanusbengalensis*	Varanidae	NT
8	Sona gui	Yellow Monitor	*Varanusflavescens*	Varanidae	NT
9	Roktochosa	Common Garden Lizard	*Calotes versicolor*	Agamidae	LC
10	Tiktiki	House Lizard	*Hemidactylus flaviviridis*	Gekkonidae	LC

SL#	Local name	Common name	Scientific name	Family	IUCN Status
11		Roofed Turtle	*Pangshuratecta*	Geoemydida	LC
12	Shundhi Kasim	Spotted Flapshell Turtle	*Lissemyspunctata*	Trionychidae	LC
13	Tokkhak	Tokay Gecko	*Gekko gecko*	Gekkonidae	LC
14	Dhum Kachchim	Brown Soft shell Turtle	*Nilssoniahurum*	Trionychidae	LC
15	Sona Bang	Indian Bullfrog	*Hoplobatrachus tigerinus*	Dicroglossidae	LC
16	Sobuj Dhani Bang	Two-striped Grass Frog	*Hylarana taipehensis*	Ranidae	LC
17	Shobuj Bang	Green Frog	*Euphlyctishexadactylus*	Dicroglossidae	LC
18	Kuno Bang	Asian Common Toad	*Duttaphrynus melanostictus*	Bufonidae	LC
19	Kotkoti Bang	Skipper Frog	*Euphlyctis cyanophlyctis*	Dicroglossidae	LC

Data source: Study team using IUCN classification system
IUCN Status code: CR - Critically Endangered, EN - Endangered, VU - Vulnerable, LC - Least Concern, NT-Near Threatened

4.10.3 Ecosystem Services and Function

The ecosystem of the study area is mainly terrestrial and aquatic. Ecosystem services and function help local people and vice versa. Major benefits of the ecosystem services of the study area are given below

- The photosynthetic processes remove carbon dioxide in the air and supplies oxygen to the environment.
- Trees serve as sources of timber for housing construction, among others
- Animals supply the protein needs of humans, serve as pets or animal skin for making shoes, bags, and other derivatives
- The watershed provides fresh, clean water for human consumption
- Trees serve as buffer against storms preventing destruction of houses by strong winds
- Some species of plants can cure human ailments
- Humus from decomposition of organic matter serve as natural fertilizer in areas cleared for agriculture

Major role of the ecosystem function are as follows

Gas Regulation

Relates to the influence of natural and managed systems in relation to biogeochemical processes including greenhouse gases, photo-chemical smog and volatile organic compounds (VOCs)

Climate Regulation

Influence of land cover and biological mediated processes that regulate atmospheric processes and weather patterns that in turn create the microclimate in which different plants and animals (including humans) live and function.

Water Regulation

The influence of land cover, topography, soils, hydrological conditions in the spatial and temporal distribution of water through atmosphere, soils, aquifers, rivers, lakes and wetlands

Soil Retention

Minimizing soil loss through having adequate vegetation cover, root biomass, retaining rocks and soil biota.

Nutrient Retention

The role of ecosystems in the transport, storage and recycling of nutrients.

Waste treatment and Assimilation

The extent to which ecosystems are able to transport, store and recycle certain excesses of organic and inorganic wastes through distribution, assimilation, transport and chemical decomposition.

Biological Control

The interactions within biotic communities that act restrain forces to control populations of potential pests and disease vectors. This function consists of natural and biological control mechanisms.

Barrier Effect of Vegetation

Vegetation impedes the movement of airborne substances such as dust and aerosols (including agricultural chemicals and industrial and transport emissions), enhances air mixing and mitigates noise.

4.10.4 Protected Areas, Wildlife Sanctuaries, Game Reserves

4.10.4.1 Protected area (PA)

A Protected Area (PA) refers to an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means, i.e. PA is predominantly a natural area established and managed in perpetuity, through legal or customary regimes, primarily to conserve their natural resources (IUCN, 1990). No PA exists at or near the project site***(Figure 4-24)***.

The project area of Araihazar EZ does not hold any Important Plant Areas (IPAs) as identified as Plant life International, Key Biodiversity Areas as identified by IUCN and Alliance for Zero Extinction Sites (AZE)

4.10.4.2 National Park (NP)

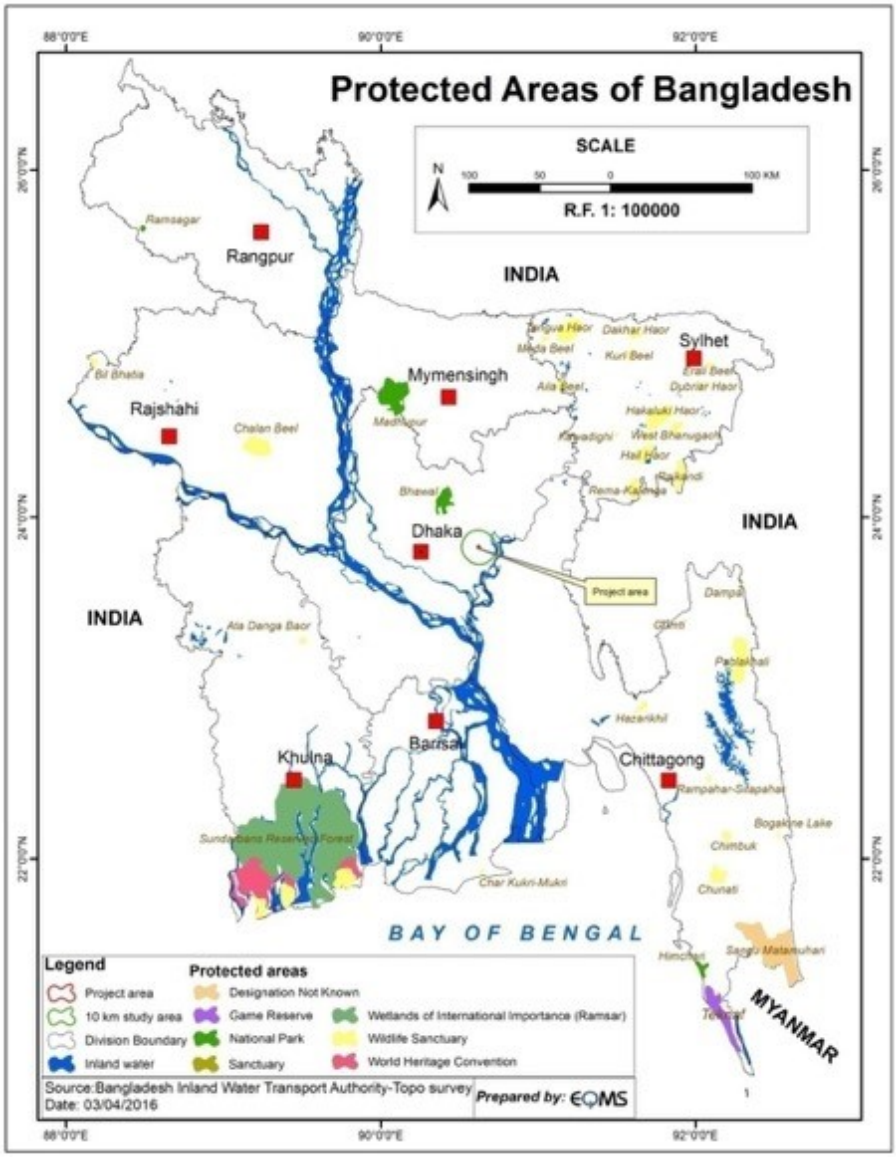
It is a reserved land, usually declared and owned by a national government, protected from most human development and pollution. No NP exists at or near the proposed project site ***(Figure 4-24).***

4.10.4.3 Game reserve (GR)

It is an area of land set aside for the maintenance of wildlife for tourism or hunting purposes. No GR exists at or near the study areas.

4.10.4.4 Wildlife Sanctuary (WS)

An area assures that the natural conditions necessary to protect nationally significant species, groups of species, biotic communities, or physical features of the environment, where these require specific human manipulation for their perpetuation. No WS exists at or near the study areas.



Source: BIWTA

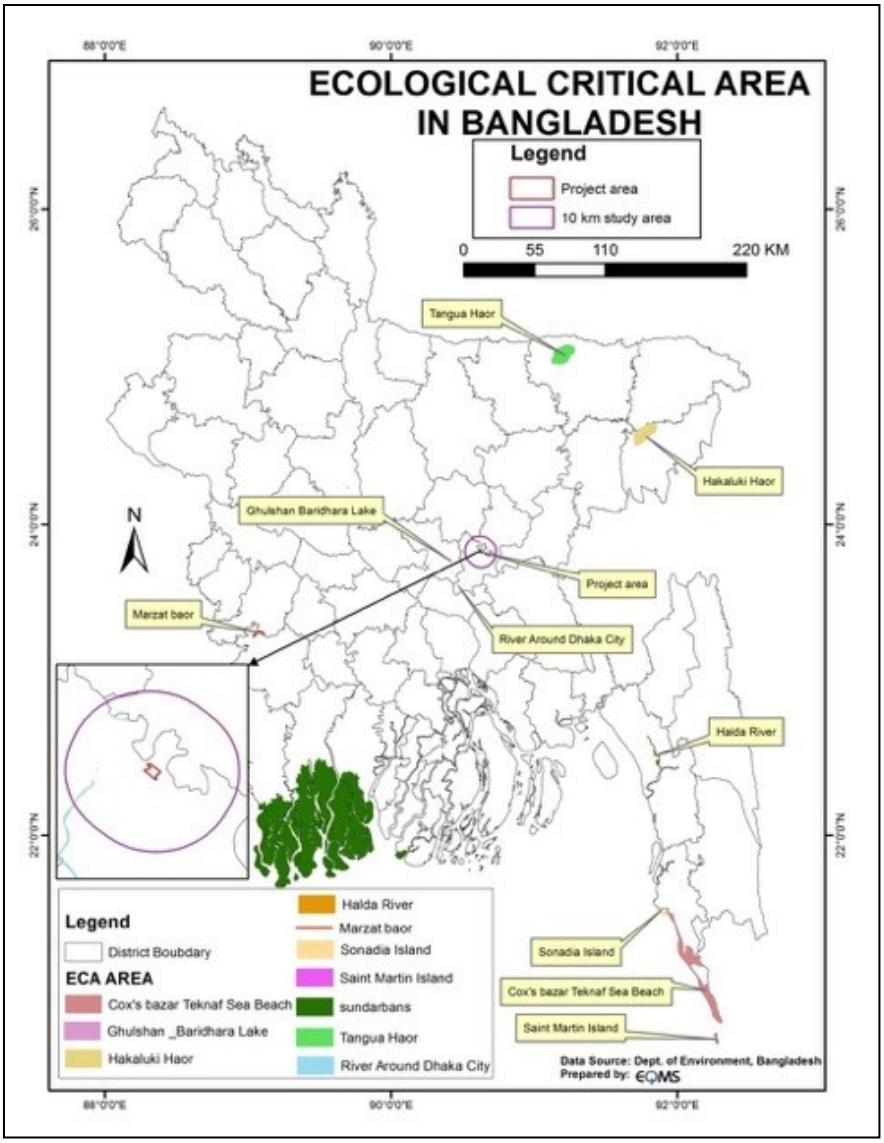
Figure 4-24: Protected Areas of Bangladesh

4.10.4.5 Ecologically Critical Area (ECA)

Bangladesh Environment Conservation Act, 1995, defines a Critical Area (ECA) where an ecosystem has been considered to be threatened and reaching a critical state (***Figure 4-25***) endangerment. In 2009, the Bangladesh Government declared the four rivers, such as Buriganga, Sitalakhaya, Turag and Balu around Dhaka city as ECAs. The Gazette notification to this effect imposes restrictions on a number of activities in these rivers and their associated riparian environs. These include all types of hunting, collection of all types of aquatic species living in the rivers, all activities that could result in the destruction of floral or faunal habitats, all activities that could destroy natural characteristics of water and soil, activities detrimental to fishery, installation of polluting industrial units, and discharge of domestic/ industrial liquid waste.

4.10.4.6 Cultural Heritage

Nothing found in the development area would be affected by the development.



Source: Department of Environment (DoE)

Figure 4-25: Ecological Critical Area in Bangladesh

4.11 Socio Economic Condition

4.11.1 Population

4.11.1.1 Demography

In the 5-kilometer study area, there are 159,785households (HHs) including squatters with a total population of 534,281 that will be somehow affected (directly or indirectly) by the implementation of the Project. Population density per square km of the study area is 2,973, which is very much higher than the national figure of 976 per square km. The average sex ratio is 107 against the national figure of 100, which depicts a higher male population than the female population. Moreover, where national household size is 4.44, the average household size of the study area is slightly higher(4.7). ***Table 4-37*** shows the Demography profile of the project study area.

The demographic information of the affected populations has been analyzed as a part of the socio-economic profile of the populations of project phase-1. This comprises of gender profile and age-sex distribution of the affected populations in project phase-1. The survey result clearly indicates that there is gender disparity in regards to male-female ration. The affected populations comprised of 59.72% of males and 40.28% females. About one-fourth (23.56%) of total populations were identified children and adolescents. Majority (67.17%) of the total affected populations belongs to 20-59 years age group, which also means that the majority of affected populations are in productive age. A total of 514 (9.27%) persons of affected population belong to the retiring and elderly age category.

Table 4-37: Demography of the project area

Upazila	Union	Total population	Total HHs	Average HH size	Sex Ratio	Population density (Sq. Km)
NarsingdiSadar	Amdia	42,118	8,637	4.9	102	2,078
	Meher Para	43,700	9,434	4.6	110	4,685
	MadhabdiPaurashava	49,583	11,323	4.3	139	3,315
	Kanthalia	38,390	7,986	4.8	100	3,204
Araihazar	Sadasardi	39,615	7,956	4.9	106	3,460
	Duptara	37,495	7,911	4.7	107	2,242
	Araihazar	25,593	25,593	4.4	102	3,215
	Fatehpur	20,834	4,354	4.8	103	2,938
	Brahmandi	48,999	10,561	4.6	101	3,002
	Satgram	41,731	8,366	5.0	103	2,126
Rupganj	KanchanPaurashava	49,468	10,912	4.5	103	3031
	Golakandail	62,747	12,744	4.9	114	3,380
	Bholaba	34,008	34,008	4.9	96	1,973
Project Study Area		**534,281**	**159,785**	**4.7**	**107**	**2,973.0**

Source: Population and Housing Census, 2011, Bangladesh Bureau of Statistics (BBS)

Demographic Profile of Affected Population

100% census and socio-economic survey was carried out in the project surroundings area. A total of 1714 households with a Project Affected Persons (PAPs) of 6,343 were identified and surveyed in phase-1 including retention pond/canal area of Araihazar Economic Zone project. The average household size is 3.70 which are significantly lower than national average. The national average household size is 4.42.

Table 4-38: General/Demographic Profile of Affected Population

Profile	Number
Number of total affected Households	1714
Number of total Population	6343
Average AHs Size	3.70

Source: EQMS survey, December 2017

4.11.1.2 Ethnic Composition

According to population and housing census (2011), only 10 ethnic households consisting31 populations are found in the Union lied within the 2km radius boundary from the project site. These ethnic groups are Marma, Chakma and Others.

According census and SES in 2017 conducted by EQMS consulting Ltd, no indigenous or ethnic minority populations were identified in the project phase-1 area.

4.11.1.3 Religion

As per BBS, Population and Census (2011), the population of the project study area primarily consists of Muslims constituting almost 94.4% of the total population. The remaining 5.6% is primarily comprised of Hindus with Christians, Buddhists, and others comprising far lesser percentages. The following ***Table 4-39*** indicates the various religious profiles of the project study area.

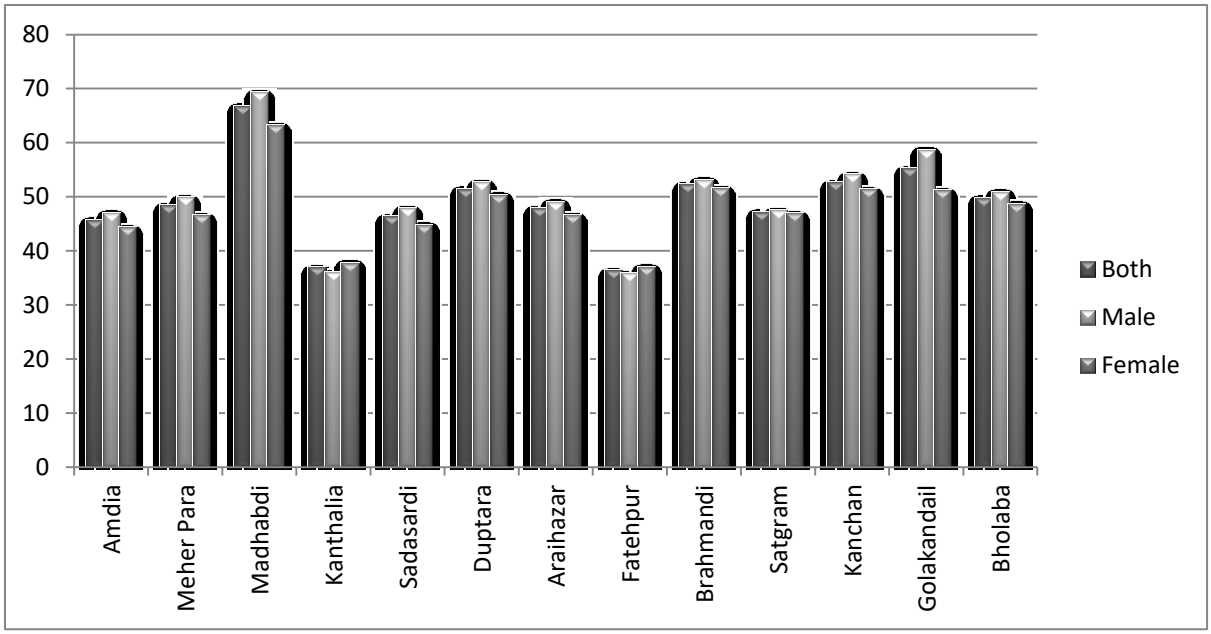
Table 4-39: Religion Profile of Project Area

Upazila	Union	Total pop.	Muslim		Hindu		Christian		Buddhist		Others	
			Pop.	%	Pop.	%	Pop.	%	Pop.	%	Pop.	%
Narsingdi Sadar	Amdia	42118	40855	97.0	1262	3.0	0	0	0	0	1	0.002
	Meher Para	43700	40923	93.6	2774	6.3	2	0.005	0	0	1	0.002
	Madhabdi	49583	44377	89.5	5194	10.5	4	0.01	7	0.01	1	0.002
	Kanthalia	38390	37891	98.7	499	1.3	0	0	0	0	0	0.000
Araihazar	Sadasardi	39615	34786	87.8	4822	12.2	7	0.02	0	0	0	0.000
	Duptara	37495	35181	93.8	2313	6.2	0	0	0	0	1	0.003
	Araihazar	25593	23603	92.2	1984	7.8	6	0.02	0	0	0	0.000
	Fatehpur	20834	20273	97.3	559	2.7	0	0	0	0	2	0.010
	Brahmandi	48999	48276	98.5	723	1.5	0	0	0	0	0	0.000
	Satgram	41731	41519	99.5	212	0.5	0	0	0	0	0	0.000
Rupganj	Kanchan	49468	46504	94.0	2914	5.9	35	0.07	8	0.02	7	0.014
	Golakandail	62747	57669	91.9	5035	8.0	19	0.03	3	0.00	21	0.033
	Bholaba	34008	32416	95.3	1592	4.7	0	0	0	0	0	0.000
Project Study Area		**534281**	**504273**	94.4	**29883**	5.6	**73**	0.01	**18**	0.003	**34**	**0.006**

Source: Population and Housing Census, 2011, Bangladesh Bureau of Statistics (BBS)

4.11.2 Education

The population and housing census (2011) shows that concentration of literate people in underlying unions of selected Upazilas is 49% which is lower than the national average of 51.8%.Like the national figure similar scenario is found in the case of female literacy which is lower than the male counterpart and its 47.7% where male literacy is 50.1%.***Figure 4-26***shows the Literacy rate of the project area.



Source: Population and Housing Census, 2011, Bangladesh Bureau of Statistics (BBS)

Figure 4-26: Literacy Rate by Sex

Education of Affected Household Head

Based on census and socio-economic data, it was revealed that majority (62.72%) of affected household head have completed primary level education while second largest (22.00%) segment are literate2. About 118 (6.88%) and 46 (2.68%) have passed secondary and higher secondary level education respectively while only 29 (1.69%) identified as privileged of having tertiary level education. 69 nos. affected household head were found illiterate. Survey result also revealed that illiteracy rate is high among male household head than female household head.

Table 4-40: Level of Education of Affected Household Head

Education	Male		Female		Total	
	Nos.	%	Nos.	%	Nos.	%
Primary	982	57.29	93	5.43	1075	62.72
S.S.C	103	6.01	15	0.88	118	6.88
H.S.C	42	2.45	4	0.23	46	2.68
B.A or Equivalent	16	0.93	2	0.12	18	1.05

[2]Literate means they can read simple native language and write their name only.

Education	Male		Female		Total	
M.A or Equivalent	9	0.53	2	0.12	11	0.64
Literate	283	16.51	94	5.48	377	22.00
Illiterate	64	3.73	5	0.29	69	4.03
Total	**1499**	**87.46**	**215**	**12.54**	**1714**	**100.00**

Source: EQMS survey, December 2017

4.11.3 Settlement and Housing

According to population and housing census (2011), total households of the project study area is 111077. Predominant structure of this study area is kutcha (71.7%) followed by Semi-pucka (21.1%), Pucka (6.7%) and Jhupri (0.5%). Housing tenancy of the study area is owned by (49.6%), rented (46.6 %) and Rent free (3.8%).***Table 4-41***and***Table 4-42***show the type of structure and Housing tenancy in the project study area.

Table 4-41: Type of structure in the project area

Upazila	Union	Number of Households	Type of Structure (%)			
			Pucka	Semi-pucka	Kutcha	Jhupri
NarsingdiSadar	Amdia	8608	1.8	11.0	86.9	0.3
	Meher Para	9300	6.2	25.8	67.3	0.6
	Madhabdi	10467	20.7	51.4	27.5	0.4
	Kanthalia	7979	1.6	8.9	88.8	0.6
Araihazar	Sadasardi	7916	6.2	15.7	77.9	0.2
	Duptara	7848	7.6	23.9	68.3	0.3
	Araihazar	5759	6.6	19.0	73.8	0.6
	Fatehpur	4333	4.5	17.7	77.7	0.1
	Brahmandi	10514	5.1	15.4	79.0	0.5
	Satgram	8342	3.8	15.5	79.9	0.8
Rupganj	Kanchan	10647	5.7	19.6	74.4	0.3
	Golakandail	12370	12.2	34.8	52.3	0.6
	Bholaba	6994	5.3	15.6	78.2	0.9
Project Study Area		**111077**	**6.7**	**21.1**	**71.7**	**0.5**

Source: Population and Housing Census, 2011, Bangladesh Bureau of Statistics (BBS)

Table 4-42: Housing tenancy in the project area

Upazila	Union	Number of Households	Housing Tenancy (%)		
			Owned	Rented	Rent free
Narsingdi Sadar	Amdia	8608	95.7	0.9	3.4
	Meher Para	9300	75.5	22.4	2.1
	Madhabdi	10467	31.6	67.2	1.2

Upazila	Union	Number of Households	Housing Tenancy (%)		
			Owned	Rented	Rent free
	Kanthalia	7979	96.9	1.5	1.5
Araihazar	Sadasardi	7916	86.1	12.2	1.7
	Duptara	7848	92.7	5.9	1.4
	Araihazar	5759	86.9	11.9	1.1
	Fatehpur	4333	97.2	1.5	1.3
	Brahmandi	10514	93.2	4.3	2.4
	Satgram	8342	96.5	2.0	1.5
Rupganj	Kanchan	10647	87.4	9.8	2.9
	Golakandail	12370	49.6	46.6	3.8
	Bholaba	6994	97.8	1.1	1.1
Project Study Area		**111077**	**83.6**	**14.4**	**2.0**

Source: Population and Housing Census, 2011, Bangladesh Bureau of Statistics (BBS)

Quantum of Affected Structures

The project first phase has very limited impact on structures. A total of 6282.95 sft. structures will be affected by the project of which 4231.95 sft is tin-made while 1511 sft. structure were identified as pucca and need to be relocated. There were no residential or commercial structures, trees and community property resources identified in retention pond/canal area. Impact on structures in project phase-1 is given in below Table.

Table 4-43: Quantum of Affected Structures

Types of Structure	Mouza	Nos	Unit	Quantum of structures	
				Total sft	Total rft
Building (*Pucca*)	Panchrukhi	5	sft	1511	----
Semi-*Pucca* building	Panchrukhi	1	sft	540	----
Tin Made	Panchrukhi	22	sft	4231.95	----
Boundary wall	Panchrukhi	3	rft	-----	265
Total		**28**	**sft**	**6282.95**	**265**

Source: EQMS survey, December 2017

4.11.4 Traffic and Transport

In the project area constituted by 5km radius, total Metalled (581.3 km), Semi metalled (194.9 km), Unmetalled (963.72km) road is 1739.92 Kilometer. In the study area, Unmetalled road is 55.4% followed by 33.4% Metalled and 11.2% Semi Metalled. Additionally, most (41%) roads lie under Rupganj upazila compared to Narshingdhi Sadar (37.5%) and Araihazar Upazila (21.5%).Moreover, there are 34 bus stands underlie within the study area.

Table 4-44: Roads communication in the project area

Upazila	Metalled Road	%	Semi Metalled Road	%	Unmetalled Road	%	Total	%	Bus Stand
Narshingdhi Sadar	245.72	14.1	21.16	1.2	385.1	22.1	651.9	37.5	7
Araihazar	159	9.1	25	1.4	190.0	10.9	374.0	21.5	18
Rupganj	176.58	10.1	148.74	8.5	388.7	22.3	714.0	41.0	9
Total	**581.3**	**33.4**	**194.9**	**11.2**	**963.7**	**55.4**	**1739.9**	**100.0**	**34**

Source: District Statistics 2011, Bangladesh Bureau of Statistics (BBS)

Rickshaw, Van, Easy Bike Tempo etc. are the main vehicles for the local/intra Upazila transportation. A Total of 16,603 different types of vehicles registered (8761) and non-registered (7842) are running within the project study area where the numbers of non-motorized vehicles number is higher than that of the motorized vehicles. Importantly, these vehicles run for inter Upazila transportation service. From this, it is assumed that Vehicular movement is higher in Narshingdhi Sadar(52.4%) compared to Rupganj (34.2) and Araihazar (13.4%).

Table 4-45: Transportation facilities in the study area

	Vehicle Types	Narshingdhi Sadar	%	Araihazar	%	Rupganj	%	Total	%
Registered	Rickshaw	6004	36.2	773	4.7	1123	6.8	7900	47.6
	Van	329	2.0	74	0.4	91	0.5	494	3.0
	Easy bike and auto rickshaw	0	0.0	0	0.0	36	0.2	36	0.2
	Tempo	126	0.8	178	1.1	27	0.2	331	2.0
Not Registered	Rickshaw	1530	9.2	847	5.1	4239	25.5	6616	39.9
	Van	75	0.5	71	0.4	63	0.4	209	1.3
	Easy bike and auto rickshaw	358	2.2	131	0.8	33	0.2	522	3.1
	Tempo	240	1.4	13	0.1	27	0.2	280	1.69
	Nochimon /Korimo/ Bhotbhoti	38	0.2	138	0.8	39	0.2	215	1.29
	Total	**8700**	**52.4**	**2225**	**13.4**	**5678**	**34.2**	**16603**	**100**

Source: District Statistics 2011, Bangladesh Bureau of Statistics (BBS)

Table 4-46: Rail and water communication in the study area

Upazila	Total railway (all broad gage, meter gage & duel gage)	Railway station	Water way in monsoon (river + canal)	Water way round the year (river + canal)	Steamer/ launch station
Narshingdhi Sadar	8	1	27.00	20.00	3
Araihazar	0	0	83	25	2
Rupganj	0	0	40.22	43.47	0
Total	**8**	**1**	**150.22**	**88.47**	**5**

Source: District Statistics 2011, Bangladesh Bureau of Statistics (BBS)

Total Railway (all broad gage, meter gage and duel gage) is8 kilometer under Narshingdhi Sadar Upazila. There is only one Railway station situated within the 5km study area. Waterway in monsoon (river + canal) is 150.22 Kilometer and Waterway round the year (river + canal) is 88.47 Kilometer. Within the project location, there are 5 numbers of Steamer and Launch stations. (Source: District Statistics 2011, Bangladesh Bureau of Statistics (BBS)

4.11.5 Public Utilities

4.11.5.1 Water supply

According to census and SES findings, it was learned that 100% affected households have access to safe water for drinking, cooking and other regular household's uses. Below Table shows the status of AHH's access to safe water.

Table 4-47: Access to Water

SL No.	Sources of Water	No. of HH by use pattern		
		Drinking	Cooking	Bath/Washing and other
1	Tube-well	1379	1379	1379
2	Motor/deep tube-well	308	308	308
3	Supply	27	27	27
4	River/canal	0	0	0
5	Pond	0	0	0
Total		**1714**	**1714**	**1714**

Source: EQMS survey, December 2017

At the project study area, the major source of drinking water is tube-well where about 93.8% population use tube-wells water. About 3.2% people have access to tap water. Other3.0% people have access neither tube-well nor tap water. An overview is depicted in **Table 4-48** below.

Table 4-48: Sources of Drinking Water and Electricity Facility of the Project Area

Upazila	Union	Number of Households	Source of Drinking Water (%)			Electricity Connection (%)
			Tap	Tube-well	Other	
Narsingdi Sadar	Amdia	8608	0.1	99.1	0.9	90.4
	Meher Para	9300	0.5	97.6	1.9	95.6
	Madhabdi	10467	26.4	73.4	0.2	98.9
	Kanthalia	7979	0.5	87.7	11.8	84.7
Araihazar	Sadasardi	7916	0.6	97.8	1.6	92.4
	Duptara	7848	7.0	88.3	4.7	92.1
	Araihazar	5759	0.5	98.4	1.1	91.9
	Fatehpur	4333	0.4	97.7	1.9	91.7
	Brahmandi	10514	0.4	97.1	2.5	93.0
	Satgram	8342	0.2	95.4	4.4	90.0
Rupganj	Kanchan	10647	3.0	91.8	5.3	92.2
	Golakandail	12370	2.1	96.5	1.3	94.9
	Bholaba	6994	0.4	98.2	1.3	86.1
Project Study Area		**111077**	**3.2**	**93.8**	**3.0**	**91.8**

Source: Population and Housing Census, 2011, Bangladesh Bureau of Statistics (BBS)

4.11.5.2 Electricity

Electricity is an important indicator for measuring the quality of life in the study area. In the project study area, 91.8% of the households have grid electricity connection. However, households mostly use the electricity for lighting and fanning purposes. Electricity connection of the study area shows ***Table 4-48*.**

4.11.5.3 Sanitation

Survey results shows that only 0.29% (5 nos.) affected households are using kutchai.e.unhygienic latrine. Apart from this almost 99.71% affected households have sanitary latrine i.e. hygienic sanitation facilities. Available sanitation facilities using by project-affected households is presented in below Table.

Table 4-49: Access to Sanitation

SL No.	Type of Latrine	No. of HH.	%
1	Sanitary Latrine	1623	94.69
2	Pit Latrine	86	5.02
3	Kutcha	5	0.29
	Total	**1549**	**1714**

Source: EQMS survey, December 2017

In the Project area, only about 11.1% and 44.7% of households use respectively water sealed and non water-sealed sanitary latrine facility, which represents the 55.8% households of the

study area. 36.7% households use non-sanitary facilities. On the contrary, 5.2% households defecate in open places with no access to hygienic latrine facilities. ***Table 4-50***shows sanitation facility of the project area.

Table 4-50: Sanitation Facility of the Project Area

Upazila	Union	Number of Households	Type of Toilet Facility (%)			
			Sanitary(water-sealed)	Sanitary(non water-sealed)	Non-sanitary	None
Narsingdi Sadar	Amdia	8608	16.7	50.2	28.8	4.4
	Meher Para	9300	22.7	50.8	22.0	4.5
	Madhabdi	10467	30.1	32.7	6.2	0.1
	Kanthalia	7979	6.4	18.4	61.3	13.9
Araihazar	Sadasardi	7916	11.4	43.0	38.4	7.3
	Duptara	7848	7.1	53.2	35.7	4.0
	Araihazar	5759	8.1	34.5	54.0	3.5
	Fatehpur	4333	5.9	49.7	37.9	6.6
	Brahmandi	10514	6.2	44.3	44.5	5.1
	Satgram	8342	2.0	49.0	43.7	5.3
Rupganj	Kanchan	10647	8.7	54.6	32.1	4.6
	Golakandail	12370	13.3	48.7	36.4	1.6
	Bholaba	6994	6.3	51.4	36.0	6.2
Project Study Area		**111077**	11.1	44.7	36.7	5.2

Source: Population and Housing Census, 2011, Bangladesh Bureau of Statistics (BBS)

4.11.5.4 Healthcare Facility

Three Upazilas; Narshingdhi Sadar, Araihazar, Rupganj, lie under the 5km project area. Within these Upazilas there 791 numbers of Beds, 376 numbers of Doctors and 369 numbers of Nurses are available including both Govt. and Private clinic facilities*(District Statistical 2011, BBS)*.Ratios of patients per bed, doctor are slightly high compared to these of national figure. For 10000 patients 5.7 beds are available where national figure is 4 beds. Patient doctor ratio is same compared to national figure (10000:3). On the other hand, 2.7 nurse for 10000 patients that are lower than the national figure 2.8.(*Source: WHO: Global Atlas of the Health Workforce)*

Table 4-51: Health facilities in the study area

	Number of Bed				Number of Doctor				Number of Nurse			
	Govt.	Private	Total	10000 Patient/ Bed	Govt.	Private	Total	10000 Patient/ Doctor	Govt.	Private	Total	10000 Patient /Nurse
Narshingdhi Sadar	200	319	519	11	35	223	258	5	67	176	243	5.1

	Number of Bed				Number of Doctor				Number of Nurse			
	Govt.	Private	Total	10000 Patient/ Bed	Govt.	Private	Total	10000 Patient/ Doctor	Govt.	Private	Total	10000 Patient /Nurse
Araihazar	31	50	81	2	20	48	68	2	1 1	33	33	0.9
Rupganj	50	141	191	4	21	29	50	1	10	83	93	1.6
Total	281	510	791	5.67	76	300	376	3	77	292	369	2.7

Source: District Statistics 2011, Bangladesh Bureau of Statistics (BBS)

4.11.5.5 Solid waste

Uncontrolled waste generation coupled with inadequate collection and disposal systems have the potentiality to give rise to pollution and environmental degradation as well as diseases. While no specific data on local waste management was collected from the study area, it is likely that – as with many other parts of rural Bangladesh – the villages within the study area have no formal waste management facilities, and that in general people dispose of their waste in landfills or in fallow land.

4.11.6 Economy and Employment

About 45.0% of total population followed by 79.9% of male and 10.1% of female population of selected Unions are engaged in economic activities. 36% of total population is engaged in domestic work where majority female of total female population (71.6%)are doing domestic work. All over 18.6% population, do not work whereas only .3% population is looking for work.

The project is located in between two major industrial and business hub of the country. But two-third of affected households depends on agriculture for their livelihood. The 1st and lowest income category is up to BDT 96000 thousand/year pertaining to the income vulnerability calculated on Cost of Basic Need (CBN) approach. Among the 1714, a total of 17 (0.99%) AHs fall into the vulnerable group. Survey result depicted that 258 AHs (15.05%) live below the poverty line. Census reveals that a substantial numbers of AHHs has higher income and belong to middle-class and upper middle-class strata of the society as the project location are a prominent business area in the country.

According to the District Statistics 2011, (BBS), Narshingdi Sadar, Araihazar and Rupganj have 6975, 5764 and 150 enlisted fishermen. Number of fishermen depicts the fishing practices of the respective Upazila.

According to the census and SES findings, most of the affected household head (66.45%) are engaged with agricultural activities. About 248 including five women household head are doing business for their livelihood. A detail of occupation distribution of affected household head is presented in below Table:

Table 4-52: Distribution of Occupation of Affected Household Head

Name of Occupation	Male		Female		Total	
	N	%	N	%	N	%
Agriculture	1110	64.76	29	1.69	1139	66.45
Teacher	10	0.58	3	0.18	13	0.76
Abroad worker	10	0.58	0	0.00	10	0.58
Private Job	94	5.48	5	0.29	99	5.78
Household work	0	0.00	165	9.63	165	9.63
Fishing	1	0.06	0	0.00	1	0.06
Business	243	14.18	5	0.29	248	14.47
Day Labor	2	0.12	0	0.00	2	0.12
Mason	9	0.53	0	0.00	9	0.53
Tailor	4	0.23	3	0.18	7	0.41
Driver	2	0.12	0	0.00	2	0.12
Elder Person	14	0.82	5	0.29	19	1.11
Total	**1499**	**87.46**	**215**	**12.54**	**1714**	**100.00**

Source: EQMS survey, December 2017

4.11.6.1 Field of Economic Activities

In accordance to the Population Census of Bangladesh (2011), Service is the dominant source of employment in the project study area. Approximately, 43.5% and 51.3% male and female involve in Service activities. Moreover, significant numbers of the population; 28.7% male and 42.1% female, of the project area are employed in Industries. Unlike other parts of the Bangladesh, only 17.2% of economically active population is engaged in agricultural sectors. ***Table 4-53***shows employment status of the project area.

Table 4-53: Employment status of the study area

Upazila	Union	Population Aged 7+, not attending school and employed		Field of Activity											
				Agriculture				Industry				Service			
		Male	Female	Male		Female		Male		Female		Male		Female	
				Pop.	%	Pop.	%	Pop.	%	Pop.	%	Pop.	%	Pop.	%
Narsingdi Sadar	Amdia	4659	297	2253	48.4	22	7.4	803	17.2	143	48.1	1603	34.4	132	44.4
	Meher Para	4921	734	567	11.5	28	3.8	1281	26.0	275	37.5	3073	62.4	431	58.7
	Madhabdi	4595	903	103	2.2	4	0.4	2160	47.0	458	50.7	2332	50.8	441	48.8
	Kanthalia	5570	858	1043	18.7	25	2.9	3628	65.1	469	54.7	899	16.1	364	42.4
Araihazar	Sadasardi	4228	551	670	15.8	40	7.3	1331	31.5	214	38.8	2227	52.7	297	53.9
	Duptara	3116	420	1012	32.5	55	13.1	506	16.2	44	10.5	1598	51.3	321	76.4
	Araihazar	3020	504	869	28.8	47	9.3	1023	33.9	284	56.3	1128	37.4	173	34.3
	Fatehpur	2853	283	910	31.9	31	11.0	961	33.7	138	48.8	982	34.4	114	40.3
	Brahmandi	4764	658	1166	24.5	34	5.2	889	18.7	354	53.8	2709	56.9	270	41.0
	Satgram	4490	365	1504	33.5	14	3.8	238	5.3	26	7.1	2748	61.2	325	89.0
Rupganj	Kanchan	4465	533	1759	39.4	31	5.8	1213	27.2	270	50.7	1493	33.4	232	43.5
	Golakandail	4636	1370	781	16.8	49	3.6	1836	39.6	945	69.0	2019	43.6	376	27.4
	Bholaba	3058	153	1751	57.3	19	12.4	345	11.3	33	21.6	962	31.5	101	66.0
Project Study Area		54375	7629	14388	27.8	399	6.6	16214	28.7	3653	42.1	23773	43.5	3577	51.3

Source: Population and Housing Census, 2011, Bangladesh Bureau of Statistics (BBS)

4.11.6.2 Industries

According to BBS 2011, about 3,337 large-scale industries and 11,783 small-scale industries are currently being operated within the 5km study area. Large-scale industries consist Textiles, Garments factory, Rice, Jute and Sugar mill, Steel and engineering and others. On the other hand, a total of 11,783 small-scale industries are being operated in the study area. Weaving/Handloom, Handy and Husking Craft mills are the major small industries in the study area.

Table 4-54: Large-scale industries in the study area

Upazila	Textiles	Garments factory	Rice Mill	Steel and engineering	Jute mill	Sugar mill	Others	Total
NarshingdhiSadar	1897	1	34	0	2	0	0	**1934**
Araihazar	1120	0	63	1	0	0	0	**1184**
Rupganj	159	27	7	0	4	3	19	**219**
Total	**3176**	**28**	**104**	**1**	**6**	**3**	**19**	**3337**

Source: District Statistics 2011, Bangladesh Bureau of Statistics (BBS)

Table 4-55: Small-scale industries in the study area

Upazila	Small Scale Industries and Cottage							Total
	Weaving/ Handloom	Handy	Husking Crafts Mill	Biri Factory	Salt Processing	Pottery	Others	
Narshingdhi Sadar	6938	365	1	0	0	1	0	**7305**
Araihazar	4205	22	65	0	0	0	0	**4292**
Rupganj	117	0	61	2	3	0	3	**186**
Total	**11260**	**387**	**127**	**2**	**3**	**1**	**3**	**11783**

Source: District Statistics 2011, Bangladesh Bureau of Statistics (BBS)

4.11.6.3 Agriculture

In the selected study area, it is found that 72.6% of total agricultural farm families are landless and marginal. High number of landless farm families signifies the high pressure on productive land for livelihood. Moreover, 22.1% is small-scale farm families. On the contrary, only 5.4% is medium and large-scale farm.

Table 4-56: Agricultural farms and distributions

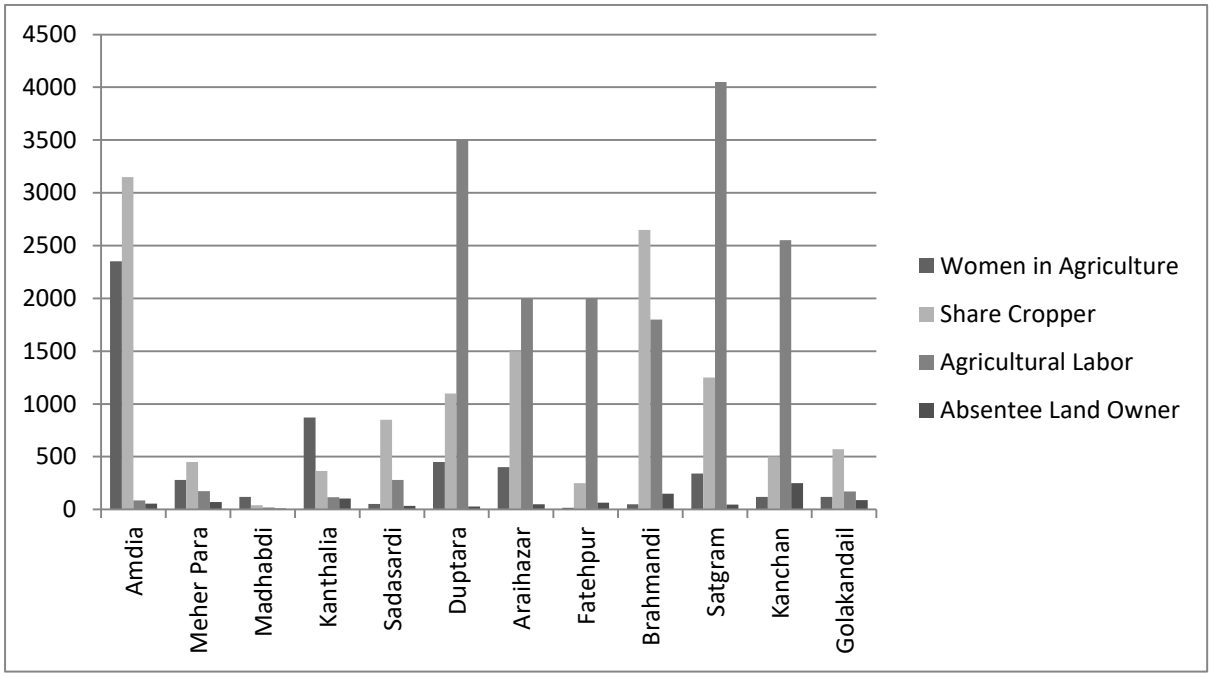
Upazila	Union	Farm Family (in nos.)	Farm Family Distribution*									
			Landless	%	Marginal	%	Small	%	Medium	%	Large	%
NarsingdiSadar	Amdia	4827	866	17.9	2123	44.0	1537	31.8	279	5.8	22	0.5
	Meher Para	2865	709	24.7	1072	37.4	897	31.3	172	6.0	15	0.5
	Madhabdi	467	100	21.4	150	32.1	215	46.0	2	0.4	0	0.0
	Kanthalia	4139	782	18.9	1648	39.8	1546	37.4	149	3.6	14	0.3
Araihazar	Sadasardi	5435	2385	43.9	2320	42.7	430	7.9	270	5.0	30	0.6
	Duptara	5747	1960	34.1	2337	40.7	1016	17.7	379	6.6	55	1.0
	Araihazar	4315	1650	38.2	1780	41.3	780	18.1	85	2.0	20	0.5
	Fatehpur	2750	830	30.2	1392	50.6	399	14.5	122	4.4	7	0.3
	Brahmandi	7560	2950	39.0	3230	42.7	1210	16.0	150	2.0	20	0.3
	Satgram	7005	1990	28.4	3450	49.3	1180	16.8	350	5.0	35	0.5
Rupganj	Kanchan	3200	595	18.6	1253	39.2	1181	36.9	164	5.1	7	0.2
	Golakandail	2515	602	23.9	817	32.5	851	33.8	209	8.3	36	1.4
	Bholaba	4587	1536	33.5	1709	37.3	977	21.3	316	6.9	49	1.1
Project Study Area		55412	16955	30.6	23281	42.0	12219	22.1	2647	4.8	310	0.6

*Landless (0.0-0.049 acre), Marginal (0.05-1.49 acre), Small (1.50-2.49 acre), Medium (2.50-7.49 acre), Large (7.50 acre or above)

Source: www.landzoning.gov.bd (accessed in November 2017)

4.11.6.4 Agriculture and Livelihood

In the study area, about 5,593 women are engaged directly and indirectly in agriculture activities. Additionally, 15,975 sharecropper and 19,996 agriculture labors are available in the study area. Moreover, 1010 absentee landowner are available.



Source: www.landzoning.gov.bd (accessed in November 2017)

Figure 4-27: Agriculture and livelihood of the study area

4.11.6.5 Fisheries

The fisheries of the project area consist of inland open water fisheries, fresh water aquaculture. Like other parts of fisheries sector, it is major sources of nutrition, income, employment, livelihood support to the people of this area.

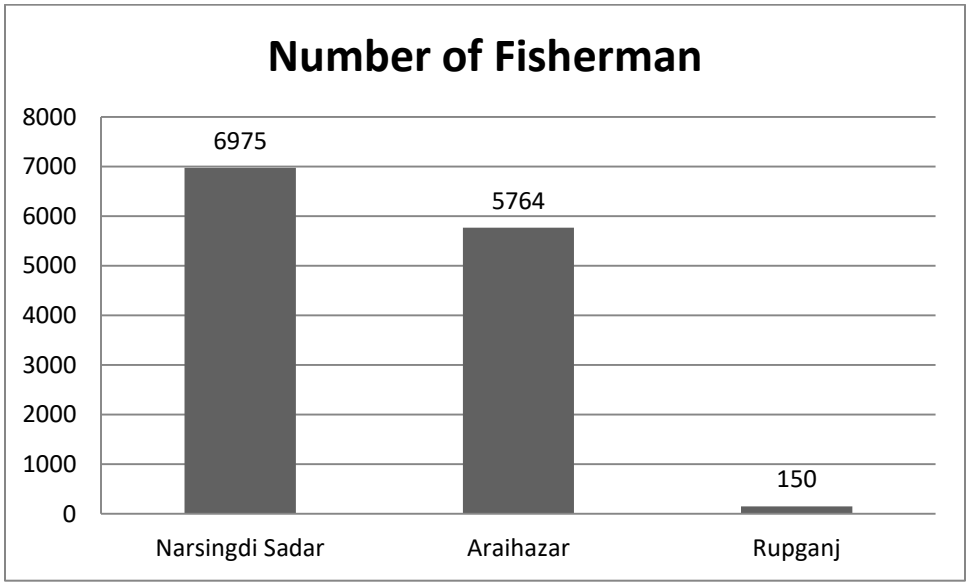
Wetlands are among the most fertile and productive ecosystem that support the life cycle of different fauna and flora resources of an area. The project area is enriched with open water fisheries that are available in the rivers, khals and floodplain.

Major native capture species are: Ilish *(Tenualoshailisha)*, Rui*(Labeoruhita)*, Catla *(Catlacatla)*, Puti *(Puntiuspuntio)*, Beda *(Nandusnandus)*, Koi *(Anabas testudineous)*, Mrigel*(Cirrhinuscirrhosus)*,Boal *(Wallagoattu)*, Taki *(Channapunctatus)*, Mola *(Amblypharyngodonmola)*, Guchi*(Macrognathuspuncalus)*, Baim *(Mastacembelusarmatus)*, Shoal *(Chanastriatus)*,Tengra *(Mystusvittatus)*, Gozar *(Channamarulius)*, Kholisha *(Colishafasciata)*, *etc.*

It is very alarming that these open water fisheries are now under threat due to different fabricated causes and natural hazards.

4.11.6.6 Fishing and Livelihood

According to the land zoning report (2016), study area consists 18395.84 ha where only 10.4% area is being used for fishing and fish culture. About 1206.42 ha is being used for fish culture which represents 58.5% of total fishing and fish culture. On the contrary, 856.34 ha is being used for fishing in dry season.



Source: District Statistics 2011, Bangladesh Bureau of Statistics (BBS)

Figure 4-28: Number of fishermen of the study area

4.11.7 Socio-Economic Study

4.11.7.1 Villages Adjacent to Project Site

Socio-economic assessment of adjacent population of the proposed project is very much crucial for project planning and implementation. Therefore, villages adjacent to the proposed project within a 2km radius were surveyed for intense socio-economic assessment. Villages are so close to proposed project and communities of the villages are rigorously connected in their daily life to the proposed project area.

Villages situated within the 2km radius from the proposed project were considered for the focus of asocial survey. To get the actual population/households of the studied villages, secondary sources; population and housing census, District Statistics and District webportal) have been used. When total numbers of the households/populations had been confirmed, considering all villages as cluster 5% households were finalized for random sampling along with specific interval.

Table 4-57: Shows the village names and numbers of households surveyed

Union	Villages	Frequency	Percent
Amdia	Kandail	20	6.8
Bholaba	Gutulia	10	3.4
Dhuptara	Kumar Para	13	4.4
	Monehor	6	2.0
	Panchbaria	30	10.2
	Raghobdi	11	3.7
	Shingrati	6	2.0
Satgram	Ghosh Para	7	2.4
	Gojariapara	7	2.4
	Khan Para	7	2.4
	Noapara	29	9.9
	Maizpara	10	3.4
	Pashchim Para	31	10.5
	Purinda	45	15.3
	Sonpara	10	3.4
	Tekpara	52	17.7
	Total	**294**	**100.0**

Source: EQMS Survey

4.11.7.2 Basic Demographical Characteristics of the Households

Basic demographic characteristics include total population, gender, age, marital status, households' structures and health status. Table 2-2 illustrates the basic demographical characteristics of the households. Survey results show a total population of about 1,349 living within the 294 households, whereas about 55.7% are male and the rest 44.3% are female. Average family size is 4.59. On the other hand, 1-98 age range has been found within the selected households of specific villages. Importantly around 81% population belongs to 14-64 age range signifying that most of the population is eligible to be active in economic activities. Contrary, only 19% of the population is found to be dependent. Additionally, 54.4% of the population is married. the overall health status among the households surveyed has been found to be quite well. Around 97.2% of the population were found to be healthy and only 2.8% were found to have chronic disease or were disabled at birth. The study area was found to be predominantly Muslim with about 98.6%-of surveyed households found to be Muslims with the remained Hindu.

Table 4-58: Basic Demographic Characteristics of the Selected Villages

SL No	Details		Frequency	Percent
1.	Total Population	Male	751	55.7
		Female	598	44.3
		Total	**331**	**100**
2.	Age	1-13	224	16.6
		14-34	622	46.1
		35-55	401	29.7
		56-64	70	5.2
		65-65+	32	2.4
		Total	**1349**	**100.0**
3.	Marital Status	Married	734	54.4
		Unmarried	607	45
		Divorced/Widowed	8	0.6
		Total	**1349**	**100.0**
4.	Health Status	No disease	1311	97.2
		Handicapped	16	1.2
		Chronic Health Problem	22	1.6
		Total	**1349**	**100.0**
5.	Religion	Muslim	290	98.6
		Hindu	4	1.4
		Total	**294**	**100.0**

Source: EQMS Survey

4.11.7.3 Households Structures and Sanitation and Other Utilities

The Survey found that among all households surveyed about 7.0% of household structures are fixed permanent building and 21.4% are non-permanent building. Moreover, about 69% of household structures are made of tin. In addition, about 2.5% household structures were found to be thatched roof dwellings.

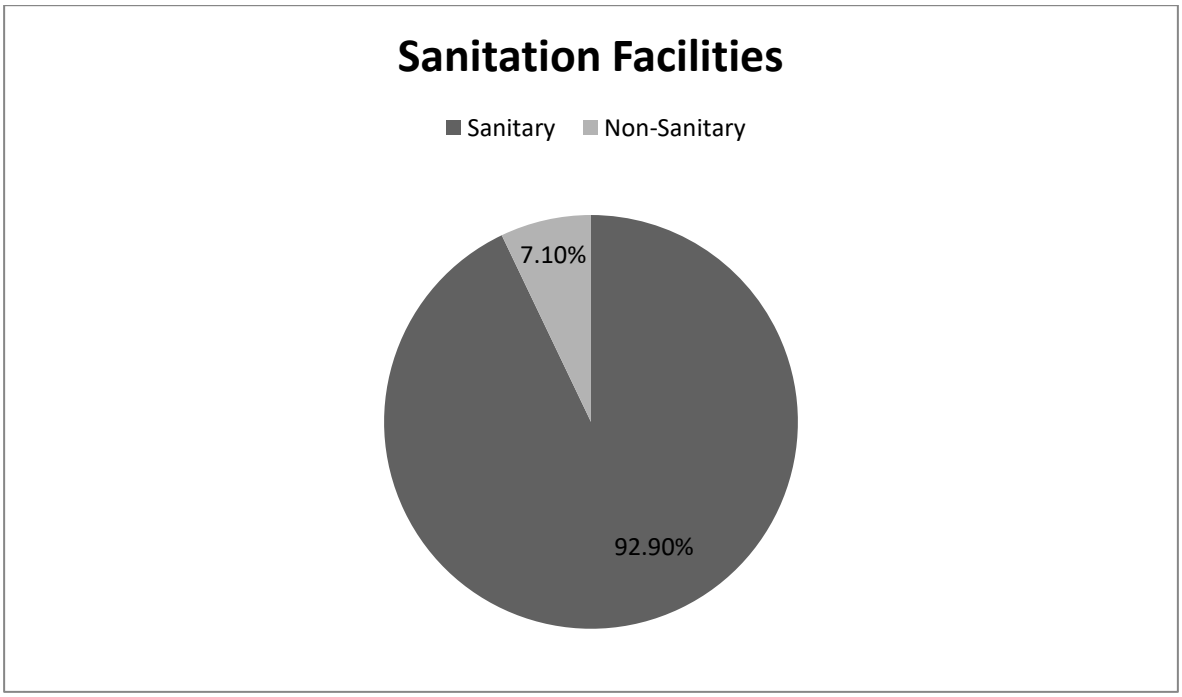
Table 4-59: Structures of the studied households

Types by Usage	Number	Types of Structures			
		Building	Semi-Building	Tin Made	Thatched
Living	439	45	134	260	0

Types by Usage	Number	Types of Structures			
		Building	Semi-Building	Tin Made	Thatched
% of Total	68.7	7.0	21.0	40.6	0.0
Kitchen	189	0	2	172	15
% of Total	29.6	0	0.3	26.9	2.3
Cattle shed	7	0	1	6	0
% of Total	1.1	0	0.2	0.9	0
Others	4	0	0	3	1
% of Total	0.6	0	0	0.5	0.2
Total N	639	45	137	441	16
% of Total	100	7.0	21.4	69	2.5

Source: EQMS Survey

Among the surveyed households, about 92.9% have sanitary toilets and the rest 7.1% haveNon-sanitary toilets. No open defecation has been found around the 2km of the radius villages.



Source: EQMS Survey

Figure 4-29: Sanitation facilities

Utilities available in the surveyed households are using Tube-wells, Water Pumps and Water Tanks with averages of .68, .42 and .41 respectively. Poultry rearing is a very common practice

in all households and this study found those households averaged .93 poultry followed by .07 Goat and .04 Sheep maintained in the homes.

Table 4-60: Households' utilities and domestic animals

	Tube-well	Water-pump	Water-tank	Cattle-shed	Cow	Buffalo	Sheep	Goat	Poultry
Mean	0.68	0.42	0.41	0.02	0.03	0.00	0.04	0.07	0.93
Median	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Std. Deviation	0.466	0.502	0.755	0.130	0.246	0.058	0.230	0.324	4.596

Source: EQMS Survey

4.11.7.4 Education

The study found that about 81.5% of the total population is literate. About 19.5% and 48.8% of the population were found to lie within the Illiterate and primary level education category. About22.3% and 6.2% of the population were found who to have completed Secondary and Higher Secondary level of formal education. On the other hand, only 3.2% were found to have graduated or went on to higher educational.

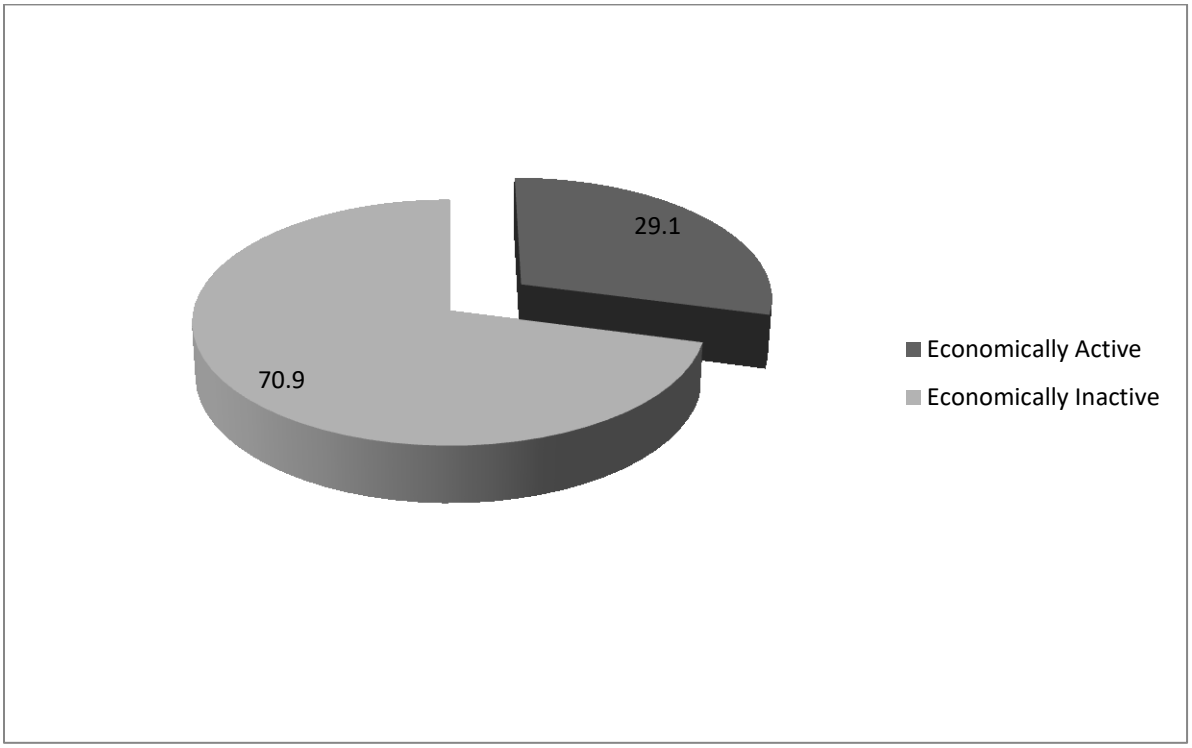
Table 4-61: Educational Attainment of the Population

Sl No.	Details	Frequency	Percent
1	Illiterate	263	19.5
2	Primary	658	48.8
3	Secondary	301	22.3
4	Higher Secondary	84	6.2
5	Graduation or Higher	43	3.2
	Total	**1349**	**100.0**

Source: EQMS Survey

4.11.7.5 Occupation and Income

Among the total surveyed population 29.1% are gainfully employed by engaging in a variety of occupations. Unlike other parts of Bangladesh, occupations within the selected villages are found to be non-agriculture based. The majority(12.4%) of the total population are engaged in business or small-scale industry activities. Moreover, 5.5% of the population is engaged somehow in agricultural activities. Non-Agricultural labor (2.8%) and private enterprises(2.7%) are also common in the study area, as this area is well known for different types of industries. Others activities (4.1%) include driving, working in bakeries etc.



Source: EQMS Survey

Figure 4-30: Economically active population of the surveyed population

Table 4-62: Occupation and Yearly Income of the Households

Occupations		Number	<5 Thousand	5 -10 Thousand	10 -15 Thousand	15-20 thousand	>20 Thousand
Agriculture-Business	N	3	1	2	0	0	0
	%	0.8	0.3	0.5	0.0	0.0	0.0
Agriculture-Fishing	N	11	0	5	4	2	0
	%	2.8	0.0	1.3	1.0	0.5	0.0
Agriculture-Others	N	1	0	0	1	0	0
	%	0.3	0.0	0.0	0.3	0.0	0.0
Agriculture	N	46	12	23	9	2	0
	%	11.8	3.1	5.9	2.3	0.5	0.0
Agriculture labor	N	13	5	3	1	0	0
	%	3.3	1.3	0.8	0.3	0.0	0.0
Non Agriculture labor	N	38	17	11	6	4	0
	%	9.7	4.3	2.8	1.5	1.0	0.0
Business	N	167	8	68	53	22	16

Occupations		Number	<5 Thousand	5 -10 Thousand	10 -15 Thousand	15-20 thousand	>20 Thousand
	%	42.7	2.0	17.4	13.6	5.6	4.1
Fishing/Fish culture	N	8	3	0	5	0	0
	%	2.0	0.8	0.0	1.3	0.0	0.0
Govt. Job	N	9	0	2	5	2	0
	%	2.3	0.0	0.5	1.3	0.5	0.0
Private Job	N	36	2	19	11	4	0
	%	9.2	0.5	4.9	2.8	1.0	0.0
House Made	N	4	4	0	0	0	0
	%	1.0	1.0	0.0	0.0	0.0	0.0
Others	N	55	11	26	12	4	2
	%	14.1	2.8	6.6	3.1	1.0	0.5
Total		**391**	**63**	**159**	**107**	**40**	**18**
Total Percentage		**100.0**	**16.1**	**40.7**	**27.4**	**10.2**	**4.6**

Source: EQMS Survey

Occupation based monthly income has also been considered during survey. It is found that most of the occupations' (Agriculture, non-agriculture labor, private enterprises, and other occupations) incomes lie within 5-10 thousand BDT monthly. Secondly, 27.4% of occupational income is between 10-15 thousand followed by 10.2% occupations have 15-20 thousand monthly income. On the other hand, only 4 % occupations have more than 20 thousand monthly income.

Survey result shows that about 30.3% households somehow depended on agriculture. Among them, 26.5% have ownership on agriculture land, garden, pond and open land. The rest of the households 3.7% do not have ownership but engage in agricultural activities.

Table 4-63: Agriculture and types of ownership of land

Ownership Types	N	Ownership Types			
		Agriculture land	Garden	Pond	Open land
Self-owned	78	46	5	21	6
%	26.5	15.6	1.7	7.1	2.0
Sharecropping	11	4	0	7	0
%	3.7	1.4	0.0	2.4	0.0
Total	89	50	5	28	6
	30.3	17.0	1.7	9.5	2.0

Source: EQMS Survey

The survey noted several land types and cropping patterns of the villages in a 2km radius from the proposed project. Most of the agricultural land is used for single cropped production. Only 1.4% households use land twice a year for agricultural production. Rice and vegetable are the two seasonal products. On the other hand, 15.6% of households use agricultural land once a year for producing rice (13.6%) and vegetables (2.0%).

Table 4-64: Agricultural cropping pattern

Agriculture Products	Frequency	Percent
Not involved in Agriculture	244	83.0
Rice	40	13.6
Vegetable	6	2.0
Rice and Vegetable	4	1.4
Total	**294**	**100.0**

Source: EQMS Survey

About 12.6% of the surveyed households were found that are involved in businesses and small industrial activities. Among them, 10.2% are involved in business whereas 2.4% are involved in small industries. Ownership patterns are self-owned 10.5% and rest 2.0%.

Table 4-65: Business and industries' ownership types

Ownership Types	N	Business	Industries
Self-owned	31	24	7
% of Total	10.5	8.2	2.4
Rent	6	6	0
% of Total	2.0	2.0	0.0
Total N	**37**	**30**	**7**
% of Total	**12.6**	**10.2**	**2.4**

Source: EQMS Survey

Common businesses are found Karbari-shops 2%, Tea stalls 1%, Grocery stores 3.4%, Clothing stores 2.7% and medicine shops 1%.

Table 4-66: Business types

Business Types	Frequency	Percent
Karbari Shops	6	2.0
Tea and bread shops	3	1.0
Grocery stores	10	3.4
Clothing stores	8	2.7
Medicine stores	3	1.0
Total	30	10.2

Source: EQMS Survey

Common industries related to the clothing business are Boutiques .7%, Blocks 1% and Dying businesses .7%.

Table 4-67: Industries types

Small Industries Types	Frequency	Percent
Boutique	2	.7
Block	3	1.0
Dying	2	.7
Total	7	2.4

Source: EQMS Survey

4.11.7.6 Energy Access

Lighting and cooking sources are the very important needed energy for any households and higher quality and easy access to quality energy can ease household's daily life. Results have found that 99.0% of the total households have access to electricity and only 1% of the total households do not have access to electricity.

Table 4-68: Different Energy Access by the Households

SL No	Details		Frequency	Percent
1.	Lighting Source	Electricity	291	99.0
		Kerosene	3	1.0
		Total	**294**	**100.0**
2.	Fuel/energy used for Cooking	Gas	126	42.9
		Crop Residue, Firewood, Cow-dung Cake	168	57.1
		Total	**294**	**100.0**

Source: EQMS Survey

In the case of cooking fuel, it is found that all the households are relying on the conventional ways of cooking. Firewood, crop residue and cow-dung cake are used for cooking fuel. Usually women are engaged in preparing these cooking fuels. In the absence of any more modern cooking system women have to work and prepare these fuels, consequently women are depriving themselves from engaging in economic activities. About 57.1% of households are relying on natural fuels (Firewood, crop residue and cow-dung cake) whereas the remaining42.9% use gas for cooking.

4.11.7.7 Access to Social Market and Medical Services

Convenient and easy access to markets and medical services help households get basic needs and health services when it is necessary or urgent. Distance may hinder easy access to these services. Survey results have found that 68.71% households have easy access to main markets

lying less than 1km followed by 31.29% lying1-2 km from the market. They can get all sorts of amenities from the markets. Purinda Bazar is the most preferable bazar for the villagers. About 43.2% households go to Purinda Bazar for their daily purposes followed by Kalibari Bazar at 15.0% and Pachrokhi Bazar at 13.3%.

Table 4-69: Access to Social Market and Medical Services

SL #	Main Market	Village Name	Distance				Total
			<1km	%	1 to 2km	%	
1	Pachrokhi Bazaar	Shingrati	0	0	6	2.0	2.0
		Khan Para	0	0	7	2.4	2.4
		Gojariapara	0	0	7	2.4	2.4
		Maizpara	0	0	10	3.4	3.4
		Sonpara	1	0.3	8	2.7	3.1
		Sub Total	1	0.3	38	12.9	13.3
2	Kalibari Bazaar	Kumar Para	13	4.4	0	0.00	4.4
		Pashchim Para	30	10.2	0	0.00	10.2
		Sonpara	1	0.3	0	0.00	0.3
		Sub Total	44	14.97	0	0	15.0
3	Purinda Bazaar	Tekpara	52	17.69	0	0.00	17.7
		Purinda	42	14.29	3	1.02	15.3
		Panchbaria	15	5.10	15	5.10	10.2
		Sub Total	109	37.1	18	6.1	43.2
4	Shornokhali Bazaar	Gutulia	0	0.00	10	3.40	3.4
5	Kandail Bazaar	Kandail	20	6.80	0	0.00	6.8
6	Patore Bazaar	Raghobdi	0	0.00	11	3.74	3.7
7	Duptara Bazaar	Pashchim Para	1	0.34	0	0.00	0.3
8	SamajKallyan Bazaar	Noapara	27	9.18	2	0.68	9.9
9	Baliachi Bazaar	Ghosh Para	0	0.00	7	2.38	2.4
10	Madhobdi Bazaar	Monehor	0	0.00	6	2.04	2.0
Total			**202**	**68.71**	**92**	**31.29**	**100.0**

Source: EQMS Survey

Easy access to hospitals enhances the frequency of health services taking frequency. Higher distance may hinder taking health services, which ultimately increase the health risk. Survey results have found that only 11.6% and 31.0% households are staying less than 1km and 1-2 km distance respectively from the hospitals. Conversely, significant numbers of the households(57.5%) are residing more than 3km distance from the hospitals. It will be clear if

you look at each individual village separately. Major preferred area for taking health services is Pachrukhi 18.0% followed by Araihazar 15.6%, Purinda 10.9% and Panchbaria 10.2%.

Table 4-70: Access to Medical Services

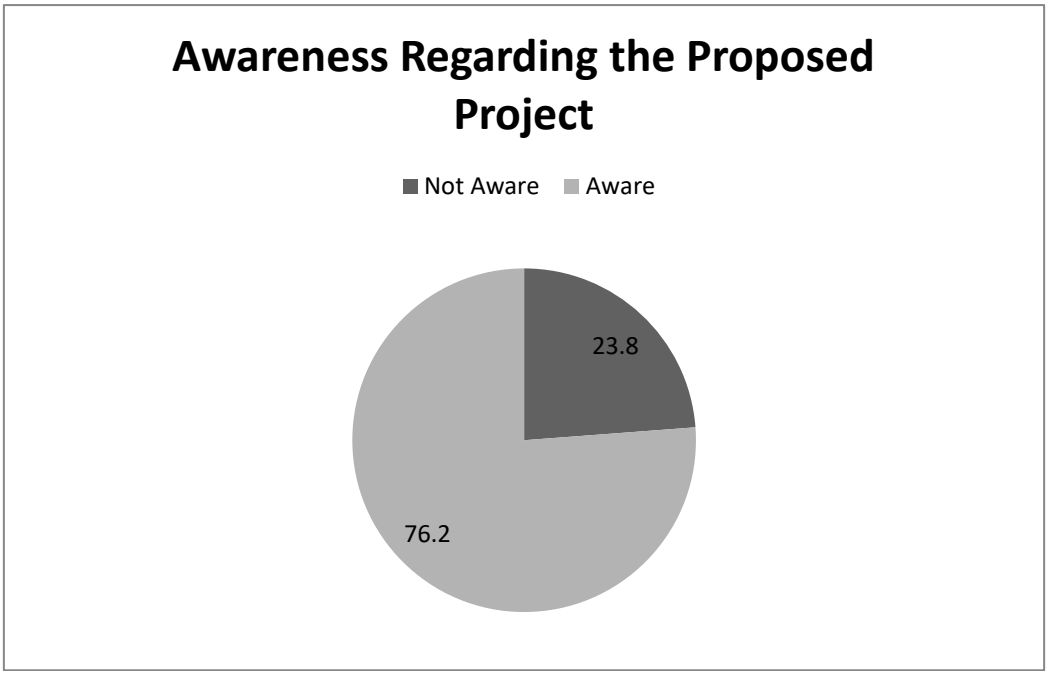
Sl #	Hospital Name/Location	Village	Distance						Total
			<1km	%	1 to 2km	%	>3km	%	
1.	Pachrukhi	Gutulia	0	0	2	0.7	8	2.7	3.4
		Shingrati	0	0	6	2.0	0	0.0	2.0
		Khan Para	0	0	7	2.4	0	0.0	2.4
		Gojariapara	0	0	7	2.4	0	0.0	2.4
		Maizpara	0	0	10	3.4	0	0.0	3.4
		Purinda	1	0.3	0	0.0	0	0.0	0.3
		Ghosh Para	0	0	3	1.0	0	0.0	1.0
		Sonpara	1	0.3	8	2.7	0	0.0	3.1
		Sub Total	2	0.7	43	14.6	8	2.7	18.0
2.	Gausiya	Kandail	0	0	0	0.0	20	6.8	6.8
3.	Patore	Raghobdi	0	0	11	3.7	0	0.0	3.7
4.	Araihazar	Kumar Para	0	0	0	0.0	13	4.4	4.4
		Pashchim Para	0	0	0	0.0	31	10.5	10.5
		Ghoshpara	0	0	0	0.0	1	0.3	0.3
		Sonpara	0	0	0	0.0	1	0.3	0.3
		Sub Total	0	0	0	0	46	15.6	15.6
5.	Satgram	Noapara	0	0	0	0.0	29	9.9	9.9
6.	Mobidi	Tekpara	0	0	1	0.3	26	8.8	9.2
	Podotto		0	0	0	0.0	25	8.5	8.5
7.	Purinda	Purinda	32	10.9	0	0.0	0	0.0	10.9
8.	Chanpara	Purinda	0	0	0	0.0	12	4.1	4.1
9.	Panchbaria	Panchbaria	0	0	30	10.2	0	0.0	10.2
10.	Ajharpur	Ghosh Para	0	0	0	0.0	3	1.0	1.0
11.	Madhobdi	Monehor	0	0	6	2.0	0	0.0	2.0
Total			**34**	**11.6**	**91**	**31.0**	**169**	**57.5**	**100**

Source: EQMS Survey

4.11.7.8 Project Awareness

Project awareness and perception may hinder or facilitate any project work's successful implementation. Survey results shows that 76.2% of total households are completely aware of

this proposed project. Conversely, 23.8% of total households are found indifference and know nothing regarding this project.



Source: EQMS Survey

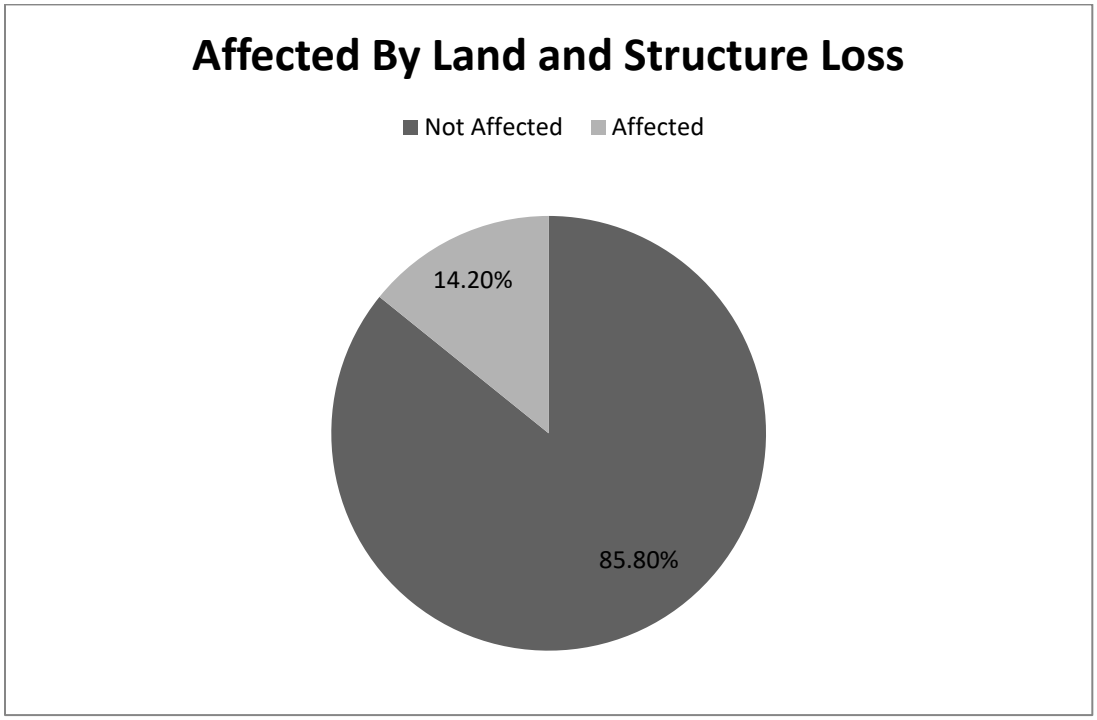
Figure 4-31: Project Awareness

4.11.7.9 Perceived Impacts

4.11.7.9.1 Negative Impacts

4.11.7.9.1.1 Land or Structure Loss

It is found that about 14.2% households will be somehow affected (structure/land) by the proposed project. Villagers living with close proximity to proposed project have found to be affected. Affected households are found living in The Gutulia, kandail, Pashchim Para, Khan Para, Tekpara, Ghosh Para, Sonpara etc. villages.



Source: EQMS Survey

Figure 4-32: Affected by land and structure loss

4.11.7.9.1.2 Other Community Problems

Study finds that, about 90.8% believe that there will be no harm on the local community as the consequence of the project establishment. On the contrary, 9.2% believe that local community will be affected by the consequences of the project development. Among them, 2.7% identifies security problem, 3.7% transportation problem, 2.0% increase of traffic accident, .3% increase the health risk and garbage.

Table 4-71: Perceived community problems

		Problems						Total
		No Problem	Security Problem	Transportation Problem	Increase the traffic accident	Health Risk	Increase Garbage	
No	N	267	0	0	0	0	0	267
	%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	90.8%
yes	N	0	8	11	6	1	1	27
	%	0.0%	100.0%	100.0%	100.0%	100.0%	100.0%	9.2%
Total	N	267	8	11	6	1	1	294
	%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: EQMS Survey

4.11.7.9.2 Positive Impacts

Among the surveyed population, about 68.4% believe that this project will bring positive impacts on the development of the local community and rest 31.6% do not believe so.

Table 4-72: Positive impacts

	Frequency	Percent
No positive Impacts	93	31.6
Positive Impacts	201	68.4
Total	294	100.0

Source: EQMS Survey

Among the positive believers majority think (37.1%) that market will be developed and business opportunity will increase. Besides this, People think that other infrastructural developments like educational institute, residence, theater, park and hospital will be developed. Some believe that basic services and quality of life will be enhanced.

Table 4-73: Perceived positive impacts

Types of Positive Impacts	Frequency	Percent
No Positive Impacts	93	31.6
Educational institutions	24	8.2
Shopping-mall	9	3.1
Residential development	11	3.7
Theater	9	3.1
Park	6	2.0
Market	109	37.1
New Hospital	15	5.1
Others	18	6.1
Total	**294**	**100.0**

Source: EQMS Survey

CHAPTER 5

5. ALTERNATIVE ANALYSIS

5.1 Environmental Sensitivity Investigation

Environmental impact assessment has been carried out considering the impacts of proposed interventions with associated activities on important components of the environment and society. Firstly, all of the environmental components sensitive to proposed activities were identified during reconnaissance field visit based on expert observation, local people's perception and worldwide practice of EIA. The scoping process, followed to identify the environment and social sensitive features included professional judgments of the multi-disciplinary EIA team members and public consultation. The preliminarily identified environmental and social sensitive components are listed in sections below.

5.2 Environmental Asset

Environmental assets identified in the study area are listed below:

1. Air Quality of the area
2. Noise level of the area
3. Agriculture land
4. Fisheries of the study area
5. Ecosystem of study area
6. Dhawrakhali Canal, Brahmaputra, Shitalakhya & Meghna River
7. Transportation system of the area

Identified environmental assets of the project are likely to be affected due to development of the off-site facilities at all the pre-construction, construction and operation stages of the project. Project activities, which may have an impact on the environmental assets and the associated impacts, are listed in ***Table 5-1***. The detailed impact identification and mitigation measures are given at ***Chapter 6***.

Table 5-1: Environmental Assets of the project area

SL#	Environmental Assets	Impact	Related Project Activity
Pre-Construction & Construction Phase			
1.	Air Quality of the study area	Degradation	• Site clearance/ preparation • Construction activities • Excavation • Exhaust from construction vehicles/machinery
2.	Noise level of study area	Increase in noise levels	• Construction activities • Movement of construction

SL#	Environmental Assets	Impact	Related Project Activity
			vehicles/machinery
3.	Eco-system of study area: Agriculture activity and aquaculture	Loss of agriculture land	• AEZ area is an Agricultural land and is also some pond used seasonally by people to carry out aquaculture activities
4.	Fisheries of study area	Increased sedimentation of water body	• Increase in run-off from construction/excavated site.
5.	Eco-system of Study area: Dhawrakhali canal, Brahmaputra, Shitalakhya & Meghna river	Increased sedimentation of water body	• Increase in run-off from construction/excavated site
Operation Phase			
6.	Air Quality of study area	Air pollution	• Industrial emissions and movement of vehicular access
7.	Noise level of study area	Increase in Noise levels	• Increased traffic movement and industrial operations
8.	Eco-system of study area: Agriculture and aquaculture	Improvement of agriculture and aquaculture production	• Setting up of agriculture & aquaculture based industries may improve the agriculture and aquaculture activities in the region • Development of paved surfaces may deplete species from AEZ area; however, 3 m wide zone of no development will be developed along Dhawrakhali Canal.
9.	Fisheries of study area	Improvement Entry of pollutant into the Dhawrakhali Canal, Brahmaputra,Shitalakhya & Meghna River & other water bodies from upcoming industries in EZ zone may impact the aquatic life	• Wastewater may discharge into the river that may affect aquatic life.
10.	Eco-system of study area: Dhawrakhali canal, Brahmaputra,	Degradation of Water Quality & Aquatic life	• Discharge of effluents from the industries which are proposed to be

SL#	Environmental Assets	Impact	Related Project Activity
	Shitalakhya & Meghna river		located in economic zone
11.	Transportation System	Traffic congestion	• Increased nos. of vehicles on Dhaka-Sylhet highway due to carrying industrial raw materials, local workers and product

5.3 Environmental Hot Spots

Economic Zone site and site for proposed off-site facilities lies in Araihazar Upazila of Narayanganj District. EZ site does not lie within Eco-sensitive/Ecological critical area. Effluent and emissions from industries may impact terrestrial and aquatic life thus only non-polluting industries are proposed for EZ zone which are light engineering, agriculture/food processing industry, RMG/ apparels, wooden products, knitting and textile, spinning, jute and jute goods materials, pharmaceutical and healthcare goods, footwear and leather goods, Bi-cycle, automobile/motor cycle parts assemble. It will be ensured that the environmental management measures should be taken as per proposed EMP.

Ecological fragile natural feature is Dhawrakhali Canal, Brahmaputra, Shitalakhya & Meghna River. No development zone of 3 m width & retaining wall will be developed all along the Dhawrakhali Canal within EZ site to prevent direct exposure of industries to Dhawrakhali Canal which connected with Brahmaputra river. In addition, it will be ensuring that no waste or effluents discharged into Dhawrakhali Canal.

5.4 Likely Beneficial Impacts

The project involves development off-site facilities for EZ. These off-site developments will make the site accessible and suitable for setting up of the industries. Development of the off-site infrastructure will attract the investors for setting up of the industries in the upcoming economic zone. Vicinity of the site to Dhaka-Sylhet highway and well-developed inland water transportation system further makes area suitable for EZ development. The likely benefits from the proposed development are listed as below:

1. Rapid Economic development (including enhancement and diversification of Industries, Enhancement of investments)
2. Large scale direct and indirect employment generation- improved quality of life
3. Development of infrastructure facilities
4. Technological enhancement for management of environmental management (like roads, water treatment, waste management, power supply, green belt, environmental monitoring)

As shown in the projected industries for AEZ, the demand from Garment & Textile manufacturing would be the dominant in the coming few years. Foreign firms are trying to

expand their share of domestic markets in Food Processing, Motorbikes, and Consumer Products. Therefore; the AEZ (Phase I) project may generate approximately 10,000 jobs in total.

5.5 Community Recommendations

Total 540.77 acres lands are needed to be acquired for AEZ. In addition, resettlement &rehabilitation is involved in land development for EZ zone and other proposed off-site facilities. As per the focused group discussions carried out with people, it was learned that people are in favour of development of EZ. Also they expect large scale employment will be generated in the area for both males and females that will enhance their standard of living.

Some of them also shared that they expect development of infrastructure facilities like power supply, roads, water supply, educational facilities, and hospitals in the area, which will further enhance standard of living. People suggested that only non-polluting industries should come up in the region and all industries should take pollution control measures so that EZ development does not have negative impact on environment and their health. In addition, they demanded that local people should be considered for provision of employment preferably.

Focused group discussions were carried out with the villagers of Sonpara village, Satgram Village, Agriculture, Fisheries, Education Department to discuss their view on the project development, the benefits and the negative impact of the project on their life and their expectations from the project. People also suggested that agro based and aquaculture industries should come up in this region so as it could be beneficial for people engaged in aquaculture activity.

5.6 Alternative Analysis

5.6.1 Alternative Study

In order to consider the project area and the shape of the Economic Zone, two alternatives were compared comprehensively from the viewpoint of technical aspect, economical aspect, safety, and social and environmental consideration.

As a result of the alternative study shown in***Table5-2***, Araihazar EZ was selected as the priority option because it has advantages from the viewpoint of technical aspect, economical aspect, safety, and environmental/social consideration as follows:

- Technical aspect: higher ground elevation
- Economic aspect: less construction cost
- Safety: less traffic volume during construction
- Environment/social consideration: less scale disruption of nature and less number of project-affected households (PAHs)

Table5-2: Result of Alternative Study

	Araihazar Economic Zone	Nayanpur Economic Zone
Location Map		
Area	Phase 1-218.84ha Phase 2-200 ha Total: 398.7 ha	Phase 1-233 ha Phase 2-208 ha Total: 441 ha
Location & District	20 km from Dhaka in direct distance, Araihazar Upazila, Narayanganj District	50 km from Dhaka in direct distance, Sreepur Upazila, Gazipur District
Highway access	Along Dhaka-Sylhet Highway	1.2 km Dhaka from Mymensingh Highway(National Highway No.3)
Distance from dhaka	26.0km from Dhaka in road distance(37 minutes)	60.9 km from Dhaka in road distance (1 hour 51 minutes)
Infrastructures	132kV/33kV substation, 2.5 km from site. BEZA stated that Petrobangla has agreed for provision of 100MMCFD of Gas to the EZ from Madhobdi TBS (VS-14). However, TITAS suggests that 6 km long pipeline and 12-inch dia. Pipe could be sufficient and more feasible cost wise for the EZ	4 km away from 132kV/33kVsubstation (Sreepur Sub-Sta.1), 3.4km from site. 12 inches gas pipeline along National Highway No. 3, 1.5km east away from site.
Land use	Farmland, double cropping	Farmland, single cropping
Site preparation	Embankment: 0.6- 2.6m (Avg.1.6m), Land elevation: Approx.6-8m above MSL, Flood water level due to rivers of Shitalakhya and Meghna: Approx.7.52m (1/100), Elevation of land preparation: 8.6m	Embankment: 0.5- 2.5m(avg. 1.5m),Land elevation: Approx. 14-16mabove MSL, Flooding: Not affected by Padma and Meghna Rivers, Avg. height of elevation: 16.5mabove MSL considering rain water gradient, Borrow pit in Barmi Bazar 17kmeast away from site
Natural environment	Rice paddy(Low risk for erosion and water logging)	Rice paddy (Low risk for erosion and water logging)

	Araihazar Economic Zone	Nayanpur Economic Zone
Environment /Social Consideration	• Since the traffic volumes resulting from the earthwork transportation during the construction phase are estimated to be smaller than in Nayanpur EZ, exhaust gas from the vehicular traffic will be less than in Nayanpur EZ. • According to the project description, the modification in the creek is not expected. Therefore, the negative impact on natural environment is forecasted as less than Nayanpur EZ. • Around 11 structures might be resettled in the Araihazar EZ area, which is less than in Nayanpur EZ area. Therefore, the social impact will be lesser than that of Nayanpur EZ.	• Since the traffic volumes resulting from the earthwork transportation during the construction phase are estimated to be larger than in Araihzar EZ, exhaust gas from the vehicle traffic will be more than in Araihzar EZ. • According to the project description, the modification in the creek is expected. Therefore, the negative impact on natural environment, Flora/Fauna and Ecosystem is expected. • More households will be resettled than Araihzar EZ area. Therefore, the social impact will be greater than that of Araihzar EZ.
Flood Water Level	The result of the 100-year rough probability calculation shows that the water level is 7.21 m at Araihazar.	The result of the 100-year rough probability calculation shows that the water level is 10.72 m at Nayanpur.
Nearest River	Shitalakhya River, Brahmaputra River and Meghna River	Turag River and Shitalakhya River
Safety	As transportation of soil for land reclamation is basically done inside the project site, the risk of traffic accident occurring outside ofthe project site is not increased.	• Since it is necessary to transport the soil for land reclamation from outside of the project site, the risk of traffic accident is increased.
Annual average revenue from fields such as rice paddies and farmlands (Tk/acre/year)	Approx. 50,000Tk/acre/year	Approx.80,000Tk/acre/year
Economic Aspect	• Since earthwork volume is smaller than Nayanpur EZ, construction cost is estimated to be less and construction period is estimated to be shorter than in Nayanpur EZ. • Since the number of PAHs will be	• Since earthwork volume is larger than in Araihazar EZ, construction cost is estimated to be higher and construction period is estimatedto be longer than in Araihazar EZ. • Since the number of PAHs will be more than Araihazar EZ as stated in

	Araihazar Economic Zone	Nayanpur Economic Zone
	less than in Nayanpur EZ as stated in the environmental/social consideration below, the compensation for resettlement will be reduced.	the environment/social consideration below, the compensation for resettlement will be increased
Evaluation	Compared with Nayanpur EZ, Araihazar EZ has advantages from the viewpoint of technical aspect, economical aspect, safety aspect, and environmental/social consideration. Therefore, Araihazar EZ is chosen as the preferred option.	

5.6.2 Zero Option

The "zero option" scenario in this report should be based on the current condition of the project and without the development of Economic Zone. The study of the zero option is shown in ***Table 5-3***below. As a result of this study, it is judged that the implementation of the Project should be undertaken because of some advantages in terms of effective urban development and economic development of the country and region including infrastructure development around Candidate Economic Zone. In addition, anticipated negative impacts could be avoided or minimized by taking the appropriate countermeasures.

Table 5-3: Study of Zero Option

Aspect		Condition Without the Project	Condition With the Project
Technical Aspect		Random development might be implemented without any plan for overall area development. Then, the future development plan might be restricted after disorderly development	Candidate Economic Zone would be developed efficiently in accordance with the planned area development plan.
Economical Aspect	Employment	• Job opportunity would not increase from the current situation	• Job opportunities would increase for local residents
	Farmer/Share Cropper/Day labor	• No need to change their occupation	• Farmer's will be compensated project proponent and they will alter by other profession
	Infrastructures	• Economic development of the entire area would be limited.	• A series of infrastructure development project (water supply, gas supply, telecommunication and power supply) would be beneficiary and cost-

Aspect		Condition Without the Project	Condition With the Project
			effectiveness for Candidate Economic Zone development as well as upcoming expansion project.
	Annual revenue from Paddy land	• Annual revenue will be increased from paddy land because of no development project	• Annual revenue will be decreased from paddy land but it will be limited
	National Economy	• Contribution of national economic development of the entire area would be limited.	• Because of high industrial development and thousand job holders will contribute on national economic growth.
Environment/ Social Consideration	Resettlement	• Involuntary resettlement would not occur.	• Impact on social aspect such as involuntary resettlement would occur.
	Environment	• Impact on natural environment that might be caused by the development of candidate Economic Zone will not occur.	• Impact on natural environment and pollution caused by the construction work and operation of candidate Economic Zone would occur.
	Social	• Impact on social environment that might be caused by the development of candidate Economic Zone will not occur.	• Impact on social environment (road accident, social conflict, Community health and safety) caused by the construction work and operation of candidate Economic Zone might occur.

Aspect		Condition Without the Project	Condition With the Project
	Environmental and Social Consideration	• Issues of environmental and social consideration might be more complicated and segmented in case random developments are conducted.	• Planned area development would effectively and comprehensively address environmental and social consideration issues. • Living environment for local residents would be improved due to the development of the surrounding infrastructure.

Source: EIA Study Team prepared based on the information from the project proponent

CHAPTER 6

6. SCOPING AND TERMS OF REFERENCE FORENVIRONMENTAL IMPACT ASSESSMENT

6.1 Screening

Screening is the step to categorize projects/activities based on degree of environmental impacts caused by the project.

The Project was classified as "Red" under regulation of Bangladesh and "A" according to the JICA Environmental Guidelines, and thus EIA is necessary to be conducted.

6.2 Procedure of Scoping for Environmental and Social Impact Assessment

In order to assess the likely significant environmental and social impacts, potential environmental and social impacts of the Project were preliminarily identified based on the project description and overall environmental and social conditions in and around Economic Zone. The impacts of pollution, natural and social environments, health and safety, emergency risk, and others were classified as A to D in accordance with the following criteria, assuming no specific measures toward the impacts are taken:

1) A-/A+: Significant negative/positive impact
2) B-/B+: Some negative/positive impact
3) C-/C+: Impacts are not clear, require more investigation
4) D: Impacts are negligible, no further study required

6.3 Results of Scoping for Environmental and Social Impact Assessment

Results of the scoping for environmental and social impact assessment are shown in ***Table 6-1***. Scoping was conducted toward the development project of Araihazar Economic Zone. These impacts were evaluated in each of the three phases separately, namely: pre-construction, construction phase and operation phase.

Table 6-1: Scoping Matrix of the Proposed Project

Field	No	Impacts	Rating		Description of the Rating
			Pre/During Construction Phase	Operation Phase	
Environmental pollution	1	Air pollution	B-	B-	**PC:** It is estimated that minimum of 6 to 7 meter land filling must be practiced. Clearance of the site will involve removal of wild vegetation, land leveling,& filling activities. These activities will lead to dust generation. **CO:** Impact on air quality due to operation of construction machineries and circulation of construction vehicles is expected. **OP:** Impact on air quality due to increase of vehicle traffic during industrial operation. Emissions would be generated from the industrial operation.
	2	Water pollution	A-	B-	**PC/CO:** Impact on water quality from muddy water flowing to the river due to land reclamation work is expected. Run-off from the construction site may carry the higher quantity of sediments and oil which may pollute the surface water and impact the aquatic life. And ground water is fresh shallow aquifers of the study area. **OP:** Impact on water quality of the surrounding water bodies is expected due to wastewater discharge from the EZ.
	3	Waste	B-	B-	**CO:** General construction waste is expected and typically managed by the appointed contractors. **OP:** Industrial waste is expected. Appropriate waste management by law and regulation is the responsibility of the tenant factory/facilities, which shall be approved by DOE for their own EIAs.
	4	Soil pollution	B-	B-	**PC/CO:** Project site and surrounding area would be contaminated by dredged soil. Development of the structures and construction of the access road may disturb the soil profile of the area. Land will be filled and compacted after filling. Also sand will be required for construction of access road and administration building which will

Field	No	Impacts	Rating		Description of the Rating
			Pre/During Construction Phase	Operation Phase	
					be sources from nearby markets or other part of the country. Storage of raw material, fuel and construction debris may contaminate the soil. **OP:** Soil contamination would occur due to the improper operation of the EZ industries.
	5	Noise and vibrations	A-	B-	**PC/CO:** Increase of noise and vibration levels due to construction machineries operation, particularly by the sand compaction and traveling of construction vehicle would temporarily occur. **OP:** An increase in noise and vibration levels due to the circulation of vehicular traffic and operation of the industries would occur.
	6	Ground subsidence	D	B-	**CO:** There is no evidence or trace of ground surface subsidence around all the project sites. **OP:** Based on the deep ground water surveys, enough ground water resources were confirmed at the deep aquifer that is deeper and different from the aquifer of the residential wells. Expansion of the EZ and other industrial Subsidence could lead to subsidence without proper ground water resource management.
	7	Offensive odors	D	D	Construction works that generate odors are not expected.
	8	Sediment quality	B-	B-	**PC:** During the land development, earth filling material may washout to the nearby canal and increase the sediment concentration. **CO:** Development of the structures and construction of the access road may disturb the bottom sediment profile of the water bodies. **OP:** Bottom sediment of the surrounding water bodies would be deteriorated by wastewater generated from the industries.
Natural environment	9	Protected areas	D	D	Since no natural preservation area and national parks exist in and around the Economic Zone, an impact on protected areas is not expected.
	10	Ecosystems	B-	B-	**PC/CO:** Extensive use of vehicle horns and dust creation has the

Field	No	Impacts	Rating		Description of the Rating
			Pre/During Construction Phase	Operation Phase	
					potential to cause disruption to the surrounding inhabiting floral and faunal species. Many species of flora and fauna would frighten easily by vehicle horns and may become distressed. **OP:** Post development of the economic zone & setting up of industries, there could produce some impacts to the ecosystem of the area. Industrial development will involve generation of emissions, effluent and increased vehicular movements. These all together may have overall negative impact on the eco-system of the site and the nearby areas as certain specific air pollutants will impact the existing vegetation and avifauna in the area.
	11	Hydrology	A-	A-	**CO**: surface water movement would be significantly changed due to the construction of the retaining walls above the existing ground level. **OP**: without EZ drainage retaining systems, excess drainage water from the EZ could flood the surrounding area.
	12	Topography and geology	A-	D	**CO:** Due to the significant sand reclamation from the surrounding river beds, erosion of the river bank could occur without proper sand dredging. **OP:** No impacts are expected
Social environment	13	Involuntary resettlement	A-	D	**PC/CO:** Land acquisition will be required and some scale of involuntary resettlement is expected. **OP:** Impact on the livelihood of relocated households is expected.
	14	Vulnerable group	D	D	**CO:** Vulnerable people in the project area would be affected. On the other hand, job opportunity and commercial opportunity would increase. **OP:** Vulnerable people would not be able to receive the benefits of the Project. On the other hand, job opportunity as workers of the industries and commercial opportunity would increase.
	15	Indigenous and	D	D	**CO:** no indigenous/ethnic people live in the project affected area.

Field	No	Impacts	Rating		Description of the Rating
			Pre/During Construction Phase	Operation Phase	
		ethnic people			**OP:** no impacts are expected
	16	Local economies, such as employment, livelihood, etc.	A-	A+	**PC/CO:** PAHs who earn income from paddy fields and/or vegetable fields might lose their income source. On the other hand, increase of job opportunity as construction workers or commercial opportunity targeting workers is expected. **OP:** Impact on the livelihood of relocated households is expected. On the other hand, an increase of job opportunity as workers of the industries or commercial opportunity targeting workers is expected.
	17	Land use and utilization of local resources	B-	D	**PC:** Total land of the project site is seasonally agricultural land. During the monsoon season the proposed land is submerged by the Dhawrakhali canal water which is connected to the river. In the pre-construction phase, the temporary storage and stockyard are built up on the agricultural lands, and then the crop production will be obstructed in those areas. Crops will also be damaged when the equipments, and heavy vehicles will pass through agricultural fields of the proposed project areas. **CO:** The 540.77 acres of agricultural land will be altered by the industrial zone. So the annual agricultural production rate of that upazila will diminish. In the project site, land is single cropped agricultural land so the impact on agriculture activities/ resources is anticipated to have a low significant impact from the project development. **OP:** Total 540.77 acres land is required for 1st phase of AEZ. Further land may be needed for the 2nd phase of economic zone development. No impact on agriculture resources is anticipated from economic zone development during the operation phase.
	18	Water usage	D	B-	**CO:** Since Araihazar EZ sites do not have existing public water supply facilities, it is necessary to utilize the nearby rivers or wells as water sources. Ground water will be used during the construction phase. So,

Field	No	Impacts	Rating		Description of the Rating
			Pre/During Construction Phase	Operation Phase	
					Excessive withdrawal of ground water may lead to depletion of aquifers. **OP:** It is obvious that there will be thousands of employees and workers who will use and consume water and generate wastewater from the office and the residential building. It is estimated app. 11000 cubic meters per day of water will be required during the operation phase. Excessive withdrawal of ground water may lead to depletion of aquifers.
	19	Existing social infrastructures and services	D	D/B	**PC/CO:** *Impact to Relocated PAHs of the Project* Accessibility of PAHs to social Infrastructure/service would be affected more or less due to the relocation. On the other hand, the proposed relocation site will be arranged with basic social infrastructures as a part of the assistance by the project *Impact to Local People in the local Community of the project area* Accessibility of social infrastructure/ service will be affected due to the increase of construction vehicles. The traffic volume should be controlled by the construction contractor to avoid serious traffic congestion. **OP:** Accessibility to social infrastructure would be limited by the existence of the industries. However, it is planned to construct a community road which has an alternative function in order to keep the accessibility of the existing road for the local community. In addition, basic infrastructures such as the existing road, gas pipeline and power supply will be improved due to the ongoing infrastructure development projects around Araihazar Economic Zone.
	20	Social institutions such as social	D	D/B+	**PC/CO:** *Impact to Relocated PAHs of the Project*

Field	No	Impacts	Rating		Description of the Rating
			Pre/During Construction Phase	Operation Phase	
		infrastructure and local decision-making institutions			Accessibility of PAHs to social Infrastructure/service would be affected more or less due to the relocation. On the other hand, the proposed relocation site will be arranged with basic social infrastructures as a part of the assistance by the project *Impact to Local People in the local Community of the project area* Accessibility of social infrastructure/ service will be affected due to the increase of construction vehicles. The traffic volume should be controlled by the construction contractor to avoid serious traffic congestion. **OP:** Accessibility to social infrastructure would be limited by the existence of the industries. However, it is planned to construct a community road having an alternative function in order to keep the accessibility of the existing road for the local community. In addition, basic infrastructures such as the existing road, gas pipeline and power supply will be improved due to the ongoing infrastructure development projects around Araihazar Economic Zone.
	21	Misdistribution of benefits and damages	A-	D	**PC**: Only land owner and property owners and affected labours will be eligible for the compensation and rehabilitation. **CO**: Not everybody could benefit from the construction work due to limited requirements and preferences of the contractors.
	22	Local conflicts of interest	D	D	**CO:** Due to an increase in employment opportunity will be increasing during construction; candidates of construction workers may experience some conflicts between communities. **OP:** Misdistribution of benefits and damages would occur since there are PAHs who lose their income source, while there are people who would get job opportunity as workers of the industries. But, more than 10,000 people will be involved directly in this Economic zone.

Field	No	Impacts	Rating		Description of the Rating
			Pre/During Construction Phase	Operation Phase	
	23	Cultural heritage	D	D	Nothing found in the development area would be affected by the development. N/A
	24	Landscape	D	B-/B+	**PC/CO:** The landscape will change by the construction work of Araihazar Economic Zone. Moreover, 218.84ha or 540.77 acres of agricultural land will be cleared and altered to industrial area as the part of Economic Zone development. But All construction activities for administration building, land filling & boundary wall will be carried out within the economic zone site and will not cause any impact on landscape and scenic beauty. A green buffer of 3.5 m only one row of trees will be developed all around the project site which will enhance the scenic beauty of the area. **OP:** Although semi- urbanization of the landscape in and around Araihazar Economic Zone is inevitable, the development will be implemented under the project proponent internal regulation which rules to secure the environmental friendliness for users and residents, and harmonization with the surrounding area.
	25	Gender	D	D	PC/CO: Despite cultural practices, no gender specific issues are observed and expected in the project area. OP: project activities do not attract gender issues
	26	Children rights	B-	B-	**PC/CO:** Due to the relocation, children's education would be temporarily disrupted. **OP:** There are 11 affected households who have school going children. They must relocate to other places and these children educational opportunity will be temporarily disrupted due to the relocation. On the other hand, children would be indirectly influenced by the improvement of social infrastructure in the region as a result of the Project.
	27	Infectious diseases	B-	B-	**CO:** There is a possibility to increase the risks of infectious diseases

Field	No	Impacts	Rating		Description of the Rating
			Pre/During Construction Phase	Operation Phase	
					due to an influx of construction workers into the Project area.
					OP: There is a possibility to increase the risks of infectious diseases due to influx of workers of the industries and the semi-urbanization of the Project area and its surrounding area.
	28	Working conditions, including occupational safety	D	B-	**PC/CO:** There would be a possibility to occur accidents and incidents during construction works for the implementation of the Project. Physical trouble, Noise, vibration, lighting, electrical, heat and cold, nuisance dust, fire/explosion, machine grinding, working space, Chemical, Gases, dusts, fumes, vapours, liquids are the major hazards which are harmful to workers health
					OP: During the operation phase each industry will start their operation, accidents or incidents are expected to occur more or less during the operation phase.
Others	29	Accidents	A-	B-	CO: Construction accidents and road accidents around the project site are expected due to the construction activities.
					OP: Road accidents would be increased due to industrial vehicles and commuter busses and motor bikes.
	30	Transboundary impact and climate change	D	B-	**CO:** Few impacts are expected.
					OP: Emissions of GHGs would be generated from vehicle traffic and industrial operations.

Evaluation: A-: Significant Negative Impact A+: Significant Positive Impact
B-: Some Negative Impact B+: Some Positive Impact
C: Impacts are not clear, need more investigation
D: No impacts or impacts are negligible, no further study is required
Source JICA Survey Team

6.4 Term of References for EIA

In order to fulfill the requirements of the JICA Environmental Guidelines and advisory instructions given by JICA Environmental and Social Consideration Advisory Committee, the JICA Survey Team prepared a term of reference (TOR) for identified uncertain impacts summarized for the JICA EIA study and RAP study. A summary of the additional survey items and their survey methodologies is presented in below

Table 6-2: Methods of Survey and Impact Assessment (TOR)

	No	Impacts	Methods of Surveys (The Content of supplemental EIA Survey and Social Impact Survey)	Methods of Predictions and other Considerations
Environmental pollution	1	Air pollution	The existing ambient air quality of the study area monitored at Four (4) locations during the monitoring period (September & October 2017). The monitoring parameters included Particulate Matter (SPM, PM_{10} and $PM_{2.5}$), Sulphur Dioxide (SO_2), Oxides of Nitrogen (NOx), and Carbon Monoxide (CO). SPM and CO monitored for 8 hours and rest of the parameters monitored on 24-hourly basis during the duration of the study.	Industrial emissions and movement of vehicular access
	2	Water pollution	Water sampling and analysis undertaken to understand the overall baseline water quality characteristics of the surface water in the study area. Samples were taken from a selected surface water body's source representing different parts of the study area. 3 Water sampling and analysis was undertaken to understand the overall baseline water quality characteristics of the groundwater in the study area.	Estimated industry types of the EZ studied in the F/S stage JICA report
	4	Soil pollution	The soil sampling strategy was designing to assess the existing soil quality over the study area. The analysis results of physio-chemical parameters (metal content), pH level of samples are studied.	Estimated industry types of the EZ
	5	Noise and vibrations	Noise levels recorded at ten (10) locations in the study area during the monitoring period. Noise levels recorded in the form of sound pressure levels with the help of a digital sound level meter.	Increased traffic movement and industrial operations
	8	Sediment quality	Sampling and laboratory test shown in #4	

	No	Impacts	Methods of Surveys (The Content of supplemental EIA Survey and Social Impact Survey)	Methods of Predictions and other Considerations
Natural environment	9	Protected areas	No protected areas, or National parks exist at or near the project area.	N/A
	10	Ecosystems	Field survey	Secondary data/studies for sensitivity of the observed species
	11	Hydrology	Secondary data	JICA F/S study
	12	Topography and geology	Secondary data	N/A
Social environment	13	Involuntary resettlement	RAP study	RAP
	14	Vulnerable group	RAP study and Focus group discussion	RAP
	16	Local economies, such as employment, livelihood, etc.	Socio-economic census surveys for affected people will be conducted to identify income and livelihood of PAPs.	RAP
	22	Local conflicts of interest	RAP	RAP
	25	Gender	RAP	RAP
	28	Working conditions including occupational safety	Secondary data (EZ development monitoring studies)	Secondary data
Others	29	Accidents	Secondary data (EZ development monitoring studies)	Secondary data

CHAPTER 7

7. ENVIRONMENTAL& SOCIAL IMPACTS

7.1 Impact Identification

An environmental impact is defined as any change to an existing condition of the environment. Findings of the assessment are presented according to site preparation, construction and operation phases. The impacts will be determined as significant, positive or negative, direct or indirect, long term or short term.

The EIA study, based on the screening and scoping of IEE study, review of proposed civil works, review of similar environmental assessment reports, baseline monitoring and stakeholder consultations, has identified 30 major environmental and social concerns that are expected from the project (***Table 6-1***). The impacts are broadly classified into following 4 rating during preconstruction, construction and operation stage:

- Environmental Pollution
- Natural Environment
- Social Environment
- Others

This chapter describes the rating and environmental impacts caused by the project both tentatively during construction and permanently during operation.

7.2 Project Impacts to key 30 Items

Project impacts to key 30 items caused by the project both tentatively during construction and permanently during operation phase is given below

7.3 Environmental Pollution

7.3.1 Air Pollution

7.3.1.1 Pre-construction Phase

Pre-construction phase will involve site clearance, leveling & filling activities for development of EZ. Upon land acquisition, BEZA plans land grading of the EZ in order for the land to be flooding resilient. Considering the amount of soil required for 218.84ha project area. River sand dredge from the Meghna River and transferred through the water vessel into the unloading point of Shitalakhya River. Due to the distance between the nearest river and the EZ site, sending river sand may require intermediate unloading point between the river and the EZ. River sand may transported by pipeline to the project site from the unloading point which will be located at Shitalakhya River.

It is estimated that minimum of 6 to 7 meter land filling must be practiced. Clearance of site will involve removal of wild vegetation, land leveling & filling activities. These activities will lead to

dust generation. However, these emissions will be limited to the site only and have impact for short duration only during clearance activity.

Mitigation Measures

To minimize the dust generation, water should be sprinkle regularly at the site and low sulphur diesel should be use in land leveling equipments to control the SO_2 emissions.

7.3.1.2 Construction Phase

All earthworks construction, site clearing, small structures demolition, civil construction, mechanical construction, handling and stocking of construction materials, dry materials stockpiling, hauling of materials, construction of access road, construction of retention pond and canal will generate dust and affect the local air shed. Construction of access roads and its dust is likely to be the most significant direct potential impact on the local community.

Carbon dioxide and nitrogen oxides may be emitting from the combustion of the petroleum products in project related vehicles, machinery, generators etc during the construction period. Their impact on air quality will not be significant as the pollutant emission activities (point and area sources) will be limited within the project boundary and the activities will be short term (only for the construction period).

The retention pond excavation may generate huge dust in the air and it will influence directly on the workers as well as local community. Dust mites are a common cause of asthma in children. The soil extractor or soil collector truck will move continuously in the project that may be emitting $CO_2$and $NO_2$from combustion of gas, oil or fuel.

The air may be polluting due to dust arisen from unpaved road, sand/ earth stockpile by wind. Bitumen will use for construction of 400 m access road and burning of bitumen may generate air pollution but the impact will be minimum.

However, this impact may further be minimized by adopting the following mitigation measures:

Mitigation Measures

- Sprinkling of water at construction site and haul roads
- Trucks transporting fine materials, soil and waste to and from the Project site will be covered to reduce the release of dust;
- Raw materials, excavated soil and other debris should be stored under covered sheds
- Generators, compressors, and other equipment to be shut down when not infuse;
- Provision of face mask to workers to minimize inhalation of dust particles
- Construction vehicles and machinery should be regularly serviced and check for pollution control
- Low sulphur diesel should be used for running construction equipment and vehicles

- Air emission monitoring programme to be undertaken quarterly by the contractor, according to the design specified in the EMP and the contract specifications. The programme mush include, as a minimum monitoring of SPM, CO, NO_2, SO_2, $PM_{2.5}$ and PM_{10};
- Green buffer should be developed all along the EZ boundary and plantation should be carried out along the both side of access road;

7.3.1.3 Operation Phase

There will be minimal dust emissions from paved access and all internal roads. Post development of the economic zone & setting up of industries, there could be some impacts on the air quality of the area. Industrial development will involve generation of emissions, and increased vehicular movements. These altogether may have overall negative impact on the air quality of the site and the nearby areas. The industries proposed as per the feasibility study are light engineering, food processing, textile industries, pharmaceutical, motor bike assembly and readymade garment manufacturing. Significant air emissions result from light-engineering industries. These are particulate matter, sulphur dioxide, metals and other criteria pollutants like ozone, oxides of nitrogen and carbon monoxide. Lead may be generated in some of the processes. Air emissions from food processing industry will contain some volatile organic compounds but do not contain any hazardous compounds. These industries emit low process-air emissions. Most processes uses electrical power and rarely emit harmful compounds to environment.

Mitigation Measures

- All industries should obtain clearance from DoE, Bangladesh;
- Latest technology, methodology, and machinery involving minimal air emissions should be adopted by industries;
- Air pollution control measures should be taken by industries as prescribed in the mitigation plan;
- Periodic renewal of ECC should be obtained by all the industries;
- Power Generators should be provided with stacks of adequate height (higher than nearest building) to allow enough dispersion of emission;
- Process emission if any shall be control with the installation of adequate air pollution control systems;
- All industries should obtain clearance from DoE, Bangladesh as applicable. Air pollution control measures shall be adopted by respective industries in line with DOE permission;
- Air pollution monitoring should be carried out quarterly by all industries to check the air pollution level;
- Preference of usage of clean fuel like LPG, low sulphur diesel should be explored;
- Energy conservation should be adopted by adopting the alternate energy options like solar power and other energy efficient technologies;
- Development of green belt (3.5 m) all along the EZ zone;

7.3.2 Water Pollution

7.3.2.1 Pre-construction Phase

Impact on water quality from muddy water flowing to the canal or adjacent river due to land reclamation work is expected. In the rainy season, dredged soil may contaminate the canal by runoff water. Therefore, proper management can reduce this impact.

Mitigation Measures

- To avoid excavation activities during rain;
- Minimize run-off by using sprays for curing;
- Proper management plan should take in the land filling period by the contractor.

7.3.2.2 Construction Phase

A. Impact on Surface Water Quality

Run-off from the construction site may carry the higher quantity of sediments and oil which may pollute the surface water and impact the aquatic life. Thus measures are required to be taken to minimize the surface water pollution.

The retention pond excavation may generate huge dust that may mix with the canal/river water through rainwater. The soil extractor or soil collector truck will move continuously in the project site that may be spill oil, which will contaminate the adjacent water bodies.

The surface water may be polluting due to dust arisen from unpaved road, sand/ earth stockpile by wind and runoff water. Access road construction materials and debris (sand, bricks, stones, brick chips, cement etc) may cause water pollution.

Mitigation Measures

- Avoid excavation activities during rain;
- Prevent piling up of excavated soil, raw material and construction debris at siteby proper management and disposal;
- Minimize run-off by using sprays for curing;
- Maintaining appropriate flow of water sprinklers at site;
- Construction of storm water drains along with sedimentation tanks with sandbags as partition as barrier for direct flow of run off to canal or river;
- Collection & Reusing of curing over flow, tyre wash water etc within the site;
- Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management;
- Construction of adequate nos. of toilets and proper sanitation system to prevent open defecation along the canals/river banks/water supply lines;
- Construction of soak pits/septic tanks to dispose-off the domestic waste water generated from labour camps to prevent disposal of sewage in surface water bodies;

- Proper collection, management and disposal of construction and municipal waste from site to prevent mixing of the waste in run-off and entering the water bodies;
- No debris/construction material should enter water body in the area.

B. Impact on Ground Water Quality

Ground water is fresh shallow aquifers of the study area. No significant impacts are anticipated on the ground water quality due to development and construction of AEZ facilities.

Mitigation Measures

- No sewage or waste water should be accumulated in any unlined structure;
- Timely disposal of the construction/chemical/hazardous waste so as to prevent leaching of any pollutant to ground;

7.3.2.3 Operation Phase

A. Impact on Surface Water Quality

Industries are likely to generate domestic and industrial effluent. Liquid waste which can be generated from light engineering industries will include waste acid, waste alkali, grease, used/spent oil, liquid metal, spent solvents etc. Wastewater is not generated in significant amount from these industries. Majorly domestic and cleaning waste is likely to be generated. No significant liquid waste is generated from RMG garments. Food processing industries similarly generate both liquid and solid waste. Concern with wastewater from the food processing industry is high BOD levels, high TSS, excessive nutrient loading like nitrogen and phosphorus compounds and pathogens. This water is to be treated essentially to achieve DoE standards to prevent the soil, water and air quality pollution. Discharge of wastewater in soil will degrade its fertility and increase the toxicity which will make it unsuitable or growth of plants and survival of micro/macro organisms. If this water is discharge into water system, will pollute the water quality and have potential to threat the aquatic life. Uncontrolled discharge of these effluents to canal/river may severally pollute the canal/river water quality. Pollutants from these industries may be discharged into canals and may be carried away to Brahmaputra & Meghna River system which supports diverse variety of fish. Run-off may significantly increase post development of economic zone. It is required to manage storm water which will be generated from EZ site post development. Measures should also be taken to prevent contamination of storm water with any industrial pollutant. Following measures should be adopted during operation phase to minimize impacts of development of Economic zone on surface water quality:

Mitigation Measures

- Each industry should obtain an ECC from the DoE Bangladesh before construction and operation of the factory and must comply with the conditions stated in the ECC.
- Each industry has to arrange pre-treatment facility to treat their processed effluent and sewage they generate to meet certain level of pollution load set by the AEZ operator;

- Pre-treated wastewater will be treated in central effluent treatment plant to meet national waste water discharge standards;
- Online based monitoring system should be installed in CETP;
- Implement the National 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management;
- Storm and industrial wastewater will be collected in separate pipe networks to prevent contamination of storm water draining to natural wetlands;
- Each industry should treat the effluent and sewage generated by them so as to achieve zero discharge and no untreated effluent should be discharged into any water body;
- Proper management of waste should be done to prevent any contact between the waste and storm water;
- Common waste disposal sites should also be developed within EZ site as per the standards and prior permission of DoE should be taken before development;
- Storm water system should be inspected & cleaned before monsoon every year;
- Peripheral drain shall also be lined and shall not be connected to internal storm water drainage system;
- River water quality shall be monitored periodically;

B. Impact on Ground Water Quality

There will be very minimal chance of contaminating ground water from wastewater and sewage during the operation phase. Pre-treated waste water will be collected from factories through anti-corrosive pipes to the treatment plant and only be discharged to nature after meeting the national discharge standards. Following measures should be taken to minimize the ground water pollution.

Mitigation Measures

- Each industry should pre-treat the effluents and sewage before sending them to treatment plant;
- Pre-treated and treatment plant sludge will be stored in impervious containers and leachate will be collected to treat in the treatment plant;
- Treated wastewater will be passed through a lagoon to ensure bio monitoring ofwater quality
- No leachate, wastewater and waste material should be stored in pervious unlined area/pond.
- Ground water quality shall be monitored periodically.

7.3.3 Waste

7.3.3.1 Construction Phase

General construction waste is expected and typically managed by the appointed contractors. Construction sludge by boring from underground and domestic waste from the base camp is generated during construction.

Excavation of retention pond and access road construction may generate both solid and liquid waste that will affect water, soil & ecology.

Mitigation Measures

- Minimize volume to use silt basin before disposing;
- Segregate waste to minimize waste material;
- Disposed in designated dumping site instructed by the section handling waste;
- Implement the national 3R ((Reduce, Reuse and Recycle) Strategy during construction phase for both solid and liquid waste management;
- Recycled as possible with consideration of soil property;

7.3.3.2 Operation Phase

Industrial waste is expected. Appropriate waste management by law and regulation is the responsibility of the tenant factory/ facilities, which shall be approved by DoE for their own EIAs.

Mitigation Measures

- Implement the national 3R ((Reduce, Reuse and Recycle) Strategy during operation phase for both solid and liquid waste management;
- Effective community consultation should require.
- Fail-safe containment of any facilities that could put the environment at risk
- Adequate buffers to nearby sensitive land uses and water resources
- Access to or provision of services that ensure potential wastes are reduced, recycled or adequately treated before safe disposal, such as pre-treatment of process fluids, then discharge to Effluent Treatment Plant scheme
- Site drainage controls to isolate potentially contaminated areas from discharge to the environment
- Environmental training and awareness programs for tenant workers should required

7.3.4 Soil Pollution

7.3.4.1 Pre-construction & Construction Phase

Project site and surrounding area would be contaminated by dredged soil. Land will be filled and compacted after reclamation. In addition, sand will be required for construction of boundary wall, access road and administration building which will be sources from nearby markets or other part of the country. Sand should be purchased from authorized vendors only to minimize the illegal mining and dredging activities storage of raw material. Fuel and construction debris may contaminate the soil thus measures should be taken to prevent the soil pollution.

During the Retention pond excavation time, the upper layer of the soil will be damaged. Soil erosion caused by running water and other pest control measures; this leads to loss of fertile land for agriculture, forest cover, fodder patches for grazing etc. The presence of heavy metals

in soil in toxic amounts can cause irreversible developmental damage in children. Improper disposal of waste may cause soil pollution.

Development of the structures and construction of the access road may disturb the soil profile of the area. Usually soil pollution by leaked petrol from pipe connection of ill-maintenance heavy equipment and storage tanks that are installed directly on the soil surface can cause oil leaking that result in pollution of subsoil and groundwater during construction. Road debris may also generate soil pollution

Mitigation measures to be adopted are mentioned below. Contractors are required to take all the proposed mitigation measures. AEZ will ensure that all the proposed mitigation measures are being incorporated in the bid document issued to the contractor and the implementation of the same during pre-construction & construction.

Mitigation Measures

- Raw material will be stored under covered sheds and paved surface;
- Fuel storage area should be proper containment;
- Adoption of best management practices to prevent any spillage of raw materials;
- Construction debris should be stored under covered sheds and paved surface and should be disposed off regularly to designated sites;
- Waste from labour camps can be segregated at site. Food waste/wet waste should be composted in pits within the campsite;
- Implement the national 3R ((Reduce, Reuse and Recycle) Strategy for both solid and liquid waste management;
- Recyclable waste should be sold to the authorized dealers ensuring environmental friendly and the remaining should be disposed off at designated sites through local agencies responsible for waste management in the area;

7.3.4.2 Operation Phase

No significant impact on soil quality is anticipated from the operations of AEZ. All waste including solid and liquid wastes will be treated properly before being disposed of into nature. After development of economic zone, disposal of industrial domestic and process waste may contaminate land and soil quality of the area. The impact can be significant and long term in case of uncontrolled discharges. Improper disposal of waste (hazardous and non-hazardous waste) may degrade soil, water, air quality and ecology of the area. As per the preliminary planning, it is planned that industries like light engineering, textile and food processing will come up in the EZ zone. These industries are not heavily polluting like tanneries, distilleries etc. but generate significant waste both hazardous and non-hazardous in nature, which can pollute the environment if not managed properly. Natures of the waste, which can be generated from these industries, are discussed below.

Waste to be generated from the light engineering industries can be solid and liquid in nature. Solid waste will include packaging waste, metal pieces, damaged electrodes, ends of coils, wires

and spools, flux cored electrodes, greased clothes/cotton, damaged rods, burnt rods, scrap flux, slag (residue from flux reaction and composed of metal and nonmetal oxides), Dross (oxidized metal expelled during thermal cutting and gouging operations), metal dust, dust collected in filter ventilation systems/air pollution control devices, floor sweepings, coal ash (if coal used as fuel), solid waste recovered from treatment of wastewater like sludge etc. Solid waste from the food processing industries includes both organic and packaging waste. Organic waste that is the rinds, seeds, skin, and bones from raw materials, results from processing operations. Inorganic wastes typically include excessive packaging items that are plastic, glass, and metal. Solid waste from textiles majorly composed of resins, fabric, apparel, dye, discarded machinery and fibers. These waste required to be collected and disposed off periodically. Lubricate oil/waste oil is generated from the machineries as hazardous waste. Mitigation measures are required to be adopted to prevent soil pollution of the area.

Mitigation Measures

- Treatment of the effluents and sewage and ensuring proper disposal;
- Effluent Treatment Plant (ETP) shall be installed each tenant during operation stage;
- Segregate non-hazardous solid waste from hazardous one and dispose properly;
- Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management;
- Industrial waste generated should be stored in impervious storage tanks;
- All factories will ensure proper storage for their chemical and hazardous materials to prevent accidental spillage;
- Provision shall be made for proper storage and disposal of industrial waste by receptive industries;
- Common waste storage areas shall be designated for industrial domestic waste;
- Waste should be segregated at source into hazardous and non hazardous waste. Further the waste should be segregated into recyclable and rejected waste;
- Recyclable waste should be sent to authorize vendors for recycling and rejected waste should be disposed off as per the norms specified by DoE for the particular waste;
- Industrial waste generated should be stored on sealed surfaces and should be disposed off as per guidelines of DoE, Bangladesh;
- No chemical/hazardous raw material should be allowed to spill over the land and should be operated in covered systems;
- Excessive packaging should be reduced and recyclable products such as aluminum, glass, and high-density polyethylene (HDPE) are being used where applicable;
- Organic waste should be resold to value addition industries or can be feeded to live stock;
- Advanced wastewater treatment should be adopted by industries;
- Use of advanced techniques to control specific portions of the manufacturing process to reduce wastes and increase productivity;
- Use of radiation to kill pathogenic microorganisms;

- Reduction or total elimination of effluent from the manufacturing process;

7.3.5 Noise

7.3.5.1 Pre-construction Phase

Pre-construction phase will involve site clearance and land filling activities. Clearance of site will involve removal of wild vegetation and leveling activities. Some noise may be generated during the pre-construction phase but that will be site specific and for short durations. Machinery to be used should comply with the noise standards prescribed by DoE.

Mitigation Measures

- Vehicles and machinery should be regularly serviced and check for pollution control;
- Machinery to be used should comply with the noise standards prescribed by DoE;
- No activities to be undertaken during night hours to prevent any disturbance to nearby residents and labours in labour camps;
- Silencer should be used for high noise equipments or machines;

7.3.5.2 Construction Phase

Operation of different machineries and equipments for construction activities, running of heavy load traffic for construction materials transportation, and regular traffic movement may generate noise during construction period. The produced noise may have impact on existing acoustic environment of rural category defined in ECR, 1997. Local inhabitants may feel disturbed due to noise from line sources (traffic movement).Impacts of noise will potentially affect the following:-

a. Impacts of Noise to Immediate Neighbors
   - Continuous exposure of neighbors to noise nuisance may result in noise induced hearing lose;
   - Noise nuisance may reduce concentration of neighbors
b. Noise Impacts to Employees
   - High noise level will force employees to shout laud when communicating to one another;
   - Exposure of employees to high noise level (above 85dB) continuous for 8hoursper day may result in noise induced haring lose;
   - Exposure of ear to peak sound level instantaneously may result to deafness

The retention pond excavation may generate noise that will influence directly on the workers as well as local community. Continuous exposure of neighbors to noise nuisance may result in noise-induced worker hearing lose. The soil extractor or soil collector trucks will movement will be main source of noise pollution.

The construction of access road is relatively near to residential area. Vehicles and machinery may generate noise. However, low-noise construction vehicles will be used and construction

work will not do at night hour. Moreover, construction period will be done as soon as possible. Hence, there would be not significant impact.

Mitigation Measures

- Machinery to be used should comply with the noise standards prescribed by DoE;
- Vehicles and machinery should be regularly serviced and check for pollution control;
- Employees who work at high noise area should provide ear plug;
- No noise generating activity shall be carried out in the night;
- No construction activities to be undertaken during night hours to prevent any disturbance to nearby residents and labours in labour camps;
- Fitting noise machines with noise reduction devices;
- Temporary noise barriers should be provided near the high noise generating areas like metal or tiles cutting sites, generator room etc;
- Any employee who may complain about ear related pain and or complication while at work to access medical attention at the expense of the contractor or project proponent;
- Regular noise monitoring, especially at the school and residential quarters located close by (monitoring requirement and cost estimate provided)

7.3.5.3 Operation Phase

In the operation phase of AEZ, traffic in the area will increase significantly which will increase the noise level of the area. Operation of tenants, water pumps, and light engineering factories in proposed EZ may increase the noise level. The following mitigation measures should be taken to prevent noise pollution during the operation phase:

Mitigation Measures

- Regular industries maintenance;
- Pumps should be fitted in acoustic enclosure to reduce the noise generation;
- Noise barriers will be mandatory for the factories generating a lot of noise during operations;
- Plantation should be developed along the roads and boundary to form continuous barrier that will reduce the noise level significantly;
- Green buffer of 3.5 m should be developed all along the project boundary. Green buffer should compose of the only one row of plants of variable height and thick canopy so as to form continuous barrier. This will help in reducing the noise level significantly;
- Regular noise monitoring, especially at the school and residential quarters located close by (monitoring requirement and cost estimate provided);
- Use of ear-muffs and ear-plugs by industries personnel working in the generator and turbine facilities of the industries.

7.3.6 Ground Subsidence

7.3.6.1 Construction Phase

There is no evidence or trace of ground surface subsidence around all the project sites. No impacts or impacts are negligible, no further study is required.

7.3.6.2 Operation Phase

Based on the deep ground water surveys, enough ground water resources were confirmed at the deep aquifer that is deeper and different from the aquifer of the residential wells. Expansion of the EZ and other industrial subsidence could lead to subsidence without proper ground water resource management.

Mitigation Measures

- Need proper ground water resource management
- Groundwater management will need to keep in reasonable balance the costs and benefits of management activities and interventions, and thus take account of the susceptibility to degradation of the hydro geological system involved and the legitimate interests of water users, including ecosystems and those dependent on downstream base flow.
- It will be necessary to set possible management interventions in the context of the normal evolution
- Prioritization of domestic water security within a strategy to implement the groundwater management program of groundwater development;

7.3.7 Offensive odors

7.3.7.1 Construction Phase

There is no evidence or trace of offensive odors around all the project sites. No impacts or impacts are negligible, so no further study is required.

7.3.7.2 Operation Phase

No activities are planned that will cause offensive odors. No impacts or impacts are negligible, so no further study is required.

7.3.8 Sediment Quality

7.3.8.1 Pre-construction Phase

During the land development, earth-filling material may washout to canal and increase the sediment concentration.

Mitigation Measures

- Earth filling material should be in proper containment;
- Proper monitoring should be taken at land development

7.3.8.2 Construction Phase

Development of the structures and construction of the access road and excavation of retention pond may disturb the bottom sediment profile of the water bodies. Storage of raw material, fuel and construction debris may contaminate the bottom sediment thus measures should be taken to prevent the sediment pollution. Mitigation measures to be adopted are mentioned below.

Mitigation Measures

- Raw material will be stored under covered sheds and paved surface;
- Fuel storage area should be proper containment;
- Adoption of best management practices to prevent any spillage of raw materials;
- Construction debris should be stored under covered sheds and paved surface and should be disposed off regularly to designated sites;
- Waste from labour camps can be segregated at site;
- Food waste/wet waste should be composted in pits within the camp site;
- Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management;
- Recyclable waste should be sold to the authorized dealers ensuring environmental friendly and the remaining should be disposed off at designated sites through local agencies responsible for waste management in the area;

7.3.8.3 Operation Phase

No significant impact on bottom sediment quality is anticipated from the operations of AEZ. Bottom sediment of the surrounding water bodies would be deteriorated by wastewater generated from the industries. All waste including solid and liquid wastes will be treated properly before being disposed of into nature.

After development of economic zone, disposal of industrial domestic and process waste may contaminate land and bottom sediment of the area. Waste to be generated from the light engineering industries can be solid and liquid in nature. Solid waste will include packaging waste, metal pieces, damaged electrodes, ends of coils, wires and spools, flux cored electrodes, greased clothes/cotton, damaged rods, burnt rods, scrap flux, slag (residue from flux reaction and composed of metal and nonmetal oxides), Dross (oxidized metal expelled during thermal cutting and gouging operations), metal dust, dust collected in filter ventilation systems/air pollution control devices, floor sweepings, coal ash (if coal used as fuel), solid waste recovered from treatment of wastewater like sludge etc. Solid waste from the food processing industries includes both organic and packaging waste. Organic waste that is the rinds, seeds, skin, and bones from raw materials, results from processing operations. Inorganic wastes typically include excessive packaging items that are plastic, glass, and metal. Solid waste from textiles majorly composed of resins, fabric, apparel, dye, discarded machinery and fibers. These waste required to be collected and disposed off periodically. Lubricate oil/waste oil is generated from

the machineries as hazardous waste. Mitigation measures are required to be adopted to prevent bottom sediment pollution of the area.

Mitigation Measures

- Treatment of the effluents and sewage and ensuring proper disposal;
- Segregate non-hazardous solid waste from hazardous one and dispose properly;
- Industrial waste generated will be stored in impervious storage tanks and will be disposed of as per guidelines of the DoE;
- Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management;
- All factories will ensure proper storage for their chemical and hazardous materials to prevent accidental spillage;
- Raw material will be stored under covered sheds and paved surface;
- Fuel storage area should be proper containment;
- Advanced wastewater treatment should be adopted by industries;
- Adoption of best management practices to prevent any spillage of raw materials;
- A site for disposal of hazardous waste can be identified within the EZ and it should be developed as per the norms of DoE and upcoming Hazardous Waste Management rules of Bangladesh.

7.4 Natural Environment

7.4.1 Protected areas

7.4.1.1 Pre-construction, Construction& Operation Phase

Since no natural preservation area and national protected area and natural packs exist in and around the economic zone, impact on protected areas is not expected.

7.4.2 Ecosystems

7.4.2.1 Pre-construction Phase

In addition to impact on land and structures, the Araihazar Economic Zone project in Araihazar has very limited impact on trees. A total 1055 trees will be affected by the project where 349 fruits trees, 127 timbers, 253 bananas and 326 Bamboos are identify. A total of 349 fruits trees were identified of which 39 were large, 75 were medium and 235 were small and saplings. Impact on trees is presented in below

Table 7-1: Number of Affected Trees (by Type and Size)

Categories of trees	Number of Trees by size (Nos)				
	Large	Medium	Small	Sapling	Total
Fruits	39	75	189	46	349
Timber	14	54	56	3	127

Categories of trees	Number of Trees by size (Nos)				
	Large	Medium	Small	Sapling	Total
Banana					253
Bamboo	318	-	8	-	326
Total	**440**	**260**	**290**	**65**	**1055**

Source: EQMS survey, December 2017

Terrestrial Ecosystems

The high presence of anthropological activity is already occurring in these areas means that carrying out survey operations during preconstruction phase is not likely to impact the ecosystems in these areas.

Extensive use of vehicle horns has the potential to cause disruption to the surrounding inhabiting floral and faunal species. Many species of flora and fauna would frighten easily by vehicle horns and may become distressed.

An increased risk of weed dispersal and invasion will be there through the increase in human and vehicular traffic movement across the project area. The seeds of weeds are often easily transferred to areas where they do not currently exist, via the wheels of vehicles or on the soles of shoes. The presence and/or invasion of weed species to an area are generally to the detriment of habitats and species present.

Aquatic Ecosystems

Similar to terrestrial ecosystems, aquatic ecosystems are also not likely to be impacted badly by the activities carried out during the pre-construction phase. Aquatic flora and most of the fauna species will not be disturbed by the survey activities of this phase. The use of vehicles may inadvertently scare nearby water birds or other species by moving too close to them and disrupting feeding or nesting behavior. Once disrupted, some bird species may not return to that particular area.

Mitigation Measures

- No solid or liquid waste shall be discharged in water bodies;
- Septic tanks/soak pit should be provided to treat sewage to be generated from labour camps and prevent its disposal in water body;
- Toilets should be provided at site to prevent contamination of water due to open defecation in nearby areas;
- Vehicle washing/equipment cleaning should not be allowed near canal/drainsin EZ site;
- Wastewater from the washing area should be collected and should be used for curing purpose or wheel washing purpose;
- Excavation and filling should be carried out in phased manner to minimize exposure of loose earth for longer duration;

- Temporary storm water drainage system should be developed at site to channelize the storm water away from excavation/filling area, debris storage area and raw material storage area;
- All the raw material and debris should be stored in covered sheds on paved surfaces to minimize the contamination of rainfall run-off;
- Diesel, paints, cements etc should not be stored near the water bodies;
- Five trees will be planted against one tree cut down.
- If any kind of trees cut down because of the project, in that case the project proponent should take NOC from Forest Department (FD).

7.4.2.2 Construction Phase

Terrestrial Ecosystems

As indicated in baseline description, there is little of the project area that has not been significantly altered by human activities. As population expands rapidly after the initiation of human settlement in these plains the pressure on the existing system of production grows and hence biodiversity continue to decrease.

The project will have moderate impact both temporally as well as spatially on the terrestrial ecosystem. The severity of the impacts from project activities will also depend on the biological communities and their resilience to handle sudden alterations. Terrestrial species would also likely to suffer from long term impacts from the project.

Terrestrial Flora

Removal of vegetation from the project site as well as surrounding area is the single most important negative impact on terrestrial flora. The severity of impact depends largely on the type and species composition, which will be removed during construction. Accordingly it is important to know the exact location of the project site and its direct and indirect impact area to pin point the vegetation types and species composition growing in those particular areas. Impacts will be temporary in most of the cases and a high-quality management plan will minimize the impacts further.

i. Agricultural Land Flora

The project will have very similar impact on agricultural vegetation. Clearing of these crop cover from the construction area will create some negative impact on food security for the community as a whole. However, the impact on environment and ecosystem will be not very high.

ii. Homestead Plantation Flora

The project activities have high potential to impact on homestead vegetation and agro-forestry by offering increased disturbance and clearing. However, almost exclusively these vegetations are very close to the homestead buildings. The project authorities try to avoid acquiring existing

homestead buildings. However, all vegetation will be cleared from the homesteads that are within the project area.

iii. Roadside Vegetation

There will be little or no impact on roadside plantations, as these strip plantations will certainly be replanted after the completion of the construction work.

Terrestrial Fauna

Relative impact on terrestrial fauna will be determined by their habitat preference, food source and sensitivity to human activities. Moreover, the species both vertebrates and invertebrates species found in the project sites, are highly adaptive to regular anthropogenic disturbance and so the impact from project activities will be short and non-severe. But, any overlap between the project activity and their breeding period will produce much greater impact.

i. Agricultural Land Fauna

The main impact will come from the displacement and disturbance due to increased noise level and human activities. Most of the fauna species inhabiting this habitat are highly adaptive to periodical human interference and so the project activities will create no real negative impact to their regular lifecycle.

ii. Homestead Plantation Fauna

As discussed in the floral impact chapter, vegetation around the homestead will be disturbed and cleared and so the faunal species inhabiting within the project area. All Medium and small mammals will avoid the locations due to increased human presence. However, these displacements and avoidance will be temporary and within a short period of time after construction these species may come back to their old habitat.

Resident birds in the homestead vegetation will be disturbed. As temporary refuge, the affected faunal population will migrate to the nearby available and undisturbed habitat.

iii. Roadside Vegetation Fauna

Disturbance and impact on roadside vegetation would be very small and should not cause any long-term negative consequences on the local faunal species.

Aquatic ecosystem

Aquatic ecosystems provide support not only to aquatic inhabitants but also supply vital ingredients to terrestrial ecosystems. The impact on aquatic ecosystem will be negative, as the area under aquatic ecosystem will be disturbed. Especially, during construction many seasonal and perennial water bodies will lose their characteristics. Run-off from construction site may contain sediments or contaminant which may pollute water quality of canals and adjacent River which will impact the aquatic life. The economic productivity of the wetlands will also decrease with the reduction of seasonally flooded areas and subsequent loss of wetland-dependant

species. The seasonal wetlands provide the basis for many fisheries production of the area. Wetland vegetation provides important shelter for many fish species.

i. Aquatic Flora

Impact on aquatic flora would be short term during construction phase. Removal of vegetation can't be envisaged, as seasonal wetlands of the project area will be dry at that time of the year. Therefore, the severity of impact will not be great. However, disturbance in the seedbeds will reduce the species density and diversity temporarily along the study area.

ii. Aquatic Fauna

Similar to that of terrestrial fauna, impact on aquatic fauna will determine by their habitat preference, food source and sensitivity. Both vertebrate and invertebrate species found in the project sites are already adapted to regular anthropogenic disturbance and so the impact from project activities will be short and non-severe. Moreover, as most of the activities of the construction would take place during dry period, hence major part of the wetlands would be dry. So the impact will be minimal.

Mitigation Measures

- No solid or liquid waste shall be discharged in water bodies;
- Septic tanks/soak pit should be provided to treat sewage to be generated from labour camps and prevent its disposal in water body;
- Toilets should be provided at site to prevent contamination of water due to open defecation in nearby areas;
- Vehicle washing/equipment cleaning should not be allowed near canal/drainsin EZ site;
- Wastewater from the washing area should be collected and should be used for curing purpose or wheel washing purpose;
- Excavation and filling should be carried out in phased manner to minimize exposure of loose earth for longer duration;
- Temporary storm water drainage system should be developed at site to channelize the storm water away from excavation/filling area, debris storage area and raw material storage area;
- All the raw material and debris should be stored in covered sheds on paved surfaces to minimize the contamination of rainfall run-off;
- Diesel, paints, cements etc should not be stored near the water bodies;

7.4.2.3 Operation Phase

Green buffer all around the project site will include most of the native plant species, which will significantly improve the ecology of the area. This green buffer will provide habitat for the avifauna, reptiles and small mammals and will enhance ecology of the area. In addition, zone of 3 m will be left as no development zone along the length of canal. This zone will also be developed as green buffer. Post development of the economic zone & setting up of industries,

there could be some impacts on the ecosystem of the area. Industrial development will involve generation of emissions, effluents and increased vehicular movements. These all together may have overall negative impact on the eco-system of the site and the nearby areas as the air pollutant will affect the existing vegetation and avifauna in the area. But the industries proposed as per the feasibility study are light engineering, food processing and textile. These industries are not heavily polluting. If appropriate measures for preventing air, water, soil and noise pollution are taken, there will be no significant impact on the ecosystem of the area.

Mitigation Measures

- Periodic monitoring shall be carried out as per the monitoring plan for air, water,noise and soil and ensure that no impact;
- No waste shall be discharged in water bodies, i.e. canal and agricultural land etc.
- Central ETP should install to treat the effluent generated and to re-use and recycleit completely. No untreated effluent should be discharged in water bodies, i.e. canal and agricultural land;
- Tree survival rate shall be monitored;
- Native species should only be planted in the region;

7.4.3 Hydrology

7.4.3.1 Pre-construction Phase

Impact on drainage pattern &hydrology is temporarily expected caused by land modification. After land development of the project site, the adjacent land may inundate by high precipitation and over flow of canal/river water. The existing canal might be affected due to the land filling and increase the sediment concentration therefore some mitigation measures is required.

It was confirmed that the path and the direction of Dhawrakhali canal would be kept intact during all phases of the project. In general, the difference in elevation between adjacent points might change but their sequence would be almost kept unchanged. As a result, surface water flow would not change significantly and would keep its current water flow.

7.4.3.2 Construction Phase

The excavation of retention pond may disturb the existing water for shorter period at monsoon season. After land development of the project site, the adjacent land may inundate by high precipitation and over flow of canal/river water. It was confirmed that the path and the direction of Dhawrakhali canal would be kept intact during allphases of the project. According to the land acquisition plan and the storm water drainage plan, theproject area would be excavated and embanked to attain a level platform with E.L. 6.5 m and general slope would be 0.2% in the direction of the drainage system with Dhawrakhali canal and then toward Brahmaputra River. The excavation and slope protection work would be designed to minimize the excavation volume and slope protection volume as much as possible. In general, the difference in elevation between adjacent points might change but their order would be almost

kept unchanged. As a result, surface water flow would not change significantly and would keep its current water flow.

Water consumed for the construction work and related activities during the construction phase would include water for washing vehicles and equipment, sprinkling water, and domestic water. The source of water during construction will be groundwater. The amount of water consumption is limited and short-term. It can be concluded that water uptake from the groundwater during the construction phase would be very limited and would not cause any significant impact on Ground aquifer as well as Dhawrakhali canal.

Mitigation Measures

- Natural drainage pattern should be maintained. Run-off assessment shall be made of catchment area and peripheral/garland drains shall be constructed around EZ site based on the assessment of catchment area (frequency, and storage area);
- Storm water drain shall have the provision of de-siltation before discharge to river;

7.4.3.3 Operation Phase

Site has been raised with the sand dredged soil from Meghna River. The proposed site will be required to be leveled at 6 to 7m height from MSL after development of the AEZ. The ground level of the zone will be around 1 m above the average flood level. Rainwater drainage ditches will be located on both sides of internal roads and will drain rainwater to the canal located along the 60m main road. A retention pond will be located at the terminal of the canal, and it will have storage functions enabling it to perform the function, preventing the impact of the change of the runoff rate accompanying land preparation, and part of the pump drainage functions during flooding. The rainwater felled in EZ is planned to be discharged to the southern small river as current. The small river merges into Brahmaputra River. For controlling drainage, The flow capacity of the planned canal is, assuming the roughness coefficient is 0.035 and the water surface gradient is 0.02%, about 34.3m^3/s when the water depth is 3.6m (if the canal bottom elevation is considered to be 2.5m, water surface elevation of 6.1m), and it can carry the planned flow rate and a water retention pond of about108,000 $m^3$of water retention capacity will be constructed in the EZ for allowing smooth drainage in gravity during normal weather condition. Also the zone will be protected by an embankment to prevent the zone from flood. If the water level outside the surrounding level is nearly 5m, discharge by natural flow will be difficult, so the gate of the surrounding levee will be closed and the system switched over to pump drainage. No significant impact on drainage is anticipated with development of the zone and its facilities.

Mitigation Measures

- Natural drainage pattern should be maintained. Run-off assessment shall be made of catchment area and peripheral/garland drains shall be constructed around EZsite based on the assessment of catchment area (frequency, and storage area);
- Storm water drain shall have the provision of de-siltation before discharge toriver;

- Management of retention ponds
- Install of additional earth drain line around the boundary ofthe project area if a flood were to occur.

7.4.4 Topography and Geology

7.4.4.1 Pre-construction & Construction Phase

Since the AEZ is being developed in the naturally depressed area filling with dredged soil, the topography of the area is likely to be changed. Due to the significant sand reclamation from the surrounding riverbeds, erosion of the riverbank could occur without proper sand dredging. There will be requirement of road construction for AEZ to connect it with highways and also national power pass through the zone, thus no further excavation is required to electric poles but excavation may required to lay pipeline.

Mitigation Measures

- Save topsoil removed at the start of the project and use it to reclaim disturbed areas upon completion of construction activities.
- Apply protective covering on disturbed soils as quickly as possible.
- Clean and maintain catch basins and drainage ditches regularly.
- Reestablish the original grade and drainage pattern to the extent practicable.
- Obtain borrow material from authorized and permitted sites.

7.4.4.2 Operation Phase

No activities are planned that will cause impact on topography and geology. Therefore, no impacts or impacts are negligible, so no further study is required.

7.5 Social Environment

7.5.1 Involuntary Resettlement

7.5.1.1 Pre-construction& Construction Phase

Land acquisition will be required and some scale of involuntary resettlement is expected. A total of 11 affected households have been identified through a series of resettlement survey. It is likely to have significant adverse impact on this item since more than 55resettlers are predicted. The proposed project required land acquisition and every affected household and landowner will be compensated properly according to government laws (approximately 1500). The entire land was lower agricultural land in the project site. There was no cultural, historical and aesthetic interesting the project land and no loss of sensible place. Detailed data is indicated in the resettlement action plan report.

The Araihazar Economic Zone in Araihazar requires approximately 1000 acres of land in two phases. The entire land selected for the project is private land and need to be acquired. The project phase-1 including canal area requires approximately 540.77 acres of private land need to be acquired. The project phase-1 has very limited impact on living and commercial structures

as well as on trees. Only 11 households will be displaced from the project area. Summary of project phase-1 is presented in below Table. The total estimated cost to be incurred for implementation of the RAP is about BDT 4,823,744,801(four hundred eighty two crores thirty seven lac forty four thousands eight hundred and one taka only) including 2% contingency provision.

Table 7-2: Summary of Impact

Descriptions	Unit	Quantity
Land required for the project phase-1	Ha.	219.21
Land to be acquired	Acre	541.47
Affected Households	Nos.	1714
Households losing structures	Nos.	11
PAPs losing land	person	6343
Affected Living & Commercial Structures	sft	6282.95
Affected Secondary Structures		
Tube – Well	No.	12
Pucca Latrine with safety tank	No.	1
Slab Latrine	No.	8
Tin Made Boundary Wall	rft	265
Affected Trees	Nos.	1055
Identified Vulnerable Households	Nos.	150
Identified Sharecropper	Nos.	23

Source: EQMS survey, December 2017

Mitigation Measures

- Proper resettlement action Plan (RAP);
- Provide adequate compensation in time to PAPs;
- The authority should be careful and take necessary measures that every displacedpeople can be resettled as per law of the land;
- Provisions for cash compensation of acquired land, affected structures, trees and other assets at full replacement cost. Provisions for appropriate resettlement assistance i.e. cash grant as transitional allowances.
- The ILRP will be carried out to assist the APs to develop new activities, priority for employment in AEZ, skill development training and to explore better income sources.

7.5.1.2 Operation Phase

No impacts or impacts are negligible, so no further study is required.

7.5.2 Vulnerable Group

7.5.2.1 Pre-construction/Construction Phase

In Araihazar Economic Zone project, out 1,714 households a total of 150 (8.75%) households were identified as vulnerable. Among them 25 are female headed having no male income earner, 58 are elderly headed and 67 were identified as extreme poor. Vulnerable households in the project phase-1 including retention pond area are presented in below Table categorically.

Table 7-3: Affected Vulnerable AHs.

Vulnerable Category	Total	%
Female Headed AH without male income earner	25	16.67
Elderly Headed Households (70+)	58	38.66
Households belonging below poverty line (96000 BDT yearly income)	67	44.67
Total	**150**	**100.00**

Source: EQMS survey, December 2017

Vulnerable people in the project area would be affected. On the other hand, job opportunity and commercial activities would increase during construction activities.

Mitigation Measures

- Promoting payment of compensation in joint name of husband and wife;
- Provide soft skill jobs (physically benign) and employment opportunities for vulnerable that may increase their participation and support them with income and livelihood.
- Organising women in self-help group to operate canteens in the EZ;
- Giving preference in physically less demanding jobs in the EZ such as cleaning, office assistant, computer operator etc ;
- Ensure non-exploitation of women in terms of equal wage, opportunity, participation indecision making etc.
- Create awareness among the workers, staff and women about the exploitation and sexual harassment at work place;
- Create awareness about sexually transmitted disease, HIV/AIDS, exploitation etc; and
- Implementation of social welfare programs targeted at vulnerable groups including old aged, physically handicapped etc. under CSR programs and activities

7.5.2.2 Operation Phase

The vulnerable groups identified for the Project are those old and aged, physically handicapped and destitute individuals that are potentially affectedly the project activities. Although women are also considered as a vulnerable and marginalized group, the impacts on the same have been identified and assessed separately. These groups of people are at a greater disadvantage or susceptible to more risk due sudden change in their socio-economic environment. The primary reasons for their vulnerability are:

- Limited control over family resources;
- Limited say in utilization of compensation money;
- Lack of capacity to adapt to changes in their socio-economic scenario; and
- Limited skill base to support alternative occupations or earning mechanisms.

The Project should ensure that land acquisition and related aspects should not result in any additional vulnerability. In case such vulnerabilities arise appropriate measures should be taken to mitigate adverse impacts. Measures from vulnerable groups are mostly in relevance to employment and livelihood opportunities created from the project activities. Livelihood restoration plans should have special emphasis on these vulnerable groups and communities such as the landless, aged and the disabled groups so as to have a positive impact in terms of income and livelihood, skill development, poverty alleviation, sustenance as well as overall participation levels. However, these same groups are also at increased risk of being marginalized and at the low end of receiving project benefits due to their physical condition, awareness levels, low skill base, age, disability, illiteracy etc. due to which other groups may be given preference.

7.5.3 Indigenous and ethnic people

7.5.3.1 Construction Phase

No indigenous/ethnic people live in the project affected area. No impacts or impacts are negligible, so no further study is required. According census and SES in 2017 conducted by EQMS consulting Ltd, no indigenous or ethnic minority populations were identified in the project phase-1 area.

7.5.3.2 Operation Phase

No impacts are expected, so no further study is required.

7.5.4 Local Economics, Such as Employment, Livelihood

7.5.4.1 Pre-construction& Construction Phase

PAPs who earn income from paddy fields and/or vegetable fields might lose their income source. Many sharecroppers (approximately 1714) depended on agriculture in dry season. They cultivate IRRI and vegetable that period. According to the census and SES findings, most of the affected household head (66.45%) are engaged with agricultural activities. About 248 including five women household head are doing business for their livelihood. Only 23 persons were identified as sharecroppers in the project area. A detail of occupation distribution of affected household head is presented in below

Table 7-4: Distribution of Occupation of Affected Household Head

Name of Occupation	Male		Female		Total	
	N	%	N	%	N	%
Agriculture	1110	64.76	29	1.69	1139	66.45

Name of Occupation	Male		Female		Total	
	N	%	N	%	N	%
Teacher	10	0.58	3	0.18	13	0.76
Abroad worker	10	0.58	0	0.00	10	0.58
Private Job	94	5.48	5	0.29	99	5.78
Household work	0	0.00	165	9.63	165	9.63
Fishing	1	0.06	0	0.00	1	0.06
Business	243	14.18	5	0.29	248	14.47
Day Labor	2	0.12	0	0.00	2	0.12
Mason	9	0.53	0	0.00	9	0.53
Tailor	4	0.23	3	0.18	7	0.41
Driver	2	0.12	0	0.00	2	0.12
Elder Person	14	0.82	5	0.29	19	1.11
	1499	**87.46**	**215**	**12.54**	**1714**	**100.00**

Source: EQMS survey, December 2017

On the other hand, increase of job opportunity as construction workers or commercial opportunity targeted to the workers is expected.

Mitigation Measures

- Income loss can be mitigated by providing alternative job opportunities for PAPs;
- Provide proper compensation to farmers and sharecroppers as per LAP
- All direct income loss must be adequately compensated within the RAP;
- A major segment of the population on the area is unemployed. Construction activity will provide employment to huge nos. of people including skilled, unskilled and non-skilled workers. This will improve the quality of life of people;
- Provision of proper training to all workers for handling the construction equipment;

7.5.4.2 Operation Phase

Long-term livelihoods will be impacted by the project. As Araihazar agrarian economy, a good percentage of the population is dependent on agriculture as an income resource. Families are taking paddy crops from their fields on an annual basis.

Consultations with select landowners (that were identified during the course of the social survey) suggest that most direct impact of land loss has been in terms of loss of earning. Stakeholders also suggest that loss of income or livelihoods will not expected to be significant for the land being acquired currently. This is due to the fact that the land is put to limited use by the affected people (it is flooded for a significant part of the year and cannot be used for agricultural purposes).

On the other hand, increase of job opportunity as workers of the industries or commercial opportunity targeted to these workers is expected. The proposed project will employ about 10,000 persons for operation and maintenance. Most of the skilled employees will be accommodated in the rented accommodations in Araihazar. This along with other project related requirements like workers, security, housekeeping, gardening etc. will create a constant requirement for labour, though very high in numbers. In addition, raw material and necessities for the functioning of the Economic zone could be sourced from the local areas, thus creating several opportunities for local suppliers and contractors for a variety of resources and commodities.

Mitigation Measures

- Income loss can be mitigated by providing alternative job opportunities for affected peoples;
- Provision of proper training to all workers for handling the construction equipment;
- A major segment of the population on the area is unemployed. Operation activities will provide employment to huge nos. of people including skilled, unskilled and non-skilled workers. This will improve the quality of life of people;

7.5.5 Land Use and Utilization of local resources

7.5.5.1 Pre-construction Phase

Total land of the project site is seasonally agricultural land. During the monsoon season the proposed land is submerged by the Dhawrakhali canal water which is connected to the river. In the pre-construction phase, the temporary storage and stockyard are built up on the agricultural lands, and then the crop production will be obstructed in those areas. Crops will also be damaged when the equipments, and heavy vehicles will pass through agricultural fields of the proposed project areas.

Mitigation Measures

- Plantation area which will be tentatively occupied during pre-construction, will be restored to original state and returned to the land owner after construction.

7.5.5.2 Construction Phase

The 540.77 acres of agricultural land will be altered by the industrial zone. So the annual agricultural production rate of that upazila will diminish. In the project site, land is single cropped agricultural land so the impact on agriculture activities/ resources is anticipated to have a low significant impact from the project development.

Mitigation Measures

- Plantation area which will be tentatively occupied during construction, will be restored to original state and returned to the land owner after construction.

7.5.5.3 Operation Phase

Total 540.77 acres land is required for 1st phase of AEZ. Further land may be needed for the 2nd phase of economic zone development. No impact on agriculture resources is anticipated from economic zone development during the operation phase. So, no impacts are expected.

7.5.6 Water Usage

7.5.6.1 Pre-construction Phase

No impacts or impacts are negligible; no further study is required;

7.5.6.2 Construction Phase

Since Araihazar EZ sites do not have existing public water supply facilities, it is necessary to utilize the nearby rivers or wells as water sources. Ground water will be used in the during the construction phase. Therefore, Excessive withdrawal of ground water may lead to depletion of aquifers. Source of water of these activities will be the ground water from own borehole.

The water source will be approximately 200m deep wells. A past survey estimated the arsenic contamination concentration to be low enough to not be a problem. Excessive withdrawal of ground water may lead to depletion of aquifers. Measures should be taken to minimize the water extraction by reducing water consumption and wastage. Mitigation measures are given below.

Mitigation Measures

- Rain water harvesting ponds should be constructed so as to store rain water for construction activities;
- Water for curing can be saved by carrying out curing in early morning or late evening and covering structures with gunny bag so as the moisture can be restored for longer time;
- Regular inspections at site to monitor leakages in water storage tanks;
- Creating awareness among construction workers about the importance of water conservation;
- Adoption of the advance technologies and machinery which helps in minimizing water requirement for construction;
- Storing the curing run-off and waste from other construction activity and using the same for sprinkling;
- Covering the water storage tanks at site to prevent evaporation losses;

7.5.6.3 Operation Phase

It is obvious that there will be thousands of employees and workers who will use and consume water and generate wastewater from the office and the residential building. It is estimated app. 7,000 Cubic meter per day of water will be required during operation phase after development of Araihazar economic zone at Araihazar, Narayanganj. The water demand can be fulfilled by withdrawing ground water through the water supply system to be developed by the project.

During the operation phase a plant of which water demand is about approximately 7,000m^3/day.

Distribution in Groundwater of Dhaka Surrounding Area and EZ Site Well testing should be conducted before the implementation stage. The position, the depth, and the interval of wells should be determined based on the confirmation of the water supply capacity, the water level recovery time, and the change of groundwater level, which were confirmed by using the value of the aquifer depth, the water quality, and pumping test that were collected during well testing. Moreover it is necessary to prevent excessive depletion of wells due to excess water usage and the subsidence of surrounding ground.

Following Measures should be taken to minimize the impacts on water usage.

Mitigation Measures

- Rain water harvesting system and storage should be developed to minimize ground water extraction;
- Centralized rainwater harvesting system will be implemented;
- Treated effluent will be recycled;
- Water efficient technologies will be adopted in central utility service divisions and also at the factory process level;
- Adoption of best management practices to prevent water wastage and minimize water loss;
- Usage of water conservation fixtures to minimize water consumption;
- Installation of leakage detection system to minimize the water loss;
- Regular monitoring of ground water level in the area should be carried out. Estimated should be made to calculate the draught and recharge of the ground water aquifers. More green space will planted to foster aquifer recharge;
- Ground water aquifer assessment studies may be undertaken to assess the ground water potential. Peizometer shall be installed to monitor variation in groundwater level in the area.

7.5.7 Existing Social Infrastructures and Services

7.5.7.1 Pre-construction& Construction Phase

No impacts or impacts are negligible

Impact to Relocated PAHs of the Project

Accessibility of PAHs to social Infrastructure/service would be affected more or less due to the relocation. On the other hand, the proposed relocation site will be arranged with basic social infrastructures as a part of the assistance by the project.

Impact to Local People in the local Community of the project area

Accessibility of social infrastructure/ service will be affected due to the increase of construction vehicles. The traffic volume should be controlled by construction contractor to avoid serious traffic congestion.

Mitigation Measures

- Proper detailed design is going to be done and the utilities line will be diverted before starting the construction activity

7.5.7.2 Operation Phase

No impacts or impacts are negligible

Accessibility to social infrastructure would be limited by the existence of the industries. On the other hands, it is planned to construct community road which has alternative function in order to keep the accessibility of the existing road for the local community. In addition, basic infrastructures such as the existing road, gas pipeline and power supply will be improved due to the ongoing infrastructure development projects around Araihazar Economic Zone.

7.5.8 Social Institutions Such as Social Infrastructure and Local Decision making institutions

7.5.8.1 Pre-construction/ Construction Phase

Impact to Relocated PAHs of the Project

Accessibility of PAHs to social Infrastructure and local decision making institutions would be affected more or less due to the relocation. On the other hand, the proposed relocation site will be arranged with basic social infrastructures and institutions as a part of the assistance by the project

Impact to Local People in the local Community of the project area

Accessibility of social infrastructure and institutions will be affected due to the increase of construction vehicles. The traffic volume should be controlled by the construction contractor to avoid serious traffic congestion.

7.5.8.2 Operation Phase

Accessibility to social infrastructure and institutions would be limited by the existence of the industries. However, it is planned to construct a community road having an alternative function in order to keep the accessibility of the existing road for the local community. In addition, basic infrastructures such as the existing road, gas pipeline and power supply will be improved due to the ongoing infrastructure development projects around Araihazar Economic Zone.

7.5.9 Misdistribution of Benefits and Damages

7.5.9.1 Pre-construction Phase

Only land owner and property owners and affected labours will be eligible for the compensation and rehabilitation. Displaced people may be suffered at the proposed project sites

Mitigation Measures

- Prepare RAP involving the following measures
  - Assessed compensation will base on the market price
  - Payment will be carried out before resettlement
- Establish external monitoring committee consists of the third party

7.5.9.2 Construction Phase

Not everybody could benefit from the construction work due to limited requirements and preferences of the contractors.

Mitigation Measures

- Prepare RAP involving the following measures
  - Assessed compensation will base on the market price
  - Payment will be carried out before resettlement
- Establish external monitoring committee consists of the third party

7.5.9.3 Operation Phase

No impacts or impacts are negligible, so no further study is required.

7.5.10 Local Conflict of Interest

7.5.10.1 Pre-construction Phase

No impacts expected or impacts are negligible, so no further study is required.

7.5.10.2 Construction Phase

Due to employment, opportunity will be increasing during construction; candidates of construction workers may have some conflicts between communities.

Mitigation Measures

- Job opportunities should be provided in fair way;
- Clear information about the needs of labor (number and qualification) should be provided with local people;
- The job skills and the priority for the affected people shall be taken into account and the workers can be chosen;

7.5.10.3 Operation Phase

No impacts or impacts are negligible

Misdistribution of benefits and damages would occur since there are PAHs who lose their income source, while there are people who would get job opportunity as workers of the industries. However, more than 10,000 people will be involved directly in this Economic zone. Therefore, in the operation phase the impact will be negligible.

7.5.11 Cultural Heritage/Asset

7.5.11.1 Pre-construction, Construction & Operation Phase

Nothing found in the development area would be affectedly the development. Therefore, no impact is expected on cultural heritage due to proposed project implementation.

7.5.12 Landscape

7.5.12.1 Pre-construction& Construction Phase

No impacts or impacts are negligible

The landscape will be changed by the construction work of Araihazar Economic Zone. Moreover, 218.84ha or 540.77 acres of agricultural land will be cleared and altered to industrial area as the part of Economic Zone development. All construction activities for administration building, land filling & boundary wall will be carried out within economic zone site and will not cause any impact on landscape and scenic beauty. A green buffer of 3.5 m only one row of trees will be developed all around the project site which will enhance the scenic beauty of the area.

7.5.12.2 Operation Phase

Landscape of EZ site is naturally depressed area which will be changed to industrial land use after development of EZ site. No major change in landscape is associated with the development of the EZ zone and other off-site facilities. Majorly land use is agricultural land, settlement and wetland area. Development of EZ will attract more infrastructural development around the project site to facilitate industrial growth changing the land use area from agriculture to industrial land use. Some of the other developments including construction of roads, housing facility, commercial areas including hotels, hospital, restaurants, schools, ancillary industries, cottage industries, etc may also occur in nearby areas. This will lead to change in landscape but will lead to significant development of the area.

Although semi-urbanization of landscape in and around Araihazar Economic Zone is inevitable, the development will be implemented under the project proponent internal regulation which rules to secure the environmental friendliness for users and residents, and harmonization with the surrounding area. In addition, greening area will be established in each plot and public space. Therefore, as long as the industries follow the internal regulation and the project proponent will make effort to maintain the public area, the landscape of the project area is expected to be well-maintained semi-urbanized area.

Mitigation Measures

- Following the rule of landscape in accordance with proposed industrial internal regulation

7.5.13 Gender

7.5.13.1 Pre-construction& Construction Phase

Despite cultural practices, no gender specific issues are observed and expected in the project area. No impact or impacts are negligible, no further study required.

7.5.13.2 Operation Phase

Project activities do not attract gender issues. No impact or impacts are negligible, no further study required.

7.5.14 Children's Right

7.5.14.1 Pre-construction& Construction Phase

The following item was examined to forecast the impact:

- May impact on educational opportunity of school going children in PAHs of the Project;
- May impact on educational opportunity of school going children in local community;
- Impact of the project on increase of child labor;

Child labor at the construction site during the project implementation shall be strictly prohibited since both Bangladesh laws and JICA guidelines ban such practices. The RAP Implementing Agency and EZ authority shall regularly monitor project sites to guide contactors and their related firms to discourage child labor. A contract between contractor and EZ authority shall include provisions for prohibition of child labor. When the child labor will be detected, the RAP Implementing Agency shall immediately report to EZ authority and EZ authority shall take necessary and decisive actions including suspension and/or rescind of the contract (if the case is extremely malicious) to the violating firms based on the applicable laws and regulations of Bangladesh.If root cause of the child labor originated from impoverished living standard of project affected families due to improper or insufficient relocation assistance, EZ authority through RAP Implementing Agency, will provide the following assistance to parents of working child:

(1) Support of sending children to school;
(2) Helping the parents with hunting for a job, including the one at the construction site;
(3) Mediation for micro credit loan;
(4) Introducing them to assistance organizations such as NGO and so forth;

7.5.14.2 Operation Phase

There are 11 affected households who have school going children's. They must be relocating to other places and these children's educational opportunity will be temporarily disrupted due to the relocation. Currently, majority of the children of PAHs in the project area go to school in

and around Araihazar Economic Zone area. For primary school (Sonpara) students, they mostly go to schools in the nearest villages such as located outer boundary of Araihazar Economic Zone.

The project proponents will implement "EZ neighbors students Support Program" as one of the community support programs targeting not only for children of PAH but also for surrounding communities. This program has contributed to provide more educational opportunity to children in the surrounding area of Araihazar EZ and it is estimated that more than 1,000 students will be benefited from these activities in the local community. In addition, the project proponent will implement this kind of educational program continuously based on needs and requests from the community. Based on above, the educational opportunity is expected to improve by the effort of the project proponent in the local community.

According to the Labour Law of Bangladesh 2006, the minimum legal age for employment is 14. However, as 93 per cent of child labourers work in the informal sector – in small factories and workshops, on the street, in home-based businesses and domestic employment – the enforcement of labour laws is virtually impossible. As mentioned above, as long as the Project and industries keep laws in Bangladesh, illegal child labor will be prevented in employment of labors. Hence, it is judged that the Project would not cause any significant negative impact on children's right in the surrounding area.

7.5.15 Infectious Diseases

7.5.15.1 Pre-construction Phase

No impact or impacts are negligible, no further study required.

7.5.15.2 Construction Phase

The entire construction phase is expected to continue for about 3 years. This will require labour of unskilled, semi-skilled, skilled and highly skilled nature. However, it is envisaged that outsourced personnel will comprise mostly of skilled labourers and workers. During Construction, in general, a lot of migrant workers flow into the sites, who may have the possibility with HIV/AID and the disease can spread among local people.

Mitigation Measures

In order to minimize the impact, preventive measures against such diseases, which is stipulated in the Environment, Health, and Safety (EHS)Guidelines of the International Finance Corporation (IFC), should be considered and implemented by construction contractor.

- To provide surveillance for worker's health;
- Prevention of illness among workers by undertaking health awareness and education initiatives and by conducting immunization programs for workers;
- To provide treatment through standard case management in on-site and community health care facilities as necessary;

- Educating project personnel and area residents on risks, prevention, and available treatment;
- Promoting collaboration with local authorities to enhance access of worker's families and the community to public health services and promote immunization as necessary;
- Promoting use of repellents, clothing, netting, and other barriers to prevent insect bites;
- Prevention of larval and adult propagation through sanitary improvements and elimination of breeding habitats close to human settlements;
- Elimination of unusable impounded water;

7.5.15.3 Operation Phase

This is a possibility to increase the risks of infectious diseases due to influx of workers of the industries and the semi-urbanization of the project area and its surroundings area.

Mitigation Measures

An HIV-AIDS awareness campaign via approved service provider shall be implemented another measures to reduce the risk of the transfer of the HIV virus between and among contractor's personnel and local community, to promote early diagnosis and to assist affected individuals. Proposed mitigation measures has been given below

- Conduct mitigation measures stipulated in the international guidelines such as EHS Guidelines of IFC
- To conduct Information, Education and Consultation Communication (IEC) campaign at least every other month to all site staff, employees, and immediate local communication concerning the risks, dangers and impact and appropriate avoidance behavior with respect to, of Sexually Transmitted Disease (STD) or Sexually Transmitted Infection (STI) in general and HIV/AIDS in particular,
- To provide male or female condoms for all staff and laborers as appropriate and
- To provide for STI and HIV/AIDS screening, diagnosis, counseling and referral to dedicated national STI and HIV/AIDS program.

7.5.16 Working Conditions, Including Occupational Safety

Working conditions are at the core of paid work and employment relationships. Working conditions cover a broad range of topics and issues, from working time (hours of work, rest periods, and work schedules) to remuneration, as well as the physical conditions and mental demands that exist in the workplace. Occupational safety and health (OSH), also commonly referred to as occupational health and safety (OHS), occupational health, or workplace health and safety (WHS), Community Health & Safety is a multidisciplinary field concerned with the safety, health, and welfare of people at work. The details of Occupational Health & Safety, Community health & Safety& Risk of fire are given in Section 7.5.17 to Section 7.5.19.

7.5.17 Occupational Health and Safety

7.5.17.1 Pre-construction Phase

No impact or impacts are negligible, no further study required.

7.5.17.2 Construction Phase

There would be a possibility to occur accidents and incident during construction works for the implementation of the Project. Physical trouble, Noise, vibration, lighting, electrical, heat and cold, nuisance dust, fire/explosion, machine grinding, working space, Chemical, Gases, dusts, fumes, vapours, liquids are the major hazards which are harmful for workers health. In order to prevent accidents and incidents, the project proponent regulates to install security and maintain safety prevention measures and devices suitable for using in each plot for construction in the internal regulation. Therefore, construction contractor based on the international guidelines should manage the working condition during the construction.

Mitigation Measures

- To provide adequate health care facilities and first aid within construction sites;
- To provide OHS training program and information of basic site rules of work, basic hazard awareness, site specific hazards, safe work practices, and emergency procedure;
- To provide adequate lavatory facilities for the number of people expected to work in the facility;
- To provide adequate supplies and easy access of drinking water with a sanitary
- To provide temporary shelters to protect against heat stroke during working activities or for use as rest areas as needed;
- To arrange for provision of clean eating areas where workers are not exposed to the hazardous or noxious substances where there is potential for exposure to substances poisonous by ingestion of food as necessary;
- To promote the use of repellents, clothing, netting, and other barriers to prevent insect bites and snake bite;
- Adequate preventive measures from negative factors such as fire precautions, lighting, safe access, work environment temperature, area signage, labelling of equipment, communicate Hazard codes, electrical;
- To establish rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures, and control of traffic patterns or direction;
- To identify and provide appropriate PPE that offers adequate protection to the worker, co-workers, and occasional visitors;
- Proper maintenance of PPE and the instruction of proper use;

7.5.17.3 Operation Phase

During operation phase each industry will start their operation, accidents or incidents are expected to occur more or less during the operation phase. Physical trouble, Noise, vibration, lighting, electrical, heat and cold, nuisance dust, fire/explosion, machine grinding, working

space, Chemical, Gases, dusts, fumes, vapours, liquids are the major hazards which are harmful for workers health. As same as construction phase, the project proponent regulates to install security and maintain safety prevention measures and devices suitable for use in each plot for operation as well in the internal regulation in order to prevent accidents and incidents. Based on the rules, the respective industries should prepare and implement appropriate mitigation measure under the respective impact assessment based on the international guidelines. Especially during the rainy season, countermeasures toward intense heat should be well prepared by each industry, while the project proponent will continuously give announcement to the operation period for the prevention of heat stroke. In addition, the accommodation for workers will be arranged according to the project proponent of logistic, residential and commercial area in order to provide dwelling place for them. Since the type of business is different in each industry, the mitigation measure should be prepared for the respective occupational risk based on the operation plan and working condition of each industry.

Mitigation Measures

- To provide adequate health care facilities and first aid within construction sites of industries or operation phase;
- To provide OHS training program and information of basic site rules of work, basic hazard awareness, site specific hazards, safe work practices, and emergency procedure;
- To provide adequate lavatory facilities for the number of people expected to work in the facility;
- To provide adequate supplies and easy access of drinking water with a sanitary means to provide temporary shelters to protect against heat stroke during working activities or for use as rest areas as needed;
- To arrange for provision of clean eating areas where workers are not exposed to the hazardous or noxious substances where there is potential for exposure to substances poisonous by ingestion of food as necessary;
- To promote the use of repellents, clothing, netting, and other barriers to prevent insect bites and snake bite;
- Adequate preventive measures from negative factors such as fire precautions, lighting, safe access, work environment temperature, area signage, labeling of equipment, communicate hazard codes, electrical;
- To establish rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures, and control of traffic patterns or direction;
- To identify and provide appropriate PPE that offers adequate protection to the worker, co-workers, and occasional visitors;
- Proper maintenance of PPE and the instruction of proper use;

7.5.18 Community Health and Safety

7.5.18.1 Pre-construction Phase

No impact or impacts are negligible, no further study required.

7.5.18.2 Construction Phase

It is envisaged that during the construction phase activities, a lot of the material and heavy equipments is scheduled to be brought to the site in vehicles via the inner access roads. Some of these impacts associated specifically with roadways are:

- Traffic congestions on roads and possible disruption to the community usage during peak movement hours;
- Increased risks with respect to safety associated with traffic movement;
- Inconvenience to community in terms of air and noise pollution caused by the movement of vehicles; and
- Structural and surface damage to road due to movement of heavy vehicles and equipments

Apart from the traffic, other community health and safety impacts resulting from the construction phase of activities would typically include (but not be limited to):

- Generation of dust, noise and odour from the construction site which may have health related impacts on the local community;
- Fire Safety from the ongoing construction activities which may include handling and storage of flammable chemicals and materials;
- Improper disposal and migration of sewage into the surroundings;
- Improper disposal of sewage and waste may lead to contamination of ground water, as the water table in the project area is very high.
- Any waste disposal in canal from the project would affect the population in downstream of water flow

Potential impacts during the construction period on existing infrastructure and community health and safety is expected to be moderate. With the implementation of the following mitigation measures the potential impacts will be further reduced.

- Provision of infrastructure for migrant labour such as water supply, electricity, sanitary facilities, medical aid and other basic amenities to avoid dependence on limited local resources;
- Proper disposal of wastes generated from the camp and construction activity to maintain general hygiene in the area;
- Creating awareness among the drivers about speed, traffic safety, use of horns etc while driving through settlement areas;
- Covering of trucks while carrying soil, sand, cement, aggregates etc to minimise spread of dust and spill over;
- Avoiding unnecessary movement of vehicle through settlement area to minimise disturbance and traffic safety related issues;

- Creating awareness among children, women, and old age people in particular and the community in general on traffic safety by using existing mediums such as school, women self help groups, village union and religious occasions;
- Strengthening and regular maintenance of village road to minimize surface and structural damage of road;
- Sprinkling of water to suppress dust generation in the construction zone;
- Provide training and create awareness about fire and safety among workers at site;
- Disposal of wastes at pre identified waste dumping site to avoid unauthorized dumping;
- Avoid disposing of wastes in the canal and providing silt traps to arrest silt flowing into the canal during the rainy season.

7.5.18.3 Operation Phase

The health and safety risks in the plant during operations include potential for respiratory diseases, burns, allergies and industrial accidents among the employees and immediate neighboring communities if adequate mitigation measures to prevent the above are not implemented. In addition, local public health centres may report an increase in cases involving respiratory ailments like coughing, phlegm; eye irritation etc. due to the dust and particulate matter from operations.

Traffic: The impacts envisaged from the project activities on with respect to community usage of access roads are mostly confined to the construction phase as well as operation phase when the resource movement in and out of the site is higher. Also, the local people would bebenefitted from the strengthening of road connecting the access road to the Project site.

Influx: Apart from the operation phase, skilled technicians and operators are also likely to be sourced for operating the plants/industries once it goes into operation. It is envisaged that during that phase these technicians would be housed in rented accommodation in and around Araihazar. This population however would be significantly higher accounting to almost 2000families due to which the associated impacts accounted for the operation phase. Also, the positive implications observed during construction phase would continue in operation phase.

Health and Safety: The key health & safety impacts on the local community during operation phase include:

- Emission & Noise generated from the operation of the industries. These emissions may include compounds of Nitrogen and Carbon which may be harmful to the surrounding community;
- Fire & Explosion Hazards;
- Improper sewage and waste disposal;

Mitigation Measures

Possible impacts to the community's health and safety during the operation phase of the project are health related, traffic issue and issues arising out of the influx of migrant populations.

Mitigation measures recommended for community health and safety impacts during operation phase of the Project are as:

- Adequate provision for suppression of dust and particulate matter originating at source;
- Provision of first aid box and trained personnel to deal with minor cut, bruise and burn;
- Provision of paramedic staff and ambulance in industry site for serious bodily injuries;
- Developing a disaster management plan and community health and safety plan to deal with emergency situations;
- Regular training of plant personnel on health and safety aspects;
- Creating awareness among the general public around the plant about possible emergency situations and way to respond to them;
- Develop an influx management plan to address the influx related issue;
- Release of nitrogen and carbon compounds within permissible limit so that human health is not affected;
- Disposal of wastes in pre identified and approved locations.

7.5.19 Risk of Fire

7.5.19.1 Pre-construction Phase

No impact or impacts are negligible, no further study required.

7.5.19.2 Construction Phase

Risk of fire might increase due to the implementation of the construction work for the Project. Labour's camp will face high risk of fire at construction period. Faulty electrics are the biggest cause of workplace fires, loose wires, plugs that are over loaded and old equipment can all make for a potential death trap. Discarded cigarettes can cause fires if not put out and disposed of properly in the project area. Smoking can be especially hazardous if it is allowed to take place near areas where flammable materials are present. It has to be said that one of the most common causes of fires in the workplace is human error. Fires can occur as a result of negligence in a variety of different ways including improper use of equipment, accidents, drinks being spilt over electrical equipment and leaving cooking unattended.

However, it would be limited because the Araihazar Economic Zone authority will regulate and apply the "building construction and fire safety" rules in the project area. According to the rules include the following drawings: 1) architectural drawings (layout plan, finishing schedule, floor plans, elevations and sections), 2) means of egress (fire escape plan), 3)emergency lighting and exit signs, 4) fire alarm and detection system, 5) emergency generator, 6) firehydrant (hose reel), 7) fire extinguisher, 8) sprinkler (if necessary), 9) dry riser/ breeching inlet (ifnecessary), 10) lightning arrester, 11) hazardous material safety plan etc.

Mitigation Measures

- To minimize the impact, the abovementioned rule and the internal regulation for the Economic Zone of Araihazar will be applied and obligate industries to install appropriate security and safety system for their implementation;
- Maintain safe housekeeping practices that reduce the risk of fire danger;
- Implement a program that includes preparation, prevention, and recognition of fire Risk;
- Proper handling of combustible and flammable material;
- Keep all fires and heaters well-guarded, especially open fires;
- Keep portable heaters and candles away from furniture and curtains;
- Don't dry or air clothes over or near the fire, or the cooker;
- Do not smoke in the project site;

7.5.19.3 Operation Phase

Risk of fire would increase due to the economic activities of the industries and population growth in and around the project area. Electrical systems that are overloaded, resulting in hot wiring or connections or failed components might occur at operation phase.

Mitigation Measures

- To minimize the impact, the abovementioned rule and the internal regulation for the Economic Zone of Araihazar will be applied and obligate industries to install appropriate security and safety system for their operations;
- The industries shall install and maintain an effective fire alarm system and firefighting system for each building in the plot, and implement emergency drill with reference to the rule and regulation;
- Implement a program that includes preparation, prevention, and recognition of fire Risk;
- Proper handling of combustible and flammable material;
- Do not smoke in the project site;
- Fit approved smoke detectors on each floor. Choose a smoke alarm that is mains operated or one with a long life (ten year) battery;

7.6 Others

7.6.1 Accidents

7.6.1.1 Construction Phase

Construction accidents and road accidents around the project site are expected due to the construction activities. Construction workers can have harmful and critical troubles.

Excavation of retention pond and access road construction period, contractor will appointed many workers for civil work and there are some possibilities to occur accidents. Improper traffic management and safety issue can increase this problem significant.

Mitigation Measures

- Follow Health and Safety Management Plan (HSMP) rules and regulations designated by contractors;
- Provision of traffic sings, road mark, bump, zebra mark, guard rail and pole, and curb stones etc;

7.6.1.2 Operation Phase

Road accidents would be increased due to industrial vehicles and commuter buses and motor lines.

Mitigation Measures

- Follow Health and Safety Management Plan (HSMP) rules and regulations designated by contractors;
- Provision of traffic sings, road mark, bump, zebra mark, guard rail and pole, and curb stones etc

7.6.2 Transboundary impact and climate change

Climate change may refer to a change in average weather conditions, or in the time variation of weather within the context of longer-term average conditions. Climate change is caused by factors such as biotic processes, variations in solar radiation received by Earth, plate tectonics, and volcanic eruptions. Certain human activities have been identified as primary causes of ongoing climate change, often referred to as global warming.

7.6.2.1 Pre-construction Phase

Impacts are negligible, no further study required.

7.6.2.2 Construction Phase

Although construction machines and vehicles generate greenhouse gases, quantities of generated gases do not give serious impact and negligible on this item. To minimize GHG emission during the construction phase, mitigation measures shall be taken by the contractor, such as management of operation time of construction machineries, avoidance of excessive loading operation, and education of construction workers/drivers about the idling stop practice for construction machineries and vehicles.

- Control of GHGs emission in the construction period;

7.6.2.3 Operation Phase

Amount of emission of Carbon Dioxides (CO_2) based on the increase of vehicles. But Emission from construction vehicles/equipments is negligible compared to the number of passing vehicles daily. In addition, energy-saving equipment and fuels that emit less GHG will be recommended to be installed to all tenants for their operations as much as possible. Besides, the utilization of commuter bus for workers to reduce traffic GHG emission will be initiated by the tenants.

Mitigation Measures

- Control of GHGs emission by energy use efficiency, process modification, selection of fuels or other materials, the processing of which may result in less emission, application of emission control techniques, if possible;
- Provision of commuter bus;

CHAPTER 8

8. ENVIRONMENTAL& SOCIAL MANAGEMENT PLAN AND MONITORING INDICATORS

8.1 Introduction

The Environmental Management Plan (EMP) is the synthesis of all proposed mitigation and monitoring actions, set to a time frame with specific responsibility assigned and follow-up actions defined. EMP is a plan of actions for avoidance, mitigation and management of the negative impacts of the project. Environmental & Social enhancement is also an important component of EMP. A detailed set of mitigation measures have been compiled in view of the likely impacts associated with the proposed off-site development in Araihazar Economic Zone.

The EMP consists of a set of mitigation, monitoring and institutional measures to be taken during the design, construction and operation (post-construction) stages of the project. The EMP has been designed keeping in view the regulatory and other requirements to ensure the following:

- Minimum disturbance to the native flora and fauna
- Compliance with the air, water, soil and noise quality norms
- Conservation of water to the extent possible through rain water harvesting, wastewater recycling

8.2 Mitigation Plan

The proposed off-site developments may have some impacts on the environment and society such as change in land use, removal of vegetation, increased dust emissions etc. Health & Safety Plan along with the EMP has been drafted. Details of which are given below. All offsite facilities shall be constructed by BEZA. EMP implementation shall also be BEZA who will intern implement it through contractor.

8.2.1 Mitigation Plan for Pre-Construction, Construction Phase& Operation Phase

A summary of mitigation measures identified for the pre-construction, construction& operation phases of the Project is presented in ***Table 8-1***. This also identifies lead responsibility for implementing the mitigation measures and sources of funds for such implementation.

Table 8-1: Environmental& Social Mitigation and Management Plan (Pre-construction, Construction & Operation Phase)

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
Pre-construction Phase						
Environmental Pollution	Air Pollution	• Involve site clearance, leveling & filling activities for development of EZ which generate air pollution • Clearance of site will involve removal of wild vegetation, land leveling & filling activities. These activities will lead to dust generation	• To minimize the dust generation, water should be sprinkled regularly at the site and low sulphur diesel should be used in land leveling equipments to control the SO_2 emissions	Appointed Contactor	BEZA	Contractor Cost
	Water Pollution	• Impact on water quality from muddy water flowing to the river due to land reclamation work is expected • Dredged soil may contaminate the canal by runoff water during rain	• Avoid excavation activities during rain; • Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Minimize run-off by using sprays for curing; • Proper management plan should take in the land filling period by contractor;	Appointed Contactor	BEZA	Contractor Cost
	Soil Pollution	• Development of the structures and construction of the	• Raw material will be stored under covered sheds and paved surface; • Fuel storage area should be	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		access road • Land filling activities • Land will be filled and compacted	proper containment; • Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Adoption of best management practices to prevent any spillage of raw materials; • Debris should be stored under covered sheds and paved surface and should be disposed off regularly to designated sites; • Waste from labour camps can be segregated at site. Food waste/wet waste should be composted in pits within the camp site; • Recyclable waste should be sold to the authorized dealers ensuring environmental friendly and the remaining should be disposed off at designated sites through local agencies responsible for waste management in the area;			
	Noise& Vibration	• Operation of different machineries • Running of heavy load traffic for sand transportation • Regular traffic	• Vehicles and machinery should be regularly serviced and check for pollution control • Machinery to be used should comply with the noise standards prescribed by DoE.	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		movement	• No activities to be undertaken during night hours to prevent any disturbance to nearby residents and labours in labour camps • Fitting noise machines with noise reduction devices;			
	Sediment Quality	• During the land development, earth-filling material may washout to canal and increase the sediment concentration.	• Earth filling material should be in proper containment; • Proper monitoring should be taken at land development	Appointed Contactor	BEZA	Contractor Cost
Natural Environment	Ecosystems	• Land filling • High presence of anthropological activity • Extensive use of vehicle horns • Disrupting feeding or nesting behavior • A total 1055 trees will be affected by the project where 349 fruits trees, 127 timbers, 253 bananas and 326 Bamboos are identify.	• No solid or liquid waste shall be discharged in water bodies; • Septic tanks/soak pit should be provided to treat sewage to be generated from labour camps and prevent its disposal in water body; • Toilets should be provided at site to prevent contamination of water due to open defecation in nearby areas; • Vehicle washing/equipment cleaning should not be allowed near canal/drains in EZ site; • Wastewater from the washing area should be collected and should be used for curing purpose or wheel washing purpose;	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
			• Excavation and filling should be carried out in phased manner to minimize exposure of loose earth for longer duration; • Temporary storm water drainage system should be developed at site to channelize the storm water away from excavation/filling area, debris storage area and raw material storage area; • All the raw material and debris should be stored in covered sheds on paved surfaces to minimize the contamination of rainfall run-off; • Diesel, paints, cements etc should not be stored near the water bodies; • If any kind of trees cut down because of the project, in that case the project proponent should take NOC from Forest Department (FD).			
	Hydrology	• Impact on drainage pattern &hydrology is temporarily expected caused by land modification • The adjacent land may inundate by high precipitation and over	• It was confirmed that the path and the direction of Dhawrakhali Canal & Brahmaputra River would be kept intact during all phases of the project • In general, the difference inelevation between adjacent points might change but their	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		flow of canal/river water	order would be almost keptunchanged. • Surface water flow would not change significantly and would keep its current waterflow.			
Social Environment	Involuntary Resettlement	• Land acquisition will be required • Total 540.77 acres of land will be acquired for Economic Zone (1st phase) • Approximately 1714 no of households and 6343 of populations will lose their land; • Total of 11 affected households will lose their structures; • A total of 6282.95 sft structures will be affected by the project of which 4231.95 sft is tin-made while 1511 sft structure wereidentified as pucca and need to be relocated.	• Proper resettlement action Plan (RAP); • Provide adequate compensation in time to PAPs; • The authority should be careful and take necessary measures that every displaced people can be resettled as per law of the land;	Appointed Contactor	DC office/ BEZA	DC office
	Vulnerable Group	• In Araihazar Economic Zone project, out 1,714 households a total of	• Promoting payment of compensation in joint name of husband and wife;	Appointed Contactor	DC office/ BEZA	DC office

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		150 (8.75%) households were identified as vulnerable. Among them 25 are female headed having no male income earner, 58 are elderly headed and 67 were identified as extreme poor.	• Provide soft skill jobs (physically benign) and employment opportunities for vulnerable that may increase their participation and support them with income and livelihood. • Organising women in self-help group to operate canteens in the EZ; • Giving preference in physically less demanding jobs in the EZ such as cleaning, office assistant, computer operator etc ; • Ensure non-exploitation of women in terms of equal wage, opportunity, participation indecision making etc. • Create awareness among the workers, staff and women about the exploitation and sexual harassment at work place; • Create awareness about sexually transmitted disease, HIV/AIDS, exploitation etc; and • Implementation of social welfare programs targeted at vulnerable groups including old aged, physically handicapped etc. under CSR programsand activities			
	Local	• PAPs who earn income	• Income loss can be mitigated by	Appointed	DC office/	DC office

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
	Economic, such as employment, livelihood	from paddy fields and/or vegetable fields might lose their income source. • Total 1714 HH's will be affected by the project. Most of the affected household head (66.45%) are engaged with agricultural activities. About 248 including five women household head are doing business for their livelihood. • Only 23 persons were identified as sharecroppers in the project area. • On the other hand, increase of job opportunity as construction workers or commercial opportunity targeted to the workers is expected.	providing alternative job opportunities for PAPs; • Give proper compensation to farmers and sharecroppers as per LAP • All direct income loss must be adequately compensated within the RAP; • A major segment of the population on the area is unemployed. Construction activity will provide employment to huge nos. of people including skilled, unskilled and non-skilled workers. This will improve the quality of life of people; • Provision of proper training to all workers for handling the construction equipment;	Contactor	BEZA	
	Land use and utilization of local resources	• The temporary storage and stockyard are built up on the agricultural	• Plantation area which will be tentatively occupied during pre-construction, will be restored to	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		lands, and then the crop production will be obstructed in those areas. • Crops will also be damaged when the equipments and heavy vehicles will pass through agricultural fields of the proposed project areas.	original state and returned to the land owner after construction.			
	Misdistribution of Benefits and Damages	• Only land owner and property owners and affected labours will be eligible for the compensation and rehabilitation. Displaced people may be suffered at the proposed project sites	• Prepare RAP involving the following measures - Assessed compensation will base on the market price - Payment will be carried out before resettlement • Establish external monitoring committee consists of the third party	Appointed Contactor	BEZA	Contractor Cost
	Children's Right	• Impact on educational opportunity on school children in PAHs of the Project; • Impact on educational opportunity of school children in local community; • Impact of the Project on increase of child	• Support of sending children to school; • Helping the parents with hunting for a job, including the one at the construction site; • Mediation for micro credit loan; • Introducing them to assistance organizations such as NGO and so forth	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		labor;				
Construction Phase						
Environmental Pollution	Air Pollution	• Earthworks construction, site clearing, small structures demolition, civil construction, mechanical construction, handling and stocking of construction materials, dry materials stockpiling, and hauling of materials will generate dust • Construction of access roads and its dust is likely to be the most significant direct potential impact on the local community. • Carbon dioxide and nitrogen oxides may be emitted from the combustion of the petroleum products in project related vehicles,	• Sprinkling of water at construction site and haul roads • Trucks transporting fine materials, soil and waste to and from the Project site will be covered to reduce the release of dust; • Raw materials, excavated soil and other debris should be stored under covered sheds • Generators, compressors, and other equipment to be shut down when not in use; • Provision of face mask to workers to minimize inhalation of dust particles • Construction vehicles and machinery should be regularly serviced and check for pollution control • Low sulphur diesel should be used for running construction equipment and vehicles • Air emission monitoring	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		machinery and generators etc. • Excavation of retention pond • Access road construction	programme to be undertaken quarterly by the contractor, according to the design specified in the EMP and the contract specifications. The programme mush include, as a minimum monitoring of SPM, CO, NO2, SO2, PM2.5 and PM10; • Green buffer should be developed all along the EZ boundary and plantation should be carried out along the both side of access road;			
	Water Pollution	**Surface Water Quality** • Run-off from the construction site may carry the higher quantity of sediments and oil which may pollute the surface water and impact the aquatic life **Ground Water Quality** • Ground water is fresh shallow aquifers of the study area. No significant impacts are anticipated on the ground water quality due to development and construction of	**Surface Water Quality** • Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Avoid excavation activities during rains; • Prevent piling up of excavated soil, raw material and construction debris at site by proper management and disposal; • Minimize run-off by using sprays for curing; • Maintaining appropriate flow of water sprinklers at site; • Construction of storm water drains along with sedimentation tanks with sand bags as partition	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		AEZ facilities; • It was learned that 100% affected households have access to safe water for drinking, cooking and other regular household's uses. • Excavation of retention pond generate lose soil which may pollute the water bodies. • Access road construction material such as brick, brick chips, sand, cement, stones etc may pollute the adjacent waster bodies.	as barrier for direct flow of run off to canal or river; • Collection & Reusing of curing over flow, tire wash water etc within the site; • Construction of adequate nos. of toilets and proper sanitation system to prevent open defecation along the canals/river banks/water supply lines; • Construction of soak pits/septic tanks to dispose-off the domestic waste water generated from labour camps to prevent disposal of sewage in surface water bodies; • Proper collection, management and disposal of construction and municipal waste from site to prevent mixing of the waste in run-off and entering the water bodies; • No debris/construction material should enter water body in the area. **Ground Water Quality** • No sewage or waste water should be accumulated in any unlined structure; • Timely disposal of the construction/chemical/hazardous			

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
			waste so as to prevent leaching of any pollutant to ground;			
	Waste	• General construction waste is expected and typically managed by the appointed contractors; • Construction sludge by boring from underground and domestic waste from base camp is generated during construction. • Excavation of retention pond • During access road construction may generate solid or liquid waste	• Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Minimize volume to use silt basin before disposing • Segregate waste to minimize waste material • Disposed in designated dumping site instructed by the section handling waste • Recycled as possible with consideration of soil property;	Appointed Contactor	BEZA	Contractor Cost
	Soil Pollution	• Development of the structures and construction of the access road may disturb the soil profile of the area. • Fuel and construction debris may contaminate the soil • Excavation of retention pond	• Implement the national national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Raw material will be stored under covered sheds and paved surface; • Fuel storage area should be proper containment; • Adoption of best management practices to prevent any spillage of raw materials;	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		• Access road construction	• Construction debris should be stored under covered sheds and paved surface and should be disposed off regularly to designated sites; • Waste from labour camps can be segregated at site. Food waste/wet waste should be composted in pits within the camp site. • Recyclable waste should be sold to the authorized dealers ensuring environmental friendly and the remaining should be disposed off at designated sites through local agencies responsible for waste management in the area.			
	Noise	• Operation of different machineries and equipments for construction activities, running of heavy load traffic for construction materials transportation, and regular traffic movement may generate noise • Continuous exposure of neighbors to noise	• Machinery to be used should comply with the noise standards prescribed by DoE; • Vehicles and machinery should be regularly serviced and check for pollution control; • Worker who will be work high noise area should provide ear plug; • No noise generating activity shall be carried out in the night; • No construction activities to be undertaken during night hours to	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		nuisance may result in noise induced hearing lose; • Noise nuisance may reduce concentration of neighbors in their private matters. • High noise level will force employees to shout laud when communicating to one another; • Exposure of employees to high noise level (above 85dB) continuous for 8hoursper day may result in noise induced haring lose; • Exposure of ear to peak sound level instantaneously may result to deafness;	prevent any disturbance to nearby residents and labours in labour camps; • Fitting noise machines with noise reduction devices; • Temporary noise barriers should be provided near the high noise generating areas like metal or tiles cutting sites, generator room etc; • Any employee who may complain about ear related pain and or complication while at work to access medical attention at the expense of the contractor or project proponent;			
	Sediment Quality	• Development of the structures and construction of the access road may disturb the bottom sediment profile of the water bodies.	• Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Raw material will be stored under covered sheds and paved surface; • Fuel storage area should be	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		• Storage of raw material, fuel and construction debris may contaminate the bottom sediment; • Excavation of retention pond may affect the sediment quality.	proper containment; • Adoption of best management practices to prevent any spillage of raw materials; • Construction debris should be stored under covered sheds and paved surface and should be disposed off regularly to designated sites; • Waste from labour camps can be segregated at site. Food waste/wet waste should be composted in pits within the camp site; • Recyclable waste should be sold to the authorized dealers ensuring environmental friendly and the remaining should be disposed off at designated sites through local agencies responsible for waste management in the area;			
Natural Environment	Ecosystems	• Biodiversity continue to decrease because of rapid population expands • Removal of vegetation from the project site • Clearing of agricultural crop cover from the	• Implement the 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • No solid or liquid waste shall be discharged in water bodies; • Septic tanks/soak pit should be provided to treat sewage to be	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		construction area will create some negative impact on food security • Overlap between the project activity and their breeding period will produce much greater impact • Disturbance due to increased noise level and human activities • Medium and small mammals will avoid the locations due to increased human presence • Resident birds in the homestead vegetation will be disturbed • During construction many seasonal and perennial water bodies will lose their characteristics • Run-off from construction site may contain sediments or contaminant which may pollute water quality of canals and	generated from labour camps and prevent its disposal in water body; • Toilets should be provided at site to prevent contamination of water due to open defecation in nearby areas; • Vehicle washing/equipment cleaning should not be allowed near canal/drains in EZ site; • Wastewater from the washing area should be collected and should be used for curing purpose or wheel washing purpose; • Excavation and filling should be carried out in phased manner to minimize exposure of loose earth for longer duration; • Temporary storm water drainage system should be developed at site to channelize the storm water away from excavation/filling area, debris storage area and raw material storage area; • All the raw material and debris should be stored in covered sheds on paved surfaces to minimize the contamination of rainfall run-off; • Diesel, paints, cements etc should not be stored near the water			

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		adjacent river which will impact the aquatic life • The economic productivity of the wetlands will also decrease	bodies;			
	Hydrology	• Impact on hydrology is temporarily expected caused by land modification • Excavation of retention pond	• The path and the direction of Dhawrakhali canal would be keeping intact during allphases of the Project. • The excavation and embankment work would be designed to minimizetheexcavation volume and embankment volume as much as possible. • The difference inelevation between adjacent points might change but their order would be almost kept unchanged. As aresult, surface water flow would not change significantly and would keep its current water flow. • Water consumed for the construction work and related activities during the construction phase wouldinclude water for washing vehicles and equipment, sprinkling water, and domestic	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
			water.			
	Topography & Geology	• AEZ is being developed in the naturally depressed area filling with dredged soil, the topography of the area is likely to be changed. • Due to the significant sand reclamation from the surrounding river beds, erosion of the river bank could occur without proper sand dredging.	• Save topsoil removed at the start of the project and use it to reclaim disturbed areas upon completion of construction activities. • Apply protective covering on disturbed soils as quickly as possible. • Clean and maintain catch basins and drainage ditches regularly. • Reestablish the original grade and drainage pattern to the extent practicable. • Obtain borrow material from authorized and permitted sites.			
Social Environment	Involuntary Resettlement	• Land acquisition will be required • Total 540.77 acres of land will be acquired for Economic Zone (1st phase) • Approximately 1500 land owners will loss their land • Total of 11 affected households will loss their structures	• Proper resettlement action Plan (RAP); • Provide adequate compensation in time to PAPs; • The authority should be careful and take necessary measures that every displaced people can be resettled as per law of the land;	Appointed Contactor	DC office/ BEZA	DC office
	Vulnerable Group	• The vulnerable groups identified for the	• Promoting payment of compensation in joint name of	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		Project are those old and aged, physically handicapped and destitute individuals that are potentially affected by the project activities • The vulnerable people who involved in agricultural work will be affected mostly by this project	husband and wife; • Provide soft skill jobs (physically benign) and employment opportunities for vulnerable that may increase their participation and support them with income and livelihood. • Organising women in self help group to operate canteens in the plant; • Giving preference in physically less demanding jobs in the plant such as cleaning, office assistant, computer operator etc; • Ensure non-exploitation of women in terms of equal wage, opportunity, participation in decision making etc. • Create awareness among the workers, staff and women about the exploitation and sexual harassment at work place; • Create awareness about sexually transmitted disease, HIV/AIDS, exploitation etc; and • Implementation of social welfare programs targeted at vulnerable groups including old aged, physically handicapped etc. under CSR programs and activities			

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
	Local Economics, such as employment, livelihood	• PAPs who earn income from paddy fields and/or vegetable fields might lose their income source. • Many sharecroppers depended on agriculture in dry season. They cultivate IRRI and vegetable that period. • On the other hand, increase of job opportunity as construction workers or commercial opportunity targeted to the workers is expected.	• Income loss can be mitigated by providing alternative job opportunities for PAPs; • Give proper compensation to farmers and sharecroppers as per LAP • All direct income loss must be adequately compensated within the RAP; • A major segment of the population on the area is unemployed. Construction activity will provide employment to huge nos. of people including skilled, unskilled and non-skilled workers. This will improve the quality of life of people; • Provision of proper training to all workers for handling the construction equipment;	Appointed Contactor	DC office/ BEZA	DC office
	Land Use and Utilization of local resources	• The temporary storage and stockyard are built up on the agricultural lands, and then the crop production will be obstructed in those areas. • Crops will also be damaged when the equipments, and heavy	• Plantation area which will be tentatively occupied during construction, will be restored to original state and returned to the land owner after construction.	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		vehicles will pass through agricultural fields of the proposed project areas.				
	Water Usage	• Araihazar EZ sites do not have existing public water supply facilities • Utilize the nearby rivers or wells as water sources. • Approximately 7973m^3/day of water will be required during construction phase for the total development area • Excessive withdrawal of ground water may lead to depletion of aquifers.	• Rain water harvesting ponds should be constructed so as to store rain water for construction activities; • Water for curing can be saved by carrying out curing in early morning or late evening and covering structures with gunny bag so as the moisture can be restored for longer time; • Regular inspections at site to monitor leakages in water storage tanks; • Creating awareness among construction workers about the importance of water conservation; • Adoption of the advance technologies and machinery which helps in minimizing water requirement for construction; • Storing the curing run-off and waste from other construction activity and using the same for sprinkling; • Covering the water storage tanks at site to prevent evaporation	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
			losses;			
	Misdistribution of Benefits and Damages	• Not everybody could benefit from the construction work due to limited requirements and preferences of the contractors.	• Prepare RAP involving the following measures - Assessed compensation will base on the market price - Payment will be carried out before resettlement • Establish external monitoring committee consists of the third party	Appointed Contactor	BEZA	Contractor Cost
	Local Conflict of Interest	• Due to employment, opportunity will be increasing during construction; candidates of construction workers may have some conflicts between communities.	• Job opportunities should be provided in fair way' • Clear information about the needs of labor (number and qualification) should be provided with local people' • The job skills and the priority for the affected people shall be taken into account and the workers can be chosen;	Appointed Contactor	BEZA	Contractor Cost
	Children's Right	• Impact on educational opportunity on school children in PAHs of the Project; • Impact on educational opportunity of school children in local community; • Impact of the Project on increase of child	• Child labor at the construction site during the project implementation shall be strictly prohibited since such practices are banned by both Bangladesh laws and JICA guidelines; • The RAP Implementing Agency and EZ authority shall regularly monitor project sites to guide contactors and their related firms	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		labor;	to discourage child labor; • Support of sending children to school; • Helping the parents with hunting for a job, including the one at the construction site; • Mediation for micro credit loan; • Introducing them to assistance organizations such as NGO and so forth			
	Infectious Diseases	• During Construction, in general, a lot of migrant workers flow into the sites, who mayhave the possibility with HIV/AID and thedisease can spread among local people;	• To provide surveillance for worker's health; • Prevention of illness among workers by undertaking healthawareness and education initiatives and by conductingimmunization programs for workers; • To provide treatment through standard case management inon-site and community health care facilities as necessary; • Educating project personnel and area residents on risks, prevention, and available treatment; • Promoting collaboration with local authorities to enhance access of worker's families and the community to public health	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
			services and promote immunization as necessary; • Promoting use of repellents, clothing, netting, and other barriers to prevent insect bites; • Prevention of larval and adult propagation through sanitary improvements and elimination of breeding habitats close to human settlements; • Elimination of unusable impounded water;			
	Working conditions, including occupational safety	**Occupational Health & Safety** • There would be a possibility to occur accidents and incident during construction works; • Physical trouble, noise, vibration, lighting, electrical, heat and cold, nuisance dust, fire/explosion, machine grinding, working space, Chemical, Gases, dusts, fumes, vapours, liquids are the major hazards	• To provide adequate health care facilities and first aid within construction sites; • To provide OHS training program and information of basic site rules of work, basic hazard awareness, site specific hazards, safe work practices, and emergency procedure; • To provide adequate lavatory facilities for the number of people expected to work in the facility; • To provide adequate supplies and easy access of drinking water with a sanitary; • To provide temporary shelters to protect against heat stroke during working activities or for use as	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		which are harmful for workers health; • May insect and snake bite in the labour camp; • Road Accident	rest areas as needed; • To arrange for provision of clean eating areas where workers are not exposed to the hazardous or noxious substances where there is potential for exposure to substances poisonous by ingestion of food as necessary; • To promote the use of repellents, clothing, netting, and other barriers to prevent insect bites and snake bite; • Adequate preventive measures from negative factors such as fire precautions, lighting, safe access, work environment temperature, area signage, labelling of equipment, communicate Hazard codes, electrical; • To establish rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures, and control of traffic patterns or direction; • To identify and provide appropriate PPE that offers adequate protection to the worker, co-workers, and occasional visitors;			
		Community Health &	• Provision of infrastructure for	Appointed	BEZA	Contractor

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		Safety • Traffic congestions on roads and possible disruption to the community usage during peak movement hours; • Increased risks with respect to safety associated with traffic movement; • Inconvenience to community in terms of air and noise pollution caused by the movement of vehicles; and • Structural and surface damage to road due to movement of heavy vehicles and equipments • Generation of dust, noise and odour from the construction site which may have health related impacts on the local community; • Fire Safety from the ongoing construction	migrant labour such as water supply, electricity, sanitary facilities, medical aid and other basic amenities to avoid dependence on limited local resources; • Proper disposal of wastes generated from the camp and construction activity to maintain general hygiene in the area; • Creating awareness among the drivers about speed, traffic safety, use of horns etc while driving through settlement areas; • Covering of trucks while carrying soil, sand, cement, aggregates etc to minimise spread of dust and spill over; • Avoiding unnecessary movement of vehicle through settlement area to minimise disturbance and traffic safety related issues; • Creating awareness among children, women, and old age people in particular and the community in general on traffic safety by using existing mediums such as school, women self help groups, village union and religious occasions;	Contactor		Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		activities which may include handling and storage of flammable chemicals and materials; • Improper disposal and migration of sewage into the surroundings; • Improper disposal of sewage and waste may lead to contamination of ground water, as the water table in the project area is very high. • Any waste disposal in canal from the project would affect the population in downstream of water flow	• Strengthening and regular maintenance of village road to minimize surface and structural damage of road; • Sprinkling of water to suppress dust generation in the construction zone; • Provide training and create awareness about fire and safety among workers at site; • Disposal of wastes at pre identified waste dumping site to avoid unauthorized dumping; • Avoid disposing of wastes in the canal and providing silt traps to arrest silt flowing into the canal during the rainy season.			
		Risk of Fire • Risk of fire might increase due to the implementation of the construction work • Faulty electrics are the biggest cause of workplace fires, loose	• To minimize the impact, the above mentioned rule and the internal regulation for the Economic Zone of Araihazar will be applied and obligate industries to install appropriate security and safety system for their implementation; • Maintain safe housekeeping	Appointed Contactor	BEZA	Contractor Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		wires, plugs that are over loaded • Old equipment can all make for a potential death trap • Discarded cigarettes can cause fires • Smoking can be especially hazardous if it is allowed to take place near areas where flammable materials are present • Improper use of equipment, accidents, drinks being spilt over electrical equipment and leaving cooking unattended • The most common causes of fires in the workplace is human error.	practices that reduce the risk of fire danger; • Implement a program that includes preparation, prevention, and recognition of fire Risk; • Proper handling of combustible and flammable material; • Keep all fires and heaters well guarded, especially open fires; • Keep portable heaters and candles away from furniture and curtains; • Don't dry or air clothes over or near the fire, or the cooker; • Do not smoke in the project site;			

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
Others	Accidents	• Construction accidents and road accidents around the project site are expected due to the construction activities. Construction workers can have harmful and critical troubles. • Excavation of retention pond • Access road construction	• Follow Health and Safety Management Plan (HSMP) rules and regulations designated by contractors; • Provision of traffic sings, road mark, bump, zebra mark, guard rail and pole, and curb stones etc;	Appointed Contactor	BEZA	Contractor Cost
Operational Phase						
Environmental Pollution	Air Pollution	• Significant air emissions result from light-engineering industries. • These are particulate matter, sulphur dioxide, metals and other criteria pollutants like ozone, oxides of nitrogen and carbon monoxide. Lead may be generated in some of the processes. • Air emissions from food processing industry will contain some volatile organic	• All industries should obtain clearance from DoE, Bangladesh; • Latest technology, methodology, and machinery involving minimal air emissions should be adopted by industries; • Air pollution control measures should be taken by industries as prescribed in the mitigation plan; • Periodic renewal of ECC should be obtained by all the industries; • Power Generators should be provided with stacks of adequate height (higher than nearest building) to allow enough dispersion of emission; • Process emission if any shall be	Tenant/Third party agency	SPC/BEZA	Tenant Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		compounds • Vehicles movement and its gaseous emission	control with the installation of adequate air pollution control systems; • All industries should obtain clearance from DoE, Bangladesh as applicable. Air pollution control measures shall be adopted by respective industries in line with DOE permission; • Air pollution monitoring should be carried out quarterly by all industries to check the air pollution level; • Preference of usage of clean fuel like LPG, low sulphur diesel should be explored; • Energy conservation should be adopted by adopting the alternate energy options like solar power and other energy efficient technologies; • Development of thick green belt (3.5 m) all along the EZ zone and organized greens within each industrial plot;			
	Water Pollution	**Surface Water Quality** • Industries are likely to generate domestic and industrial effluent. • Liquid waste which	**Surface Water Quality** • Each industry should obtain an ECC from the DoE Bangladesh before construction andoperation of the factory and must comply	Tenant/Third party agency	SPC/BEZA	Tenant Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		can be generated from light engineering industries will include waste acid, waste alkali, grease, used/spent oil, liquid metal, spent solvents etc • Domestic and cleaning waste is likely to be generated • Food processing industries similarly generate both liquid and solid waste. • Discharge of wastewater in soil will degrade its fertility • Uncontrolled discharge of these effluents to canal/river may severally pollute the canal/river water quality **Ground Water Quality** • There will be very minimal chance of contaminating ground water from wastewater andsewage during the	with the conditions stated in the ECC. • Each industry has to arrange pre-treatment facility to treat their processed effluent and sewage they generate to meet certain level of pollution load set by the AEZ operator; • Industrial wastewater will be treated in ETP of each tenant to meet national wastewater discharge standards; • Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Online based monitoring system should be installed in CETP; • Storm and industrial wastewater will be collected in separate pipe networks to prevent contamination of storm water draining to natural wetlands; • Each industry should treat the effluent and sewage generated by them so as to achieve zero discharge and no untreated effluent should be discharged into anywater body; • Proper management of waste			

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		operation phase. • During the operation phase EZ of which water demand is about approximately 70,00m^3/day;	should be done to prevent any contact between thewaste and storm water; • Common waste disposal sites should also be developed within EZ site as per the standards and prior permission of DoE should be taken before development; • Storm water system should be inspected & cleaned before monsoon every year; • Peripheral drain shall also be lined and shall not be connected to internal storm water drainage system; • River water quality shall be monitored periodically; **Ground Water Quality** • Each industry should pre-treat the effluents and sewage before sending them to CETP; • Treated wastewater will be passed through a lagoon to ensure bio monitoring of water quality • No leachate, waste water and waste material should be stored in pervious unlined area/pond. • Ground water quality shall be monitored periodically.			
	Waste	• Industrial waste is	• Implement the national 3R	Tenant/Third	SPC/BEZA	Tenant

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		expected. Appropriate waste management by law and regulation is the responsibility of the tenant factory/ facilities, which shall be approved by DoE for their own EIAs.	(Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Fail-safe containment of any facilities that could put the environment at risk • Adequate buffers to nearby sensitive land uses and water resources • Access to or provision of services that ensure potential wastes are reduced, recycled or adequately treated before safe disposal, such as pre-treatment of process fluids, then discharge to effluent treatment scheme • Site drainage controls to isolate potentially contaminated areas from discharge to the environment • Environmental training and awareness programs for tenant workers	party agency		Cost
	Soil Pollution	• All waste including solid and liquid wastes may cause soil contamination • After development of economic zone, disposal of industrial	• Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Treatment of the effluents and sewage and ensuring proper disposal;	Tenant/Third party agency	SPC/BEZA	Tenant Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		domestic and process waste may contaminate land and soil quality of the area. • Improper disposal of waste (hazardous and non-hazardous waste) may degrade soil, water, air quality and ecology of the area. • Significant waste both hazardous and non-hazardous in nature, which can pollute the environment if not managed properly • Lubricate oil/waste oil is generated from the machineries as hazardous waste.	• Segregate non-hazardous solid waste from hazardous one and dispose properly; • Industrial waste generated will be stored in impervious storage tanks. • All factories will ensure proper storage for their chemical and hazardous materials to prevent accidental spillage; • Provision shall be made for proper storage and disposal of industrial waste by receptive industries; • Common waste storage areas shall be designated for industrial domestic waste; • Waste should be segregated at source into hazardous and non hazardous waste. Further the waste should be segregated into recyclable and rejected waste; • Recyclable waste should be sent to authorize vendors for recycling and rejected waste should be disposed off as per the norms specified by DoE for the particular waste; • Industrial waste generated should be stored on sealed surfaces and			

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
			should be disposed off as per guidelines of DoE, Bangladesh; • No chemical/hazardous raw material should be allowed to spill over the land and should be operated in covered systems; • Excessive packaging should be reduced and recyclable products such as aluminum, glass, and high-density polyethylene (HDPE) are being used where applicable; • Organic waste should be resold to value addition industries or can be feeded to live stock; • Advanced wastewater treatment should be adopted by industries; • Use of advanced techniques to control specific portions of the manufacturing process to reduce wastes and increase productivity; • Use of radiation to kill pathogenic microorganisms; • Reduction or total elimination of effluent from the manufacturing process;			
	Noise	• Traffic in the area will increase significantly • Operation of tenants, water pumps, and light	• Pumps should be fitted in acoustic enclosure to reduce the noise generation; • Noise barriers will be mandatory	Tenant/Third party agency	SPC/BEZA	Tenant Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		engineering factories to be operated in proposed EZ may increase the noise level	for the factories generating a lot of noise during operations; • Plantation should be developed along the roads and boundary to form continuous barrier that will reduce the noise level significantly; • Green buffer of 3.5 m should be developed all along the project boundary. Green buffer should compose of the only one row of plants of variable height and thick canopy so as to form continuous barrier. This will help in reducing the noise level significantly;			
	Ground Subsidence	• Based on the deep ground water surveys, enough ground water resources were confirmed at the deep aquifer that is deeper and different from the aquifer of the residential wells. • Expansion of the EZ and other industrial subsidence could lead to subsidence without proper ground water resource management.	• Need proper ground water resource management • Groundwater management will need to keep in reasonable balance the costs and benefits of management activities and interventions, and thus take account of the susceptibility to degradation of the hydrogeological system involved and the legitimate interests of water users, including ecosystems and those dependent on downstream base flow. • It will be necessary to set possible	Tenant/Third party agency	SPC/BEZA	Tenant Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
			management interventions in the context of the normal evolution • Prioritization of domestic water security within a strategy to implement the groundwater management program of groundwater development;			
	Sediment Quality	• Bottom sediment of the surrounding water bodies would be deterioratedby wastewater generated from the industries. • After development of economic zone, disposal of industrial domestic and process waste may contaminate land and bottom sediment of the area. • Solid waste from textiles majorly composed of resins, fabric, apparel, dye, discarded machinery and fibers. • Solid waste from the food processing industries includes both organic and	• Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • Treatment of the effluents and sewage and ensuring proper disposal; • Segregate non-hazardous solid waste from hazardous one and dispose properly; • Industrial waste generated will be stored in impervious storage tanks and will be disposed of as per guidelines of the DoE; • All factories will ensure proper storage for their chemical and hazardous materials to prevent accidental spillage; • Raw material will be stored under covered sheds and paved surface; • Fuel storage area should be proper containment; • Advanced wastewater treatment	Tenant/Third party agency	SPC/BEZA	Tenant Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		packaging waste. • Organic waste that is the rinds, seeds, skin, and bones from raw materials, results from processing operations.	should be adopted by industries; • Adoption of best management practices to prevent any spillage of raw materials; • A site for disposal of hazardous waste can be identified within the EZ and it should be developed as per the norms of DoE and upcoming Hazardous Waste Management rules of Bangladesh.			
Naatural Environment	Ecosystems	• Post development of the economic zone & setting up of industries, there could be some impacts on the ecosystem of the area. • Industrial development will involve generation of emissions, effluents and increased vehicular movements may have overall negative impact on the eco-system. • Air pollutant will impact the existing vegetation and avifauna in the area	• Periodic monitoring shall be carried out as per the monitoring plan for air, water, noise and soil and ensure that no impact; • Implement the national 3R (Reduce, Reuse and Recycle) strategy for both solid and liquid waste management; • No waste shall be discharged in water bodies, i.e. canal and agricultural land etc. • Central ETP should install to treat the effluent generated and to re-use and recycle it completely. No untreated effluent should be discharged in water bodies, i.e. canal and agricultural land; • Tree survival rate shall be monitored; • Native species should only be	Tenant/Third party agency	SPC/BEZA	Tenant Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
			planted in the region;			
	Hydrology	• Impact on hydrology is expected caused by the existence of development area.	• Natural drainage pattern should be maintained. • Run-off assessment shall be made of catchment area and peripheral/garland drains shall be constructed around EZ site based on the assessment of catchment area (frequency, and storage area); • Storm water drain shall have the provision of de-siltation before discharge to river;	Tenant/Third party agency	SPC/BEZA	Tenant Cost
Social Environment	Water Usage	• Thousands of employees and workers who will use and consume water and generate wastewater from the office and the residential building; • Water demand can be fulfilled by withdrawing ground water • During the operation phase a plant of which water demand is about approximately 7,000m^3/day;	• Rain water harvesting system and storage should be developed to minimize ground water extraction; • Implement the national 3R (Reduce, Reuse and Recycle) strategy for reusing the recycled solid waste and treated water in the EZ area; • Centralized rainwater harvesting system will be implemented; • Treated effluent will be recycled; • Water efficient technologies will be adopted in central utility service divisions and also at the factory process level; • Adoption of best management	Tenant/Third party agency	SPC/BEZA	Tenant Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
			practices to prevent water wastage and minimize water loss; • Usage of water conservation fixtures to minimize water consumption; • Installation of leakage detection system to minimize the water loss; • Regular monitoring of ground water level in the area should be carried out. Estimated should be made to calculate the draught and recharge of the ground water aquifers. More green space will planted to foster aquifer recharge; • Ground water aquifer assessment studies may be undertaken to assess the ground water potential. Peizometer shall be installed to monitor variation in ground water level in the area.			
	Landscape	• Although semi-urbanization of landscape in and around Araihazar Economic Zone is inevitable;	• The development will be implemented under the project proponent internal regulation, which rules to secure the environmental friendliness for users and residents, and harmonization with the surrounding area. • Greening area willbe established in each plot and public space;	Tenant/Third party agency	SPC/BEZA	Tenant Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
			• Therefore, as long as the industries follow the internal regulation and the project proponent will make effort to maintain the public area; • The landscape of the project area is expected to be well-maintained semi-urbanized area.			
	Children's Right	• Children's educational opportunity will be temporarily disrupted due to the relocation • Child Labour	• Project proponents will implement "EZ neighbors students Support Program" as one of the community support programs targeting not only for children of PAH but also for surrounding communities. • The project proponent will implement this kind of educational program continuously based on needs and requests from the community. • Support of sending children to school; • Introducing them to assistance organizations such as NGO and so forth • According to the Labour Law of Bangladesh 2006, the minimum legal age for employment is 14. • The Project and industries keep laws in Bangladesh; illegal child	Tenant/Third party agency	SPC/BEZA	Tenant Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
			labor will be preventing in employment of labors.			
	Infectious Disease	• This is a possibility to increase the risks of infectious diseases due to influx of workers of the industries and the semi-urbanization of the project area and its surroundings area.	• Conduct mitigation measures stipulated in the international guidelines such as EHS Guidelines of IFC • To conduct Information, Education and Consultation Communication (IEC) campaign at least every other month to all site staff, employees, and immediate local communication concerning the risks, dangers and impact and appropriate avoidance behavior with respect to, of Sexually Transmitted Disease (STD) or Sexually Transmitted Infection (STI) in general and HIV/AIDS in particular, • To provide male or female condoms for all staff and laborers as appropriate and • To provide for STI and HIV/AIDS screening, diagnosis, counseling and referral to dedicated national STI and HIV/AIDS program.	Tenant/Third party agency	SPC/BEZA	Tenant Cost
	Working Conditions, including	**Occupational Health and Safety** • Accidents or incidents	• To provide adequate health care facilities and first aid within construction sites of industries or operation phase;	Tenant/Third party agency	SPC/BEZA	Tenant Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
	occupational Safety	are expected to occur more or lessduring the operation phase • Physical trouble, Noise, vibration, lighting, electrical, heat and cold, nuisance dust, fire/explosion, machine grinding, working space, Chemical, Gases, dusts, fumes, vapours, liquids are the major hazards which are harmful for workers health. • Road Accident	• To provide OHS training program and information of basic site rules of work, basic hazard awareness, site specific hazards, safe work practices, and emergency procedure; • To provide adequate lavatory facilities for the number of people expected to work in the facility; • To provide adequate supplies and easy access of drinking water with a sanitary means To provide temporary shelters to protect against heat stroke during working activities or for use as rest areas as needed; • To arrange for provision of clean eating areas where workers are not exposed to the hazardous or noxious substances where there is potential for exposure to substances poisonous by ingestion of food as necessary; • To promote the use of repellents, clothing, netting, and other barriers to prevent insect bites and snake bite; • Adequate preventive measures from negative factors such as fire precautions, lighting, safe access,			

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
			work environment temperature, area signage, labeling of equipment, communicate hazard codes, electrical; • To establish rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures, and control of traffic patterns or direction; • To identify and provide appropriate PPE that offers adequate protection to the worker, co-workers, and occasional visitors; • Proper maintenance of PPE and the instruction of proper use;			
		Community Health and Safety • The health and safety risks in the plant during operations include potential forrespiratory diseases, burns, allergies and industrial accidents among theemployees and immediate neighboring communities	• Adequate provision for suppression of dust and particulate matter originating at source; • Provision of first aid box and trained personnel to deal with minor cut, bruise and burn; • Provision of paramedic staff and ambulance in industry site for serious bodily injuries; • Developing a disaster management plan and community health and safety plan to deal with emergency situations;	Tenant/Third party agency	SPC/BEZA	Tenant Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		• The impacts envisaged from the project activities on with respect to community usage of access roads • Emission & Noise generated from the operation of the industries. These emissions may include compounds of Nitrogen and Carbon which may be harmful to the surrounding community; • Fire & Explosion Hazards; • Improper sewage and waste disposal;	• Regular training of plant personnel on health and safety aspects; • Creating awareness among the general public around the plant about possible emergency situations and way to respond to them; • Use of water ways for movement of goods to minimise heavy traffic movement through settlement areas; • Develop an influx management plan to address the influx related issue; • Release of nitrogen and carbon compounds within permissible limit so that human health is not affected; • Disposal of wastes in pre identified and approved locations.			
		Risk of fire • Risk of fire would increase due to the economic activities of the industries and population growth in andaround the project area.	• To minimize the impact, the above mentioned rule and the internal regulation for the Economic Zone of Araihazar will be applied and obligate industries to install appropriate security and safety system for their operations; • The industries shall install and maintain an effective fire alarm	Tenant/Third party agency	SPC/BEZA	Tenant Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		• Electrical systems that are overloaded, resulting in hot wiring or connections or failed components might occur at operation phase. • Old equipment can all make for a potential death trap • Discarded cigarettes can cause fires • Smoking can be especially hazardous if it is allowed to take place near areas where flammable materials are present • Improper use of equipment, accidents, drinks being spilt over electrical equipment and leaving cooking unattended • The most common causes of fires in the workplace are human error.	system and firefighting system for each building in the plot, and implement emergency drill with reference to the rule and regulation; • Implement a program that includes preparation, prevention, and recognition of fire Risk; • Proper handling of combustible and flammable material; • Do not smoke in the project site; • Fit approved smoke detectors on each floor. Choose a smoke alarm that is mains operated or one with a long life (ten year) battery; • Proper handling of combustible and flammable material; • Keep all fires and heaters well guarded, especially open fires; • Keep portable heaters and candles away from furniture and curtains; • Don't dry or air clothes over or near the fire, or the cooker; • Do not smoke in the project site;			
Others	Accident	• Road accidents would be increased due to	• Follow Health and Safety Management Plan (HSMP) rules	Tenant/Third party agency	SPC/BEZA	Tenant Cost

	Item	Expected Environmental and Social Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Implementing Organization	Responsibility for supervision	Mitigation Cost Source
		industrial vehicles and commuter buses and motor lines.	and regulations designated by contractors; • Provision of traffic sings, road mark, bump, zebra mark, guard rail and pole, and curb stones etc			
	Transboundary impact and climate change	• Emission of Carbon Dioxides (CO_2) • The utilization of commuter bus for workers to reduce traffic GHG emission will be initiated by the tenants;	• Control of GHGs emission by energy use efficiency, process modification, selection of fuels or other materials, the processing of which may result in less emission, application of emission control techniques, if possible; • Provision of commuter bus;	Tenant/Third party agency	SPC/BEZA	Tenant Cost

8.3 Enhancement Plan

The proposed project involves development of EZ and off-site facilities for the upcoming Araihazar EZ. These off-site facilities will be developed by BEZA. Development of these off-site infrastructure facilities will attract the investors and make the proposed site location more accessible for trading and business. Proximity of the proposed project site to the Dhaka-Sylhet Highway adds to the suitability of site for setting up the industries. As enhancement plan, it is proposed that BEZA/EZ developer should develop a thick green belt all around the EZ site, proper storm water drainage to prevent flooding and rainwater harvesting system to harvest rainwater and use it to meet daily water demand and reduce pressure on ground water resources.

8.4 Contingency Plan

In order to be in a state of readiness to face adverse effects of accidents, a Contingency Plan is required to be prepared which includes on-site and off-site emergency plan by the individual industry and industrial estate. BEZA is committed to develop a Contingency Plan in consultation with district authorities and industry association. The Contingency Plan will have the following minimal components:

- Accidents preventions procedures/ measures
- Fire prevention planning and measures
- Fire water storage and foam system
- Accident/emergency response planning procedure
- Communication
- Emergency control centre
- Emergency information system with role & responsibility and command structure
- Recovery procedure
- Assessment of damages and rectification
- Evaluation of functioning of disaster management plan
- Accident investigation
- Clean-up and restoration

8.5 Monitoring Plan

The objective of environmental monitoring during the construction and operation phases is to compare the monitored data against the baseline condition collected during the study period to assess the effectiveness of the mitigation measures and the protection of the ambient environment based on national standards. A monitoring schedule has been sketched based on the environmental components that may be affected during the construction for 3 years time period and operation of the project for 1 year is given below in ***Table 8-2***.

Table 8-2: Environmental & Social Monitoring Plan

Project Stage/ Affected Component	Environmental Issue	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
Site Preparation and Construction Phase							
General	Inspection of mitigation compliance	General compliance with mitigation measures presented in the EMP and as specified in Contractor Manual	Project Activity areas and construction workers camp	Visual inspection of all active work areas	Daily	EHS Team of Contractor	Contractor Cost
Ambient Air Quality	Dust generation	SPM, PM 2.5,PM10,CO, SOx, NOx	At 4 Locations	24-hour	Quarterly	Contractor/ 3rd Party Environmental Consultant	Contractor Cost
Noise	Increase in ambient noise levels	Noise levels in Leq, Leq_{day}, Leq_{night} and hourly Leq	At 5 Locations (Important Sensitive Receptors)	24-hour Once every fortnight	Monthly	Contractor/ 3rd Party Environmental Consultant	Contractor Cost
Soil	Quality of filling earth/ sand	pH, salinity, NH4+, total- P,heavy metals, oil & grease	Barge/ trawler	Standard analytical methods	The first delivery from any source and then random sampling of deliveries from that source	Contractor/ 3rd Party Environmental Consultant	Contractor Cost
Water	Contamination of surface water	Turbidity, pH, DO, Total dissolved solids, oil & grease, total coliform, heavy metals	At 2 locations	Standard Analytical methods	Monthly	Contractor/ 3rd Party Environmental Consultant	Contractor Cost
	Ground water quality	Drinking water quality parameters as per Schedule 3 of ECR 1997	At 2 locations	Standard Analytical methods	Quarterly	Contractor/ 3rd Party Environmental	Contractor Cost

Project Stage/ Affected Component	Environmental Issue	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
						Consultant	
Hydrology	- Groundwater level - Ground elevation level - Consumption of groundwater amount	Compliance with mitigation measures presented in theEMP	Well near the construction site	Visual inspection of all active work areas	Once/ months	Contractor	Contractor Cost
Social Environment	-Involuntary Resettlement -Living and Livelihood -Vulnerable Group -Misdistribution of Benefit and Damage -Children's Right	-Monitoring of the implementation status of Resettlement works such as provision of assistance package for project affected persons, and common assets; -Monitoring of the implementation status for CSR activities such as community support program	Around project site	Visual inspection of all active work areas	Once/year	BEZA	BEZA
Occupational Health and Safety	Accidents or incidents due to construction activities, workers health	Near-misses, incidents, occupational diseases, dangerous occurrences	Project activity areas and construction workers camp	As defined in construction phase Health & Safety Plan to be prepared by contractor	As defined in H&S Plan	Contractor/ EHS Team of Contractor	Contractor Cost
Community Health and Safety	Community disturbance and potential safety hazard due to road traffic	Accidents, incidents and complaints	Approach Road	Incidents, accidents and community complaints	Based on occurrence	Contractor/ EHS and/or Community Liaison Officer of Contractor	Contractor Cost

Project Stage/ Affected Component	Environmental Issue	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
Operation Phase							
General	Inspection of mitigation compliance	General compliance with mitigation measures presented in the EMP and as specified in Contractor Manual	Project activity areas and construction workers camp	Visual inspection of all active work areas	Daily	EHS Team of BEZA and individual industry	Included in operation and maintenance (O&M) cost
Air Pollution	Stack emissions concentrations	NOx, SOx, CO, SPM	Stack of individual industry who has stack for exhaust emission			Tenant/3rd Party Environmental Consultant	O&M cost
	Ambient air quality	PM10, PM2.5, SOx, NOx, CO	At 4 Locations	Standard methods	Quarterly	Tenant /3rd Party Environmental Consultant	O&M cost
Noise	Noise generation by individual industry operation	Sound Pressure Level	1 m from the noise generating equipment	Noise monitor	Monthly	Tenant / EHS Team or 3rd Party Environmental Consultant	O&M cost
	Ambient noise	Ambient noise levels	At 5 locations (Important Sensitive Receptors)	Noise monitor with data logger	Quarterly	Tenant /3rd Party Environmental Consultant	O&M cost
Water	Ground water quality	Drinking water quality parameters as per Schedule 3 of ECR1997	Borewell water to be used for domestic purposes and treated water	Standard analytical methods	Quarterly	Tenant /3rd Party Environmental Consultant	O&M cost

Project Stage/ Affected Component	Environmental Issue	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
			quality to be used for drinking				
	Wastewater	Turbidity, pH, DO, Total dissolved solids, oil & grease, total coliform, heavy metals	Outlet of discharge canal	Standard analytical methods	Quarterly	Tenant /3rd Party Environmental Consultant	O&M cost
	Surface water quality	Turbidity, pH, DO, Total dissolved solids, oil & grease, total coliform, heavy metals	At 2 locations	Standard analytical methods	Quarterly	Tenant/individual industry EHS Team or 3rd PartyEnvironmental Consultant	O&M cost
Solid & hazardous waste	Internal domestic/ kitchen waste, and medical centre waste	Solid waste	Waste disposable point	Waste a quality	Daily	Tenant	O&M Cost
Soil Pollution	Status of control of solid and liquid waste which causes soil contamination	Solid waste and liquid waste	Each Tenant	Visual inspection of all active work areas	Half yearly	Tenant	O&M Cost
Aquatic Ecology	Fisheries	Visible fish kills	Outlet of the discharge	Visual inspection	Fortnightly	Tenant EHS Team	O&M Cost
Terrestrial Ecology	Ecology	Visible flora and fauna monitoring	Plant surrounding area of2km radius	Abundance, species composition	Half yearly initial 2 years of operations. Any further	Tenant /3rd Party Environmental Consultant	O&M cost

Project Stage/ Affected Component	Environmental Issue	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
					monitoring based on the analysis of results		
Works health and safety Monitoring	Accidents or incidents due to operation and maintenance activities, workers health	Near-misses, incidents, occupational diseases, dangerous occurrence etc.	Project activities areas	As to be defined in the H&S plan to be prepared BEZA	As defined in H&S plan	Tenant and monitored bi BEZA	O&M Cost
Health Monitoring	Community disturbance and potential safety hazard due to road traffic	Accidents, incidents and complains	Access Road	Accidents, incidents and complains	Based on occurrence	Tenant and monitored by BEZA	O&M Cost
	Public Concern	Complains	Neighboring communities	As to be defined in the H&S plan to be prepared by BEZA	Continuous	Tenant and monitored by BEZA	O&M Cost
Disaster Management Plan (DMP) Monitoring	Earthquake	Structure Design	Project Area	As to be defined in the DMP to be prepared by BEZA	Continuous	Tenant	O&M Cost
CSR Activities	Community Development	Activities/Programmes and No. of beneficiaries	Neighboring communities around the Project activity areas	No. of beneficiaries and outcome of the activities	Periodic and need based	Admin/ HR Manager and Station Manager	CSR Budget

8.6 Monitoring Indicators

The physical, biological and social components, which are of particular significance to the proposed project are listed below:

- Air quality
- Water quality
- Noise levels
- Solid & Hazardous Waste Management
- Re-plantation success / survival rate
- Soil Contamination & Soil Erosion

These indicators will evaluated periodically based on the monitoring results, baseline conditions, predicted impacts and mitigation measures.

8.7 Institutional Arrangement for EMP & EMoP

The main purpose of this environmental assessment is to delineate the correct measures to enhance the environmental sustainability of the proposed project through providing suggestion on design considerations, implementation, management and operation as suggested in the EMP. The effective implementation and operation of EMP depends on regular monitoring. The organogram of the proposed Environmental management &monitoring during construction phase directorate may be as ***Figure 8-1.***Each contractor will implement EMP and EMoP for each subproject and submit the environmental monitoring report to BEZA and Consultant based on its IEE/EIA. BEZA will submit the monitoring report to DoE and JICA based on the results of implementation of EMP and EMoP.

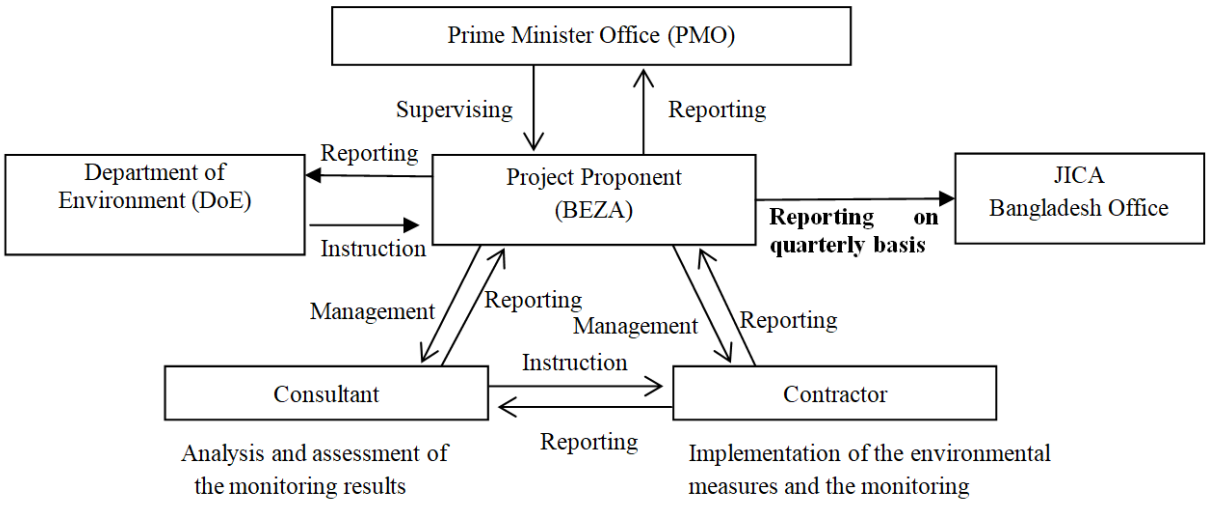


Figure 8-1: Implementation Structure / Mechanism of Environmental Management and Monitoring during Construction Phase

The organizational structure for the operation and management of environmental monitoring is shown in the ***Figure 8-2***. Each tenant will implement EMP and EMoP for each business and

submit the environmental monitoring report to SPC based on its IEE/EIA, and SPC will submit the whole result to the project proponent. BEZA will submit the monitoring report to JICA based on the results of implementation of EMP and EMoP which will be submitted by SPC.

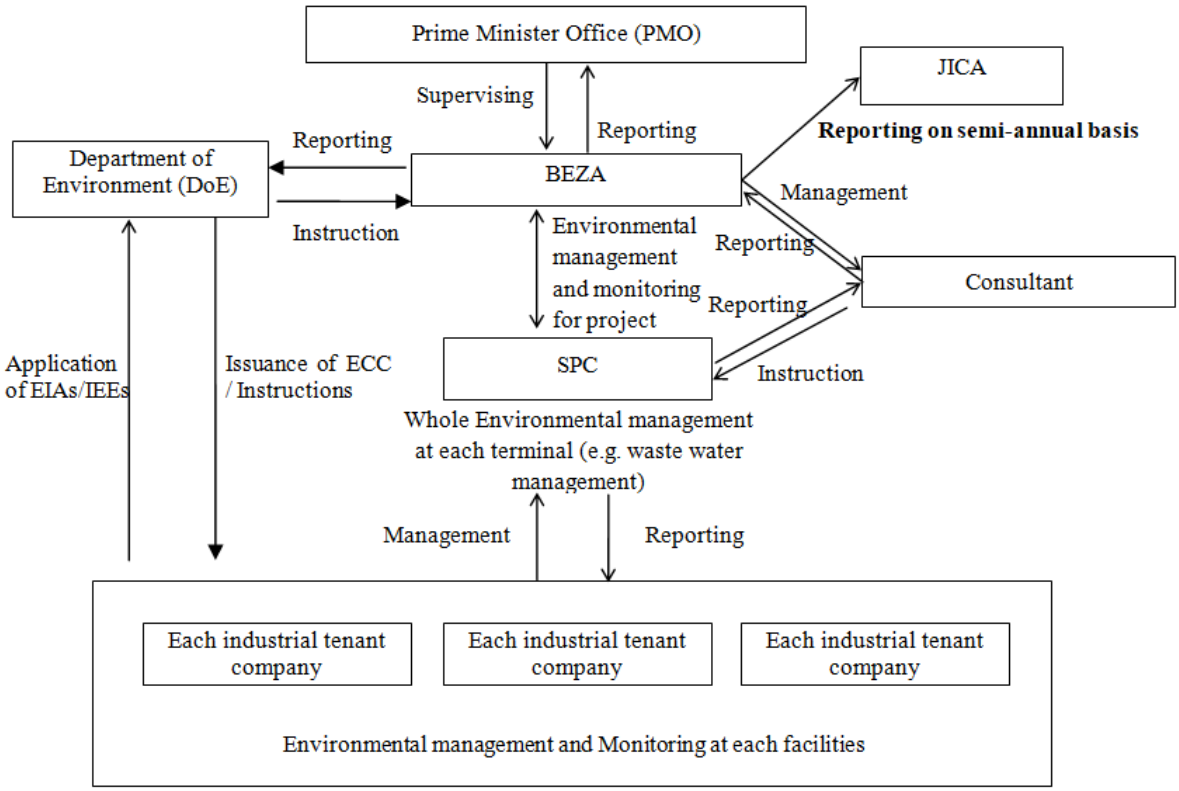


Figure 8-2: Implementation Structure / Mechanism of Environmental Management and Monitoring during Operatiom Phase

CHAPTER 9

9. COST ESTIMATION FOR ENVIRONMENTAL MITIGATION MEASURES AND MONITORING

BEZA will allocate a separate budget for environmental management plan implementation, training, environmental monitoring, analysis and reporting, verification monitoring and capacity building. It should be noted that cost for many in-built mitigation measures, such as, acoustic enclosures for noise control, water and wastewater treatment etc, need to be included in the contract cost estimation and/or operating cost estimation. The environmental management budget estimation for construction and operation phase of the Project is provided in ***Table 9-1***, ***Table 9-2*** *&* ***Table 9-3***. The EZ's tenant companies will be required to acquire their factory/facility environmental clearances from DoE, and they will have to enforce the instructions from EMP and secure a budget to monitor instructed environmental parameters accordingly. The following table shows the overall cost for the EZ development and its monitoring only without individual tenant factories/facilities' requirements.

Environmental Management Budget:

Table 9-1: Environmental Management Cost (A) in BDT

No.	Description of Item	Unit	Quantity	Unit Rate	Item Total
Pre-construction/Construction Stage					
01	Dust management by water sprayer	LS	-	-	1,000,000
02	Maintenance and protection of traffic including construction of diversion road, warning signs, and posting of signboard detaining project activities	LS	-	-	200,000
03	Campsite waste disposal facilities	Nos.	-	-	1,000,000
04	First aid box for treatment of injuries in emergency situations	Nos.	-	-	200,000
05	Water Supply	Nos.	-	-	500,000
06	Sanitary facilities	Nos.	-	-	200,000
07	Tree plantation and green area development plan	LS	-	-	5,000,000
08	Water quality protection measures: soil erosion and sedimentation control at the construction site and prevention of spillages, leakages of polluting materials, etc. to be at the satisfaction of the engineer.	LS	-	-	100,000
09	Stripping topsoil from borrowed agricultural lands, stockpiling and	LS	-	-	Included in the

No.	Description of Item	Unit	Quantity	Unit Rate	Item Total
Pre-construction/Construction Stage					
	replacing the same to rehabilitate the land to the entire satisfaction of the owner and the engineer				construction cost
10	Rehabilitation of ancillary sites including stockpile sites, brick crushing sites, borrow areas, work force camps/ site office, etc and turfing to the entire satisfaction of the engineer.	Sq.m	-	-	200,000
11	Orientation to the technical personnel/ Construction worker associated with the Economic Zone about the key issues of EMP	LS	-	-	Included in the construction cost
Total Environmental Management Cost (A)					**8,400,000**

Table 9-2: Environmental Management Cost (A) in BDT

No.	Description of Item	Unit	Quantity	Unit Rate	Item Total
Operation Stage (Yearly)					
01	Maintenance and protection of traffic including construction of diversion road, warning signs, and posting of signboard detaining project activities	LS	-	-	100,000
02	Campsite waste disposal facilities	Nos.	-	-	100,000
03	First aid box for treatment of injuries in emergency situations	Nos.	-	-	50,000
04	Water Supply	Nos.	-	-	Included in Operation & Maintenance Cost
05	Sanitary facilities	Nos.	-	-	Included in Operation & Maintenance Cost
06	Tree plantation and green area development plan	LS	-	-	300,000
07	Orientation to the technical personnel/ Construction worker associated with the Economic Zone about the key issues of EMP	LS	-	-	Included in the Operation & Maintenance Cost

No.	Description of Item	Unit	Quantity	Unit Rate	Item Total
Operation Stage (Yearly)					
Total Environmental Management Cost (B)					**550,000**

Table 9-3: Environmental Monitoring Cost (C) in BDT

Component	Stage	Item	Unit Cost	Quantity	Total Costs
Involuntary Resettlement	Pre-Construction &During Construction	Monitoring of Compensation for impact	-	-	Included in RAP Cost
Accident	During Construction	Ensuring that HSMP works right on the road track	-	-	Included in Construction Cost
	During Operation	Installing traffic signs, road mark, bump, zebra mark, guard rail and pole, and curb stones etc	-	-	Included in Construction Cost
HIV/ AIDs	During Construction	Ensuring that contractor's personnel and local community understand HIV-AIDS awareness campaign	-	-	Included in EMP Cost
	During Operation	HIV-AIDS awareness campaign	-	-	Included in EMP Cost
Air pollution	During Construction	Measurement of SPM, PM 2.5, PM10, CO, SOx, NOx	50,000	48	2,400,000
	During Operation	Measurement ofPM10, PM2.5, SOx, NOx, CO	50,000	16	800,000
Water pollution (Surface & Ground Water)	During Construction	***Surface Water*** Turbidity, pH, DO, Total dissolved solids, oil & grease, total coliform, heavy metals ***Ground Water*** Drinking water quality parameters as per Schedule 3 of ECR 1997	30,000	48	1,440,000

Component	Stage	Item	Unit Cost	Quantity	Total Costs
	During Operation	***Surface Water*** Turbidity, pH, DO, Total dissolved solids, oil & grease, total coliform, heavy metals ***Ground Water*** Drinking water quality parameters as per Schedule 3 of ECR 1997	30,000	16	480,000
Waste	During Operation	Turbidity, pH, DO, Total dissolved solids, oil & grease, total coliform, heavy metals	30,000	4	120,000
Noise	During Construction	Periodical maintenance of construction vehicles and installation of sound insulation cover(Noise levels)	5,000	180	900,000
	During Operation	Securing of a buffer zone around 100m as noise decay distance (Noise levels)	5,000	60	300,000
Soil	During Pre/ Construction	pH, salinity, NH4+, total- P, heavy metals, oil & grease	-	LS	240,000
Offensive odor	During Construction	Odor inspection to ensure harmful odor is not released from equipment and waste	-	-	Included in Construction Cost
Occupational Health & Safety and Community Health& Safety	During Construction	Accident or incidents due to construction activities, dangerous occurrences	-	-	Included in EMP Cost
	During Operation	Hazard due to road traffic	-	-	Included in EMP Cost
Ecology	Aquatic and Terrestrial Ecology	Visible flora and fauna monitoring	-	-	Included in EMP Cost

Component	Stage	Item	Unit Cost	Quantity	Total Costs
Total Environmental Monitoring Cost (C)					**6,680,000**
Environmental Training	During Operation	Orientation Workshop and follow up training program for capacity building/ institutional development program	-	LS	2,000,000
Environmental Training Costs (D)					**2,000,000**
Grand Total (A+B+C+D)					**17,630,000**

CHAPTER 10

10. EMERGENCY RESPONSE PLAN & DISASTER MANAGEMENT PLAN

10.1 Introduction

An Emergency Response Plan (ERP) is a written document, which is required for an organization according to occupational health safety standards and must be displayed at every job site with a certain number of employees (usually five to ten). It is a detail step-by-step procedure to follow in emergency such as fire, chemical spill or a major accident. An emergency response plan also includes information such as whom to notify, who should do what, and location of emergency stock. The Emergency Response Plan includes any measures that should be in place at all facilities to combat an accident resulting from fire, explosion or due to any natural calamities (e.g. Earthquake, cyclones, flood).

10.2 Purpose

This Emergency Response Plan has been developed to provide an organizational and procedural framework for the management of emergencies in the Araihazar Economic Zone project. The purpose of an ERP is to facilitate and organize employer and employee actions during workplace emergencies. Well-developed emergency plans and proper employee training (such that employee understand their roles and responsibilities within the plan) will result in fewer and less severe employee injuries and less structural damage to the facility during emergencies. A poorly prepared plan, likely will lead to a disorganized evacuation or emergency response, resulting in confusion, injury and property damage. To respond immediately for any kind of emergency/ hazardous condition as well as to take proper action immediately/ in a short time to normalize or minimize the situation as soon as possible.

10.3 Scope

This Emergency Response Plan covers those designated actions managers and employees must take to ensure employee and consumer safety from technological and natural hazards as well as other emergencies. This plan includes: emergency escape procedures and emergency escape route assignments, procedures for employees who have to stay to operate critical plant operations after they evacuate, procedures to account for employees after emergency evacuation has been completed, rescue and medical duties for those employees who are to perform them, the preferred means of reporting fires and other emergencies; and individuals who can be contacted for further information about the plan. All of this operation depends on Araihazar Economic Zone project site and surroundings environment and Senior Manager, ERP coordinators, HOD's.

10.4 Objectives

In general, objectives of a plan describe what we expect to achieve by a plan. Even if the nature of the research or plan has not been clear to a person from the hypotheses, s/he should be able to understand the research from the objectives. An emergency plan specifies aim and procedures for handling sudden or unexpected situations. For Emergency Response Plan some select outstanding objectives are given below-

1. To identify the various types of natural, manmade and technological disasters and hazards this may impact on the Project
2. Consequence of these hazards in the Project
3. To propose some necessary action plan for minimize the worst situations.
4. To conduct safety operation for save life and properties
5. To build up awareness among employee to prevent fatalities and injuries
6. To ensure proper duty at the hazardous period and communication system
7. To ensure the duty of management to take emergency action in a short time
8. Reduce damage to buildings, stock and equipment. Acceleration the resumption of normal operation
9. To find out the means are available to stop or prevent the situation.
10. To ensure Occupational Health & Safety

10.5 Potential Emergencies

Any incident affecting the entire building, which may place life and property in a disaster and hazard, is considered an emergency. Outside emergency services will be required, as will major efforts from various governmental agencies. Various kinds of emergencies are as follows:

Examples of technological hazards are

1. Fire
2. Explosion
3. Gas leak
4. Electric power or gas cut
5. Building collapse
6. Chemical hazard
7. Major structure failure
8. Spills of flammable liquids
9. Accidental release of toxic substances
10. Terrorist activities, riot, bomb threat, hostage incident, sabotage
11. Exposure to ionizing radiation
12. Loss of water supply

13. Loss of communication
14. Crash or collision

Examples of natural hazards are

1. Flood
2. Cyclone
3. Earthquakes
4. Tornadoes
5. Sever extremes of in temperature (cold or hot)

10.6 Plan for Sudden Fire in the Project area

Warn other building tenant, and gather assembly point outside of the building. Ensure one operator is always present at Hydrant system area when using the fire Hydrant system and ensure the last person has come out from the room but not lock the door. Remain available to give vital information to Crisis Management Team professional firefighters about location, size, occupants, and shut off valves.

Steps to Safety in fire incident

- Call to the Control room or Emergency Response Team
- Isolate the area by shutting doors when exiting.
- Use stairs; never take the elevator during a fire.
- Never attempt to re-enter the building unless cleared to do so by the Fire Department.
- If able, assist people with special needs.

If Caught in Smoke

- Drop to hands and knees and crawl towards the nearest exit.
- Stay low, smoke will rise to ceiling level first.
- Hold your breath as much as possible; breathe through your nose and use a filter such as a shirt, towel or handkerchief.

If Trapped in a Room for Smoke

- Close as many doors as possible between you and the fire.
- Wet and place cloth material around or under the door to help prevent smoke from entering the room.
- If the room has an outside window, be prepared to signal to someone outside.

Clothing on Fire (Stop, Drop and Roll):

- Direct or assist a person to roll around on the floor to smoother the flames.
- Only drench with water is immediately available.
- Obtain medical attention.
- Call Control Room
- Report incident to Senior Authority

10.7 Plan for Sudden Flood Protection

There are two types of floods, which occur in Bangladesh: annual floods (barsha) that inundate up to 20% of the land area; and low frequency floods of high magnitude that inundate more than 35% of the area (bonna). The major floods that occurred in 1954, 1955, 1974, 1984, 1987, 1988, 1993, 1998, 1999, 2000, 2007 and 2017 have been very destructive and caused serious threat to lives and economy. In the context of human exposure in flood hazard zones, nearly 19,279,960 people are present in these zones and Bangladesh ranks 1st among 162 nations.

In order to confirm the real site flood levels of Araihazar, hearing surveys have been conducted for residents and upazilas of Project sites. The main target high water levels are obtained from hearing surveys of local residents (patriarchs) who experienced the 1988 and1998 floods, then converted to the altitude of digital mapping. According to the results of these surveys, the past average flood water level of Araihazar was + 6.3 m. The past flood water levels of Araihazar was affected by the high water level of the nearby rivers, and can be treated as a static water surface for simplicity's sake.

10.7.1 Short Term Protection Plan

(a) Factory Perimeter: When the flood is eminent a sand bag wall (3'/covered with polythine roller sheet to be created around the factory necessary preparations for this to be made soon after getting the flood

(b) Plants/Systems/Machinery: Removal/shifting of machinery will not feasible. So, these are to be protected through building wise secondary wall and water pumping facilities.

(c) Stores/ Warehouses:

- Racking system to be used to increase the height
- Emergency shifting of un-racked items to higher places

(d) Dangerous Chemicals: To be shifted to higher and safer place in case of flood

(e) Power Stations: Power Stations are considered to be at risk-free height. All the holes at the cable tray (inlets/outlets) to be made fully water tight for prevent any leakage

(f) WTP: Considered to be at risk-free height. However the pipe line system to be made absolutely leakage free to avoid any contamination of water;

(g) Labor Sheds: Sandbag walls to be made for protection

(h) Vehicles: In extreme case all vehicles to be moved to higher and safer place

10.7.2 Long Term Protection Plan

The long-term protection plan is given below

a. An embankment may be made for flood water of river

b. All the production floor levels may increase.

c. All the machine bases may be increase.

d. All the Power Stations bases may be increase.

10.7.3 Other Action Plan

a. Flood Protection Cell: Factory in charge, Deputy Manager Admin, manager HRM, Deputy Manager Compliance will constitute this cell. To be activated once Orange Alert is declared. Coordinate all flood protection activities.

b. Flood Level Monitoring System: The river water level to be monitored and recorded in the Control Room.

Flood Alert:

Orange Alert	Orange Alert to be enforced when flood water is within 2′ of Factory level. Preparations for temporary protection to be started at this state.
Red Alert	Red Alert to be enforced when flood water is within 1′ of factory level.

a. Temporary Protection Measures are to be implemented at this state.

b. Emergency Power: DG and REB to be used as emergency power to keep at least the security lighting & Floor lighting system operational.

c. River Transports: All river transports to be kept operational to meet any emergency. (if any)

10.8 Emergency Procedure

Safety Operating Procedure of Emergency Response Plan means executing systematic operation of any Emergency, which can occur inside the Economic Zone.

Based on these events, the required actions are determined. For Example

1. Declare emergency
2. Siren/Sound and alert
3. Evacuate danger zone
4. Close main shutoffs
5. Call for external aid
6. Initiate rescue operation
7. Attend to casualties
8. Fight against the hazard.

The final consideration is a list and the location of resources needed

1. Medical supplies
2. Auxiliary communication equipment
3. Power generator
4. Chemical and radiation detection equipment
5. Emergency protective clothing
6. Mobile equipment
7. Firefighting equipment
8. Ambulance
9. Rescue equipment
10. Trained personnel

Any person noticing the emergency shall report to their Department Head/Shift Executive/Shift Supervisor either in person or through the intercom. The department Head/Shift Executive/Shift Supervisor on receipt of the emergency shall visit the site to assess the situation. If the situation is an emergency then he/she calls for an emergency.

10.9 Emergency Communication

An emergency communication is a system that is organized for the primary purpose of supporting one way or two-way communications of emergency massages between both individuals and group of individuals. These systems are commonly designed to integrate the cross communication of massages between a variety of communication technologies, forming a unified communication system intended to optimize communications during emergencies.

At the emergency period need to communicate with Control Room or Emergency Response Team for informing hazard nature, effected persons/materials quantity, location etc. Person should report activity to emergency responders when they arrive on the scene.

- Keep all kind of electronic communication system functional like mobile phone and computer networking system.
- Notify the emergency according to its degree.
- Notice the emergencies to the emergency response team.
- Use alarm bells, visual alarms or other forms of communication to reliably alert employees to an emergency.
- Mark specific areas where employees should gather during an alarm or any emergency announcement.
- Effective rescue operation to save lives and properties

- Only responsible team (Emergency Rescue Team) will conduct the operation.
- If any case of failure or additional help a definite number of persons can move on according to call for Emergency Rescue Team.
- Ensure availability of rescue equipment's list.
- Sound communication system of road.
- No need to overcrowd in incident area and it need for a sound communication.
- Need to review incident reports for past five years
- Ensure a vital Evacuation Plan
- Availability of medical equipment

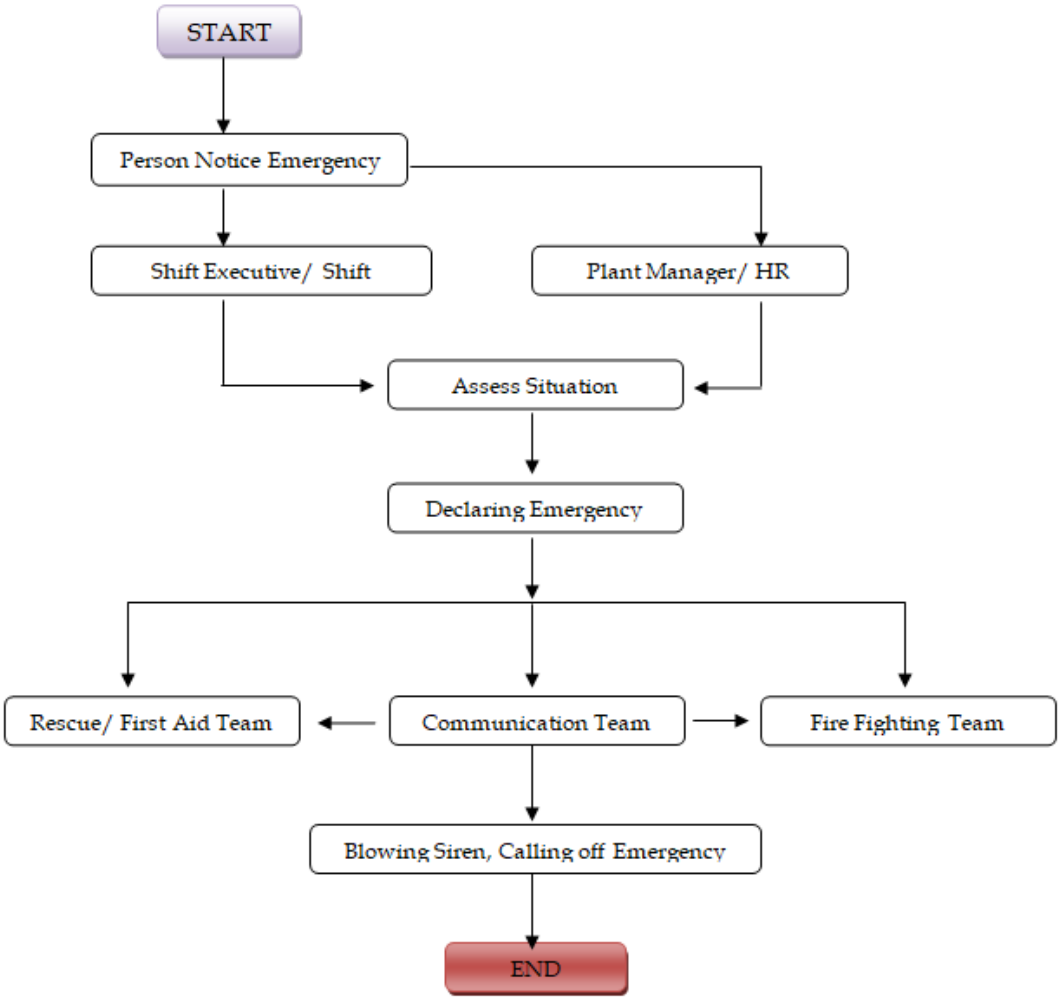


Figure 10-1: Emergency Communication System

10.10 Activities Due to Emergency

Attendee of incident place shall inform Control Room & Emergency Response Team in case of emergency.

- Stop work immediately and vacate the workplace.
- Shut down the electrical connection.
- All employees will go to the designated Fire Assembly Point located & mark in the specific area of Araihazar Economic Zone.
- Any Emergency Response Team member or designated person shall notify the fire department and fire service and important person by phone.
- Once fire department has been notified and it is safe to do so, trained Fire Fighting team may attempt to extinguish small fires. All fires need to be reported to the senior authority.
- When the incident place has been evacuated a head count shall be done by the designated person accounting for all employees on place including those who may be trying to extinguish the fire
- A List of personnel on place, updated and current will be kept in the Personnel office.
- The Emergency Response Team is responsible to ensure the requirement of fire department and gives all pertinent information.
- Facility should provide first aid attendants as well as medical equipment suitable for the people if any injury took place during incident and quickly react to give maximum medical facility.

10.11 Record Keeping

Record is a combination of information and helps employers and workers to understand industrial hazards its causes and implementation of proper task. Record keeping of any incident shows require steps need to be taken and weakness of previous incident. For proper recordkeeping need to maintain some regular procedure as-

- Emergency Response Plan
- Emergency training records
- Previous incident record
- Module and materials used for training
- Emergency preparedness drill/rehearsal
- Evaluation feedback from training and emergency drills;
- Records and information about previous incidents

10.12 Responsibility

ERP Coordinators: Any person of Emergency Response Team can act as a responsible person during working day. They are responsible to handle any types of emergency situation individually and follow up the all preventive procedure followed by respective team. They communicate to all the industries, all local administrative personal or offices during emergency occur.

Shift Executive: Shift Executive is acting as a site controller's role during night shift operation and will be continuing the role till any above mention person comes to the factory. Security supervisor is to assess all types of emergency work with the shift executive**.**

Security supervisor: Security supervisor is acting as a site controller role during Holiday or weekly off day and he will be continuing the role till any above mention persons comes to the factory.

First Aid Team: The member of the first aid team is totally responsible to handle any type of personal injury / accident and communicate the same to crisis management team and follow up their guidance and procedure as illustrated bellow**.**

10.13 Emergency Response for Natural Hazards

10.13.1 Flood

- Evacuate the people from flooded area and send them to a safe area.
- Switch of the power supply from effected area.
- Remove all types of obstructions from the drainage system.
- Coordinate with the Emergency Response Team and take action as per their guideline.
- In cases of any accident in human life please call first aid team and get medical attention as soon as possible.
- Call local fire brigade through communication system in case of worst or out of control situation.
- In case of over flood polythine and sand bag to protect adverse effect

10.13.2 Cyclone

- Switch off the Power Supply of Sub-station.
- Close all the in & out doors where possible wind enters.
- Open windows, exhaust at the top of the walls if present and allow the wind go from top which enters into the industry/plant shades.
- Instruct all the associates including workmen not to allow them to go outside till the wind & cyclone effect reduces to the normal level

- After the cyclone, inform to Emergency Response Team to investigate the property loss in the industry for further action.

10.13.3 Earthquake

- Isolate electrical supply where ever it is possible.
- Do not use elevators.
- All electric connection of the Araihazar Economic Zone should be cut off on that time. And the important thing is that, everybody will go in a safe place from near of the building.
- Ensure fire and siren alarm system in all floors. During earthquake all the employees will come down in safe place in a row through stair after hearing the alarm.
- Have to follow the instruction regarding earthquake
- Have to evacuate as per evacuation plan
- We should have Rescue Team to help the injured employees or who get down. And they will also take the injured employees in a safe place
- Isolate all pipelines of steam, gas pipeline, compressed air, fuel and CO_2 when they are not in use.
- Check availability of security personnel and have a chat with them in view of likely immediate action to be taken.
- Empty such tanks which are installed in vertical and relatively unstable conditions.
- Take a review of material storage and ensure that maximum of such material is removed from places from where it can fall down. Uniform Material distribution at a lowest height from floor is the safest way of storage.
- Ensure caps on all compressed gas cylinders,
- Immediate ready to use all Emergency equipment like stretchers, breathing equipment, PPEs, Dewatering, portable welding gas cutting equipment, Spill kits, emergency lights, Battery operated public address equipment, Ropes, lifting tackles, trolleys, emergency medical equipment, etc.
- Emergency transport vehicle shall be parked in open so that it is free from any falling object.
- Identify critical and weak areas of the building and organize to support them adequately to prevent collapse.
- Check storage of Hazardous Chemicals to comply with normal storage safety requirements.

- Keep Fire Hydrant accessible, Keep newest and good conditioned fire hoses and Fire extinguishers readily available.
- Remove unwanted combustible material.
- Review that room heater, electric hot plates and other sources of ignition that are normally used in winter situations are operated, handled and stored safely.
- Ensure that flammable liquids i.e. Petrol, Diesel and other petroleum products are stored under secondary containment with due precautions.
- Over and above ensure that personnel are alert and do not panic.
- Ensure the average 6 feet height of raw materials and finish good.

10.14 Emergency Response Plan for Other Hazards

10.14.1 Fire

- Evacuate the people from Fire occurred surrounding area and send through safe exit direction.
- Remove unwanted combustible material.
- Keep cool and do not panic.
- Inform to substation and electrician to get the affected area isolated from power supply.
- Keep Fire Hydrant accessible.
- Keep newest and good conditioned fire hoses and Fire Extinguishers readily available.
- Ensure one operator is always present at Hydrant system area when using the fire Hydrant system.
- If the fire is very small, use the correct Fire Extinguisher for extinguishing the fire.
- Try to isolate the fire by removing the surrounding inflammable material from within reach of fire.
- In case of big fire use local Hydrant system for extinguishing the fire
- If the fire is beyond the control inform the security or higher authority to call local fire Brigade and Inform Senior manager (Factory/EZ In charge) or Emergency Response Team.
- On arrival of the fire brigade pave way for them reach the exact site of fire.
- In case of any accident in human life please call first aid team and get medical attention as quickly as possible.

10.14.2 Fatal Accidents

- During emergency operation if there is any injured person, carry out victim /causality to the security room and Conference Room also OHS Room beside the support of company recommended nursing home.
- Call First Aid Team and carry out the first aid with the help of first aid item.
- Inform to Emergency Response Team.
- If the accident is severe, then call emergency vehicle and immediately rush the injured person to local hospital or company recommended nursing home. Phone numbers are available in bellow.
- Fill in the accident report form with the help of witness and deposit the same to the Emergency Response Team.

10.14.3 Utilities Failure

Examples of utility failure that may occur are electrical outage, plumbing failure/flooding, natural gas leak, steam line break, ventilation problems and/or elevator failure. In the event of a failure, immediately notify Emergency Response Team.

- For emergencies and potential danger or after hours call to Control room
- In a situation where a building needs to be evacuated, please proceed to the building specific evacuation area.
- Turn off equipment, machines and computers.
- Assist disabled persons as needed.
- Do not use elevators.
- Stay at the designated evacuation area until the fire department or designated representative has given the "all clear" to re-enter the building.

CHAPTER 11

11. PUBLIC CONSULTATION AND DISCLOSURE

11.1 Introduction

As per the JICA Environmental Guidelines, BEZA has disclosed the project information and provided opportunities for stakeholders, particularly project affected stakeholders including landless share croppers, to participate the EIA and RAP preparation. Based on the past records in Bangladesh, stakeholders' participation could lead timely land acquisition and resettlement as well as less conflicts during the construction and operation stages between project proponents and local stakeholders. Unlike the government-funded projects, it is particularly important to understand the community needs for livelihood recovery assistances, which are not provided by the government funded projects but are mandatory for the JICA funded projects. BEZA has been committed to comply with the JICA Environmental. Guidelines and adapted to enhance the benefits of the project affected persons (PAPs) through the project activities and livelihood recovery assistance programmes.

11.2 Approach and Methodology for Public Consultation& Disclosure Meeting

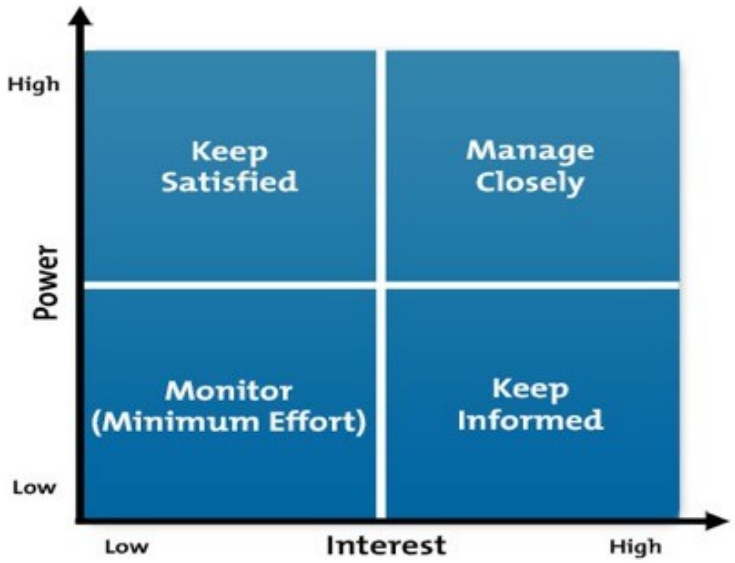
The approach undertaken for information disclosure and consultation involved the following key processes.

- Mapping and Identification of key stakeholders such as primary (direct project influence) and secondary (indirect project influence) stakeholders;
- Undertaking expert consultations, interviews and focus group discussions(FGD) with the respective stakeholders;
- Undertaking structured on field consultations, interviews and focus group discussions (FGD) with the respective stakeholders;
- Assessing the influence and impact of the project on these stakeholder groups;
- Summarizing of key findings and observations from the consultations; and
- Preparing a future stakeholder engagement strategy consultation plan for amore detailed assessments at a microscopic level taking into account the various project lifecycle phases and their implications on the stakeholder.

11.3 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 (Manage Closely): People who have high power and interest are grouped in this category. They always must be managed closely. 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 (Keep Satisfied/ keep informed): People who have high power but low interest as well as who have high interest but low power should be kept satisfied or informed. 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 (Monitor with minimum effort): This implies a low degree of influence or interest of the stakeholder on the project in terms of participation and decision making or low priority for project proponent to engage that stakeholder.



Power/Interest Grid for Stakeholder Prioritization

How they are likely to feel about and react to the project, how best to engage them in the project and how best to communicate with them, are measured by getting answers of following questions;

- What financial or emotional interest do they have in the outcome of your work? Is it positive or negative?
- What motivates those most of all?
- What information do they want from the project?
- How do they want to receive information? What is the best way of communicating?
- What is their current opinion? Is it based on good information?
- Who influences their opinions generally?
- If they are not likely to be positive, what will win them around to support the project?
- What should be done to manage stakeholders' opposition?
- Who else might be influenced by stakeholders' opinions?

Stakeholders were talked directly and asked their opinions in building a successful relationship with them.

Table 11-1: Stakeholder Mapping for the Project

Stakeholders	Category of stakeholder	Brief profile	Overall influence on the project	Basis of Influence Rating
Project Management				
Bangladesh Economic Zone Authority (BEZA)	Primary	• BEZA is the primary project proponent own a controlling stake of 100% in the project	Highest	• Primary project proponents • Primary financial beneficiaries • Responsible for all the project risks and impact liabilities • Responsible for establishment and operation of this project
Project Financiers	Primary	• Financiers at the corporate and project level of BEZA for the project. • May include local and regional bank, national and international banks as well as development	Highest	• Engagement is limited at the corporate management level. • Key participants in the decision making process • Compliance to funding agencies' safeguard and other policies
EPC Contractor/ Developers	Primary	• Construct to deliver a functioning facility or asset to their clients	Medium	• Carry out the detailed engineering design of the project • Procure all the equipment and materials necessary • carry out the works in accordance with the
Community				
Settler households	Primary	• Primarily includes households who are currently living within the proposed project site.	Medium	• A total of 11 households have been identified who are living in the proposed project site. All households will lose their homestead land and need to shift their all movable structures before project activities

Stakeholders	Category of stakeholder	Brief profile	Overall influence on the project	Basis of Influence Rating
				started; • Households' livelihood and quality of life will be hampered consequently; • High interest with low influence
Vulnerable Households	Primary	• Primarily includes those households who underlie in low yearly income and female/handicapped/ elderly person headed	Medium	• Vulnerable households have common tendency to fail cope up with the drastic change of the existing settings. It results impoverishment of the vulnerable households. • Vulnerability can be defined by who underlies below poverty line, elderly, women and handicapped headed households. • Interest is high with low influence
Farmers and sharecroppers and Agriculture labor	Primary	• Primarily includes the farmers and sharecroppers who do farming in the proposed project area	Medium	• About 540.77 acre land will be acquired for the proposed project. • Acquired land is currently being used for agricultural production. • Significant numbers of farmer's including landless, marginalized, small, medium and large categories are currently involved with agricultural activities in the proposed project site. • Landless farmers are those who do sharecropping activities with the agricultural landowners. These sharecroppers also work as a labor in other

Stakeholders	Category of stakeholder	Brief profile	Overall influence on the project	Basis of Influence Rating
				agriculture land. • Farmers' land, income and livelihood will be affected in different degrees. • High Interest with low influence
Local Community	Primary	• Primarily includes adjacent community to the project site	Medium	• Improvement in infrastructure in the area • Project will bring development to the area • Increase in employment opportunities and preference in job. • Approach road will be developed near future • Business/Economic condition will be improved; • High interest with low influence;
Fisheries Community	Primary	• Primarily includes those fishermen who catch fishes within the proposed project area.	Medium	• Few numbers of fisheries communities live around the proposed project site. They catch fish from the Canal that goes through the proposed project site. • In wet season this project area becomes a major source of indigenous fisheries for the fishermen. • Fisheries community may not continue their fishing activities when project activities starts. • Interest is high with low influence
Regulatory/Administrative Authorities & Agencies				
Dept. of Environment,	Primary	• The Department of	High	• Government Regulatory agency to provide

Stakeholders	Category of stakeholder	Brief profile	Overall influence on the project	Basis of Influence Rating
Bangladesh, DoE		Environment is the primary government regulatory authority for Environmental protection in Bangladesh.		Environmental Clearance (EC) to the project based on evaluation and approval of Environmental Impact Assessment (EIA) study • Responsible for monitoring project's Environmental compliance throughout the project lifecycle • High influence and high interest
Department of Agriculture	Secondary	• Local governmental agency responsible for implementation of governmental agricultural activities;	Low	• Very marginal impact on total Upazilas' agriculture land and agricultural production. • Dust may decrease the agricultural and vegetation production. • Interest level is low with low Influence level.
Department of Fisheries	Secondary	• Local governmental agency responsible for implementation of governmental fisheries activities	Medium	• Existing Dhawrakhali Canal should be kept as it is or indigenous fisheries supply will be reduced dramatically in the local area. • Water and fisheries may be negatively impacted by water disposal in adjacent cannel. • Interest level is high with low influence.
Department of Education	Secondary	• Local governmental agency responsible for implementation of governmental educational	Medium	• Dust and heavy vehicle may create obstacle for students for going educational institute. Thus, proper mitigation measures should be employed by the proponent

Stakeholders	Category of stakeholder	Brief profile	Overall influence on the project	Basis of Influence Rating
		activities		• Interest high with low influence
Department of Public Health Engineering	Secondary	• Local governmental agency responsible for implementation of governmental public heath activities	Medium	• Accidental spillage may pollute soil as well as ground water that causes public health vulnerable. • Interest high with low influence
Political Administration				
Upazila (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 • Low interest with high influence
Union leaders& local representatives	Secondary	• Elected representative at ward 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 • Low interest with high influence
Other Institutional Stakeholders Groups				
Local NGOs and Community & Social Welfare Groups (CSWG)	Secondary	• Microfinance agencies, social welfare groups and charitable organizations working in the area	Low	• No major involvement in the project as per today • Possible inclusion during future stages of the project with respect to community welfare activities is low • Low interest with low influence

11.4 Information disclosure and consultation

Number of consultation exercises was conducted during this phase of EIA preparation. The stakeholders consulted include local People, community in the vicinity of project area, local elected representatives and other external stakeholders such as government officials. The details of consultations held with issues raised or discussed and suggestions provided by the respective stakeholders are presented in below

Key informant interview

Details of key informant interview with major stakeholders is given below

Table 11-2.Photographs of the KII are shown in ***Annex B.***

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

- Key informant interview (KII);
- Focus group discussions (FGDs); and
- Public Consultation meetings (PCMs)
- Public Disclosure meetings (PDMs)

11.4.1 Key informant interview

Details of key informant interview with major stakeholders is given below

Table 11-2: Details of Key informant interview

Date	Stakeholder Details	Details of participants	Issues discussed/raised	Outcomes of the Brief
26.11.17	Department of Fisheries	1. Mohammed Anisuzzaman, Fisheries Officer, Araihazar Upazila 2. Md. Najmul Hossain, Consultant, EQMS Consulting Limited 3. Abu Mohammed Nasiruddin, Assistant Consultant, EQMS Consulting Limited	• Role and responsibility of the local fisheries departments • Where are the primary fishing point located in and around in Araihazar Upazila and respective Union. • Details of Fishing production in respective Unions • Details on the key species of fishes observed in adjacent Rivers and water bodies, • Understanding on the Fishermen community and their practices, • Total number of fisherman • Critically endangered fish species • Type of fishing activity • Fish landing site • Commercial fish drying activity • Possible threats in fisheries as the consequence of proposed Economic Zone.	• The Department of Fisheries (DoF) is under the administrative control of the Ministry of Fisheries and Livestock. It is headed by a Director General, who is assisted by four Directors (one reserve) and 2 Principal Scientific Officer (equivalent to Director). There are administrative set-ups at division, district and Upazila (sub district) levels headed by Deputy Director, District Fisheries Officer and Senior/Upazila Fisheries Officer respectively. • Upazila Fisheries office rendersits services to achieve the mission and vision of theDoF. • Total areas of capture and culture fisheries in Araihazar are 2503.44 hectare and 1036.98 hectare respectively. All over production in this upazila is comparatively low than other districts of Bangladesh. • In Satgram Union, fish culture and capture practice is comparatively low. About 165.26 hector fish culture and 19.64 hector fishcapture is recorded. • No major fishing sanctuary is located in project surrounding area.

Date	Stakeholder Details	Details of participants	Issues discussed/raised	Outcomes of the Brief
				• There is a canal named Dhawrakhali goes through the proposed project site. It goes Northern to Southern West direction. This canal is an important source of indigenous fish for this locality. As this Canal is connected to river, in wet season a large amount of indigenous fish come through this canal. Local fishermen catch fish from this canal and live their livelihood on that time. • A total of 50 registered fishermen identified in Satgram (19) and Duptara (31) Union. • Approximately 8-12 fishermen do fishing in the project area during wet season. • Fishermen use push net for fishing. • No major fish landing site is situated adjacent to project site • No Commercial fish drying activities are carried out. • Heavy metal and chemical may use in the Proposed Economic Zone. Appropriate measures should be taken for not contaminating the open water bodies. • Existing Dhawrakhali Canal should be kept as it is. Affected fishermen, who can't continue to fishing activities as the consequence of the project, should be considered for livelihood assistance for alternative income generation.
26.11.17	Department of	1. Md. Abdul Kadir, Agriculture Officer,	• Understanding and Broad overview of the agricultural	• Total agriculture land of the AraihazarUpazila is 18,115.7 hector where

Date	Stakeholder Details	Details of participants	Issues discussed/raised	Outcomes of the Brief
	Agriculture	AraihazarUpazila, 2. Md. Najmul Hossain, Consultant, EQMS Consulting Limited 3. Abu Mohammed Nasiruddin, Assistant Consultant, EQMS Consulting Limited	sector in AraihazarUpazila and respective Unions, • Information on the cropping pattern in the area and agricultural practices, • Wage rate in agricultural labor (with food and without food), • Agricultural production per acre • Price of paddy and Mustard • Possible threats in Agriculture as the consequence of proposed Economic Zone.	in Araihazar union is 1963.97 hector that represents 4.4% of whole Upazila. • In Satgram Union about 75.38% land is agricultural land. Single cropped area is 237 ha (16%), Double cropped area is 888 ha (60%) and triple cropped area is 355 ha (24%). Most of the proposed acquired lands are used for single cropped production. But some portion is sometimes used for double cropped production. Mostly paddy is produced in these lands but sometimes mustered is produced also. • Common agricultural products are Paddy, Mustard, Dhaincha, Potato, Jute, Pulses and vegetables. • Proposed 166.03 acre land of Panchgaog Mouza underlies in Panchgaog Block. This block comprises Low and middle low land. Most of the lands of this Mouza are used for double cropped production namely Buro and RupaAmon. Approximately 400 agricultural land owners and 250 sharecroppers may involve in this proposed land area. • Proposed 325.45 acre land of PanchrukhiMouza underlies in Panchrukhi Block. Most of this block land comprises low in nature and are used for single cropped production namely Buro. • Maximum production (paddy) 3700kg per ha and (Mustard) 1300 kg per ha;

Date	Stakeholder Details	Details of participants	Issues discussed/raised	Outcomes of the Brief
				• (Paddy) BDT 1200-1250 per 40 kg and (Mustard) BDT 1700-1800 per 40 kg; • Wage rate in agricultural labor vary from season to season 350-400 tk. • There is a Canal goes through the proposed project site. It works to drain up the excessive water during the rainy season. This Canal should be kept as it is otherwise adjacent agricultural land will be inundated during the rainy season.
26.11.17	Department of Public Health Engineering	1. Al Farhad, Assistant U.D., Araihazar Upazila, 2. Md. Najmul Hossain, Consultant, EQMS Consulting Limited 3. Abu Mohammed Nasiruddin, Assistant Consultant, EQMS Consulting Limited	• Number of deep tube-well and shallow tub-well number in project area, • Arsenic and Iron concentration of the project located union and upazila • Source of water for drink and agriculture, • Testing water quality when installed the tube-well	• A numbers of deep tube-well and shallow tube-well is installed in the project area, • Arsenic and Iron level within the project location is in standard limit. Standard Deep tube-well depth is 650 feet and shallow tube-well depth is 250-300 feet. • Tube-well is used for drinking and cooking purpose and deep/shallow tube-well, pond and cannel water are used for agriculture production purposes. • Test for Arsenic and Iron contamination has been considered before tube-well installation
26.11.17	Department of Education	1. Rabeya Khatun Education officer, Araihazar Upazila 2. Md. Najmul Hossain, Consultant, EQMS Consulting Limited	• General educational institution information; • Possible threats in Agriculture as the consequence of proposed Economic Zone; • What short of awareness need	• There are 12 primary school are situated within the 2 km radius from the proposed EZ consisting approximately 5100 students. • Use less noise generating machines • Considering not creating any dust during construction period.

Date	Stakeholder Details	Details of participants	Issues discussed/raised	Outcomes of the Brief
		3. Abu Mohammed Nasiruddin, Assistant Consultant, EQMS Consulting Limited	to highlight during this construction phase; • Sufficient mitigation measures and safe waste management plan should be developed; • How may BEZA contribute in primary education development the in project area people?	• Sufficient mask and caution sign will be required for the health and safety of the school going students. • Reduce Air and noise pollution. • Industrial solid wastes dump the safe place. • Ensure the waste water treatment. • BEZA may help by contributing in the improvement of the existing schools' facilities.
26.11.17	Grameen Bank, NGO	1. Shanjay Kumar Das, Manager, Purinda Bazar Branch 2. Md. Najmul Hossain, Consultant, EQMS Consulting Limited 3. Abu Mohammed Nasiruddin, Assistant Consultant, EQMS Consulting Limited	• Perception about the proposed project; • Details of NGO activities in the project area • Number of Beneficiaries • How may NGO help the project organization to engage in community development implementation?	• This kind of project creates opportunity to enhance economic and social development. Job, business opportunity will be created. Unemployment rate for both male female will be decreased. Economic solvency may contribute to reduce the social/gender based violence. • Grameen Bank is working in the project area for giving microfinance facilities to the local people. Currently, seven groups consisting 50-55 people each group are active beneficiaries of Grameen Bank. • Most of the people take micro-credit for doing cloth and boutique business. • Grammen Bank works for the financial sovereignty of the local people only. Other community development activities are not the major concern of Grameen Bank.

11.4.2 Focus Group Discussions (FGDs)

Focus group Discussion (FGD) is a small, but demographically diverse group of people and whose reactions are studied especially in market research or political analysis in guided or open discussions about a proposed project or something else to determine the reactions that can be expected from a larger population. It is a form of qualitative research consisting of interviews in which groups of people are asked about their perceptions, opinions, beliefs, and attitudes towards the project, service, concept, advertisement, idea or packaging. Questions are asked in an interactive group setting where participants are free to talk with other group members.

Discussion was held with the local people at near the proposed project site. Date, location and the number of participants of each discussion is listed in ***Table 11-3***. Different categories of local people were grouped and discussed with many issues to capture their perceptions. The summary of focus group discussions (FGDs) is shown in ***Table 11-4***, ***Table 11-5***, ***Table 11-6***&***Table 11-7***. Photographs of focus group discussion are shown in ***Annex B***.

Table 11-3: Details of Focus Group Discussions (FGDs)

Sl.	Date	Location of the FGD	Participants			Category of participants
			Total	Male	Female	
1.	22.11.2017	Sonpara	11	11	0	Local Community
2.	22.11.2017	Pachrukhi	8	8	0	Land Owners and Farmers
3.	23.11.2017	Maizpara	6	6	0	Sharecroppers and Agriculture labor
4.	23.11.2017	Bonderpara	6	6	0	Fishermen

Table 11-4: Summary of Focus Group Discussion with Local Community

Issues discussed	Participant's Opinion, comments and Suggestions	Response to Questions/Action Point
General perception and awareness about the proposed project	Most of the participants are in favor of the project and have been made aware through the various surveys that have taken place.	Consultants made a clear description about the proposed project. People are aware about the project in project study area.
Support of local people for the proposed project	Almost everybody said that they will support the project and advised the Consultants to take precautions in the environmental and social mitigations to avoid the various impacts anticipated during the preconstruction, construction and operation stages of the project.	The Consultants informed that during the design and layout of all infrastructures all the adverse impacts have been anticipated;

Issues discussed	Participant's Opinion, comments and Suggestions	Response to Questions/Action Point
Does the proposed Project create any problem with ambient air, noise quality or water quality?	Most of the Participants don't have proper knowledge regarding this issue. Few emphasized that "client should take care surrounding environment of the proposed project"	Impact of the project upon ambient air, noise quality, water quality has been assessed during EIA study;
Any critical issue or concern by the local people regarding the project? On the other hand, any criteria you would like to see considered during project design, construction and operation stage?	Participants requested that environmental hotspots (like school, hospital, graveyard etc.) should be avoided as much as possible. Moreover, dust suppression, noise mitigation must be considered;	Dust suppression measures and noise mitigation will be considered in the EMP;
Is the proposed project going to provide better traffic system?	All the participants assumed that traffic will be increased after the proposed project starting its construction. Participants came to the consensus that better traffic system should be developed by the proponent;	Design measures such as increased number of sign board, road mark, bump etc. will be proposed to develop.
Protected areas (national parks, protected forest, religiously sensitive sites, historical or archaeological sites) if any	There is no such kind of protected area in proposed project construction site.	No concerns over the park, the nearest sites with terms of cultural or religious significance are far from the project area. Project is designed to avoid most of those structures.
Employment Status: Percentage of employment/unemployment/ underemployment	Employment opportunity is expected to increase in the project area. Participants expected that local people might be given priority for employing in the required fields.	Job chance and employment will be enhanced and promoted once the construction is started. Will propose to pay extra priority for the local people;
Others Benefits	Most of the participants believed that infrastructural development will be accelerated. Secondly, majority also believed that basic services and business opportunity	

Issues discussed	Participant's Opinion, comments and Suggestions	Response to Questions/Action Point
	will also be increased.	
Other Negative Impacts	This proposed project will produce a large amount of waste periodically. Most of the participants believed that in absence of proper waste management plan and proper implementation, living standards of surrounding community will be hampered.	Proper waste management plan and implementation will be proposed;

Table 11-5: Summary of Focus Group Discussion with Land Owners and Farmers

Issues discussed	Participant's Opinion, comments and Suggestions	Response to Questions/Action Point
General perception and awareness about the proposed project	Most of the participants are in favor of the project and have been made aware through the DC's notice and various survey those have been taken place.	Consultants made a clear description about the proposed project. People are aware about the project in project study area.
Support of local people for the proposed project	Almost everybody said that they will support the project and advised the Consultants to take precautions in the environmental and social mitigations to avoid the various impacts anticipated during the preconstruction, construction and operation stages of the project.	The Consultants informed that during the design and layout of all infrastructures all the adverse impacts have been anticipated.
Perception regarding the land acquisition	Most of the participants have positive perception regarding the land acquisitions. Though, this land acquisition will create landlessness for the limited affected peoples but for the national development it can be considered if properly compensated.	All development projects require land acquisition which causes land loss. But in compared to national development this loss is very negligible.
What are the characteristics of the lands those are going to be taken for the proposed project?	Proposed land is low in nature. Therefore, during wet season no agricultural activities can be done. Thus most of the land is used for single cropping production especially in winter season. Some	-

Issues discussed	Participant's Opinion, comments and Suggestions	Response to Questions/Action Point
	lands of the southern east side are used for double cropping production because this land. Most of the lands are used for paddy production and small amount of mustard is also produced. Production rate is very high in these lands. Paddy produced approximately 26kg per decimal.	
How do the land owners and farmers depend on the lands those are going to be taken for the proposed project? How does this dependency contribute to the livelihood?	Paddy that produced from the land is mostly used for daily life consumption. After that the surplus amount is sold. Thus the dependency is two folds, daily life consumption and financial benefits. Most affected persons have other job or business too. Agricultural production contributes to enhance the food availability and solvency for these affected households. But there are some affected persons too who only depend on agricultural production for their livelihood.	Detailed RAP along with proper compensation packages and livelihood assistance will be proposed to prepare for all affected persons respective to all dependencies so that all affected persons can restore their livelihood after the land acquisition.
How do other people who are not land owners depend on the acquired land? What are the common practices for renting lands to the sharecroppers?	Some people do sharecropping production. These people are usually landless. They don't have land but they rent this land for specific time duration to produce crop for their livelihood. Two common practices are prevailed in this area those are One, yearly 3 thousand BDT rent per 30 decimal and the sharecropper will use this land for one year. Second, sharecroppers do not give any rent but share the yields in 50:50 ratios.	-
What should be done to minimize the livelihood impacts on the land users? (land	Land compensation should be compatible to market price so that land owners can buy land in adjacent area.	Extra privileges for the affected persons in getting job respective to their skills will be proposed.

Issues discussed	Participant's Opinion, comments and Suggestions	Response to Questions/Action Point
owners, sharecroppers)	Some believed that land availability is another challenge for the affected farmers. Sometimes farmers may not be able to buy land in the adjacent area; in that case it won't be possible to go miles for doing agricultural production. Moreover, sharecropper will not get any land compensation but they will be affected. So, affected persons should be given priority when job opportunity creates in the proposed project site.	

Table 11-6: Summary of Focus Group Discussion with Sharecropper and Agricultural Labor

Issues discussed	Participant's Opinion, comments and Suggestions	Response to Questions/Action Point
General perception and awareness about the proposed project	Most of the participants are in favor of the project and have been made aware through the DC's notice and various survey those have been taken place.	Consultants made a clear description about the proposed project. People are aware about the project in project study area.
Support of local people for the proposed project	Almost everybody said that they will support the project and advised the Consultants to take precautions in the environmental and social mitigations to avoid the various impacts anticipated during the preconstruction, construction and operation stages of the project.	The Consultants informed that during the design and layout of all infrastructures all the adverse impacts have been anticipated.
Perception regarding the land acquisition	Most of the participants have positive perception regarding the land acquisitions. Though, this land acquisition will create landlessness for the limited affected peoples but for the national development it can be considered if properly compensated.	All development projects require land acquisition which causes land loss. But in compared to national development this loss is very negligible.
How much are the sharecroppers depended on the	Most of the sharecroppers are landless or marginal landowners. Due to lack of agricultural land	-

Issues discussed	Participant's Opinion, comments and Suggestions	Response to Questions/Action Point
lands those are going to be acquired?	ownership, they have to depend on other land owners for continuing their agricultural activities. Their livelihood is totally depended on the acquired land seasonally. They engage in agricultural production in winter. That time they also work as agricultural labor to other land owners' land and earn extra which help them financially. One time yields support them approximately for six months. Rest of the months, they usually engage in non-agricultural works.	
How does land sharing happen between the land owners and the sharecroppers?	Sharecropping happens based on personal relationship. Landowners give the land to those sharecroppers whom they personally know and have trust on them. Barely written deed is incurred between the landowners and the sharecroppers. In that case, how would the sharecropper's number be confirmed?	Proper guideline will be proposed to confirm the exact numbers of the sharecropper.
What are the common practices for renting lands to the sharecroppers?	Two common practices are prevailed in this area those are One, yearly 3 thousand BDT rent per 30 decimal and the sharecropper will use this land for one year. Second, sharecroppers do not give any rent but share the yields in 50:50 ratio.	-
What should be done to minimize the livelihood impacts on sharecroppers and agricultural labor?	If land owners lost their land, sharecroppers won't manage to cultivate on other land owners' land as sharecropping is incurred on the basis of personal relationship. They assumed that permanent seasonal inactivity will be happened as a result. They think that if project	Study will propose to design and implement proper livelihood restoration plan for the affected persons.

Issues discussed	Participant's Opinion, comments and Suggestions	Response to Questions/Action Point
	proponent considers employing them in the project works based on their skills or assisting them to get alternative occupations, this will help them to restore their livelihood.	

Table 11-7: Summary of Focus Group Discussion with Fishermen

Issues discussed	Participant's Opinion, comments and Suggestions	Response to Questions/Action Point
General perception and awareness about the proposed project	Most of the participants are in favor of the project and have been made aware through various survey those have been taken place.	Consultants made a clear description about the proposed project. People are aware about the project in project study area.
Support of local people for the proposed project	Almost everybody said that they will support the project and advised the Consultants to take precautions in the environmental and social mitigations to avoid the various impacts anticipated during the preconstruction, construction and operation stages of the project.	The Consultants informed that during the design and layout of all infrastructures all the adverse impacts have been anticipated.
How much are the fishermen depended on the lands those are going to be acquired?	Usually this proposed project site remains inundated almost for six months in a year. There is a canal goes through the proposed project site which is connected to the River. Therefore, a large amount of indigenous fisheries are always available in this location. Fishermen (10-15) catch fishes in this location all the time during wet season and live their livelihood. In other time, they catch fishes from other location or buy and sell fishes to the local market. Fishermen though have no land in the proposed project site but they will lose to access to the fishing area.	-
What should be done to minimize the	If fishermen permanently lose to get the access in the project site	Study will propose to design and implement proper

Issues discussed	Participant's Opinion, comments and Suggestions	Response to Questions/Action Point
livelihood impacts on fishermen?	area, they preferred to get work opportunity from the project proponent.	livelihood restoration plan for the affected persons.

11.4.3 Public Consultation Meetings (PCMs)

a) Accountability and Community Participation

As per the JICA Environmental Guidelines, BEZA has disclosed the project information and provided opportunities for stakeholders, particularly project affected stakeholders including landless sharecroppers, to participate the EIA and RAP preparation. Based on the past records in Bangladesh, stakeholders' participation could lead timely land acquisition and resettlement as well as fewer conflicts during the construction and operation stages between project proponents and local stakeholders. Unlike the government-funded projects, it is particularly important to understand the community needs for livelihood recovery assistances, which are not provided by the government funded projects but are mandatory for the JICA funded projects. BEZA has been committed to comply with the JICA Environmental Guidelines and adapted to enhance the benefits of the project-affected persons (PAPs) throughout the project activities and livelihood recovery assistance programs.

b) The 1st Joint Public Consultation for the EZ EIA preparation and Stakeholder Meeting for the EIA preparation

A joint public consultation for the EZ EIA preparation and stakeholder meeting for the RAP preparation was held on 22thNovember 2017 at the union office of one of the major project impacted communities (Satgram Union Parishad, Purinda Bazar). Prior to the notice, BEZA consulted with the union leader and was requested to conduct the joint consultation/meeting at the primary school behind the union office where there is enough space for more than 100 persons under the shadow. The venue was selected in terms of easy accessibility from villages in and around Araihazar Economic Zone and the meeting room capacity of the building.The project proponent prepared the invitation letter together with the notice of the meeting in Bangali language and announced to the invitees, who are villagers in Araihazar EZ and relevant governmental organizations, non-governmental organizations (NGOs), community-based organizations (CBOs), and anyone who are interested.

Basically, information on the meeting was announced to the invitees one week in advance before the meeting by sending invitation letters to the respective invitees.

As per the JICA Environmental Guidelines, advanced newspaper notice of the consultation was published on 16th November (***Annex D***).

The presentation and handouts were prepared and explained in Bangali language. The opinions from the participants were received in the question and answer session. Additionally, separately talked with participants so that those who are hesitant to speak out in public could

share their views and comments. Furthermore, female assistants were also available for the female participants who need any help. The presentation material and handouts both in Bangali language, and a sample of the feedback form are shown in ***Annex E***.

c) Summarized Outcomes of PCMs

A joint public consultation for the EZ EIA preparation and stakeholder meeting for the RAP preparation was held on 22th November 2017 at the union office of one of the major project impacted communities (Satgram Union Parishad, Purinda Bazar). The joint consultation/meeting was participated by roughly 95persons (***Annex B*).**The list of participants from these groups and attendance sheet are shown in ***Annex C***.

In the consultation meeting, after the explanation on the project outline planned in Araihazar EZ, which includes the industrial area, residential and commercial areas, and the logistic area, the expected key environmental and social benefits as well as potential negative impacts were explained during the construction and in the operation stage. In addition, survey items of the baseline EIA study and future schedule for the EIA were presented to the participants. At the end, a question and answer session was organized in all the meetings. As a whole, seven questions were raised from the participants and discussed with the project proponent and coordinating organization. Key points raised by the participants are shown in ***Table 11-9***.

Table 11-8: Summary of Public Consultation Meeting for EIA at the Scoping Stage

Time and Date	**1st Public Consultation Meeting:** Date: 22 November, 2017 Day: Wednesday Time: 10:00 AM to 1:00 PM **2nd Public Consultation Meeting:** Date: 22 November, 2017 Day: Wednesday Time: 1:00 AM to 2:00 PM
Venue	Satgram Union Parishad, Purinda Bazar, Araihazar, Narayanganj
Invitees	- Deputy Commisioner (DC), Narayanganj - Manager (Administration), BEZA - Police Super, Narayanganj - Upazila Nirbahi Officer, Araihazar, Narayanganj - Executive Engineer, Roads & Highway Department/ DPHE, Narayanganj - Director General, PBS, Narayanganj - Assistant Commissioner (Land), Araihazar, Narayanganj - Social Specialist, BEZA project - Chairman, Araihazar upazila parishod - Upazila Agriculture/ Fisheries/ Education Officer, Araihazar upazila - Union Chairman, Shatgram union parishod - Union Chairman, Duptara union parishod

	- Local residents in and around Araihazar EZ area - Other organizations and individuals who are interested in the Project
Attendee	**1st Public Consultation Meeting:** 95 people (men: 91, women: 4) Age range: 21-74 Category of participants: Project affected people, local community and relevant stakeholders including both governmental and private sector representatives irrespective of gender; Occupation: Farmer, Businessman, Service holder, Teacher, Police, Student & Unemployed Persons **2nd Public Consultation Meeting:** 11 people (men: 11, women: 0) Age range: 35-70 Category of participants: Person to be displaced
Agenda	- Brief explanation on the past EIA-related studies - Project brief in the industrial area, residential and commercial areas, and the logistic area planned in Araihazar EZ area - Major positive and negative findings on the draft scoping results - Scope of the EIA study - Further schedule of EIA
Language Used	In local language: Bangali language

Table 11-9: Key Points Raised by the Participants

Relation	Comment/Question	Respondent: Response
Land Owner, Pachrukhi Village	• We are very happy to know that our local people will be privileged by the all benefits of EZ. Initially, land owner like us have to pay for it for the better future and we are ready for it. However, if we get proper land value as compensation compared to market price, we may survive. Otherwise, we will be marginalized or landless. In that case, other benefits of EZ may not solely be sufficient to restore our livelihood. • We came to know that land acquisition is incurred by the Deputy Commissioner (DC) and the land price is finalized by the theDC's Mouza rate. According to the 1982 act, the DC pays 1.5 times of the Mouza rate. But usually, the DC's Mouza rate is 3-4 times lower than the market price. Lately, he heard that a revised on 1982 act has been gazette. Where, the DC's payment rate has been mended 1.5 times to 3 times.	• BEZA: We are working hard to implement the revised gezetted act. We have already approached our administrative procedure. Hopefully, we will be successful in doing so. • UNO: After reviewing all land ownership deeds, R.S. allocation holders' name and the relevant documents, an actual legal owner will be identified and compensated.

	• What would be the DC's rate in the proposed project? • How will the legal land owners be paid?	
Resident, Sonpara	• There are more than hundred residential settlements are residing in northern side those are actually very close to project site. Is there any chance to acquire this adjacent residential side too?	• BEZA: At the screening stage, we tried to minimize the adverse impact as much as possible and design this project. We redesigned our project for not impacting the residential settlements. There is no plan to acquire this residential site. BEZA will try and take all precautions not to cause any negative impacts on this residential community.
Resident, Sonpara	• There is an existing canal going through the project site. When the construction work starts, land filling will occur. Water flow of the canal may be disrupted. Consequently, adjacent low lands will be inundated during wet season. Is BEZA aware of this situation	• BEZA: The existing canal will be improved with a well drainage system. I detailed master plan will be designed and implemented as well.
Resident, Maizpara	• The adjacent resident(s) may be directly affected adversely by air and water pollution. Is there any consideration to protect the local community?	• BEZA: ETP, WTP will be established. Moreover, in accordance to the DoE regulation, industries will be established. Therefore, pollution will be reduced to a minimum level.

CHAPTER 12

12. CONCLUTION AND RECOMMENDATIONS

Bangladesh Economic Zones Authority (BEZA) has been emerged by the Bangladesh Economic Zones Act, 2010; The Bangladesh Economic Zones Authority (BEZA) was officially instituted by the Government on 9 November 2010. BEZA aims to establish economic zones in all potential areas in Bangladesh including backward and underdeveloped regions with a view to encouraging rapid economic development through increase and diversification of industry, employment, production and export'.

The government of Bangladesh has requested the government of Japan to provide Yen loan for "the Foreign Direct Investment Promotion Project (hereinafter FDIPP)" in order to establish a new EZ mainly targeting Japanese companies and to further facilitate investments from Japan. The loan agreement for FDIPP was already signed in December 2015.Taking into consideration the site location, available infrastructure, existing industries, investors interest and infrastructure and logistic requirement of the proposed industries, Araihazar Economic Zone is more like to be selected for EZ development through FDIPP.

As per the procedure, the Bangladesh Economic Zone Authority (BEZA) has gotten the approved ToR from the department of Environment. Approved ToR was granted by DoE vide Memo No. 22.02.0000.018.72.003.17/334 dated 21 June, 2017. The EIA study for the development of proposed Araihazar Economic Zone has been carried out as per the ToR issued by DoE.

The proposed Araihazar Economic Zone (AEZ) site is located at Mouza: Satgram, Shatgaon, Union: Satgram & Duptara, under Araihazar Upazila, which is adjacent to the Dhaka– Sylhet highway. The total land of Araihazar Economic Zone (AEZ) is approximately 218.84ha or 540.77 acres for 1st phase. Upon completion, AEZ is envisaged to create approximately 10,000 jobs when fully occupied by investors.

Most of the impacts are controlled and limited in and around the project area. The key negative impacts such as emission of gas and dust, deterioration of water quality, generation of noise, soil pollution, 540.77 acres land acquisition and some scale of involuntary resettlement are expected. Impact on livelihood of the project-affected persons (PAPs) including vulnerable people and children all are expected during the pre-construction, construction and operation phase. Clearance of existing vegetation during construction phase though there is no sensitive ecological protection area. However, implementation of appropriate mitigation and management plan is given in Chapter 8. On the other hand, some positive impacts of the Project such as increase in job opportunity (approximately 10,000) and improvement of social infrastructure are also expected.

In consideration of the result of the EIA study for the Project, the Environmental Management Plans (EMPs) including adequate mitigation measures to reduce the negative impacts and

Environmental Monitoring Plan (EMoP) are proposed for this Project: pre-construction phase, construction phase, and operation phase.

It was confirmed that the environmental, social and health impacts of the Project were assessed and the Environmental Management Plan was formulated properly. In the process of EIA, opportunity of public involvement was ensured and comments from the public were reflected into the final EIA Report. The Public consultation meeting was held on 22th November 2017 at Satgram Union Parishad, Purinda Bazar. Affected persons, local community and relevant stakeholders including both govt. and private sector representatives irrespective of gender were participated in this Public Consultation Meeting. The proceedings commenced at 10:00 am. The meeting was attended by a total of 95 people. Thus, the EIA was completed in accordance with the requirements of the EIA Procedure properly in case that project proponent will follow EMP accordingly.

Recommendations made for the project development on the basis of EIA study are given below:

- Dhawrakhali canal should be retained in its natural position
- Proposed Environment & social management plan should be implemented strictly both during pre-construction, construction and operation phase of the project
- Suggestions & requests made by public for employment shall be taken into consideration
- Proper training of maintaining environment, health and safety should be given to Project management unit in both constructions an operation phase
- Provision of CETP, WTP, Drainage system, Retention pond and green belt shall be adhered.
- Rainwater harvesting should be carried out to reduce the pressure on surface and ground water resources.
- Construction activities for proposed off-site developed should only be started after obtaining environment clearance certificate from DoE, Bangladesh
- Environmental monitoring should be conducted as proposed in environment and social management plan
- Separate Environment impact assessment study is to be carried out for individual industries where applicable as per the ECR‟1997.

ANNEX A- APPROVED TOR FROM DOE

Government of the People's Republic of Bangladesh
Department of Environment
Head Office, E-16 Agargaon
Dhaka-1207
www.doe.gov.bd

Memo No: 22.02.0000.018.72.003.17/334 Date: 21/06/2017

Subject: Approval of Terms of Reference (TOR) for EIA of Araihazar (Japanese) Economic Zone Ltd at Araihazar, Narayanganj.

Ref: Your Application dated 07/06/2017.

With reference to your application dated 07/06/2017 for the subject mentioned above, the Department of Environment hereby gives approval of the Terms of Reference (ToR) for Environmental Impact Assessment (EIA) Study of the proposed Araihazar (Japanese) Economic Zone Ltd at Araihazar, Narayanganj subject to fulfilling the following terms and conditions:

I. The project authority shall conduct a comprehensive Environmental Impact Assessment (EIA) study considering the overall activity of the said project in accordance with this ToR and following additional suggestions.

II. The EIA report should be prepared in accordance with following indicative outlines :

Executive summary

1. Introduction: (Background, brief description, rationale of the project, scope of study, methodology, limitation, EIA team, references)
2. Legislative, regulation and policy consideration (covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared)
3. Project Description
   - i. Introduction
   - ii. Project Objective
   - iii. Project Options
   - iv. Interventions under Selected Options
   - v. Project activities: A list of the main project activities to be undertaken during site clearing, construction as well as operation
   - vi. Project schedule: The phase and timing for development of the project
   - vii. Resources and utilities demand: Resources required to develop the project, such as soil and construction material and demand for utilities (water, electricity, sewerage, waste disposal and others), as well as infrastructure (road, drains, and others) to support the project
   - viii. Map and survey information
     Location map, cadastral map showing land plots (project and adjacent area), geological map showing geological units, fault zone, and other natural features.
   - ix. Project Plan, Design, Standard, Specification, Quantification, etc.
4. Environmental and Social Baseline
   - 4.1 Meteorology
     - 4.1.1 Temperature
     - 4.1.2 Humidity
     - 4.1.3 Rainfall
     - 4.1.4 Evaporation
     - 4.1.5 Wind Speed
     - 4.1.6 Sun Shine Hours
   - 4.2 Air Quality and Noise

1/4

4.2.1 Ambient Air Quality of the project site with respect to Standards of ECR, 1997
4.2.2 Ambient Noise level of the project site with respect to Standards of Noise Pollution (Control) Rules, 2006
4.2.3 Air pollutant and noise sources from existing and known sources

4.3 Water Resources
- 4.3.1 Surface Water System
- 4.3.2 Tropical Cyclones and Tidal Flooding
- 4.3.3 Salinity
- 4.3.4 Drainage Congestion and Water Logging
- 4.3.5 Erosion and Sedimentation
- 4.3.6 River Morphology
- 4.3.7 Navigation
- 4.3.8 Ground Water System

4.4 Land Resources
- 4.4.1 Agro ecological Regions
- 4.4.2 Land Types
- 4.4.3 Soil Texture
- 4.4.4 Land Use

4.5 Agriculture Resources
- 4.5.1 Farming Practice
- 4.5.2 Cropping Pattern and Intensity
- 4.5.3 Cropped Area
- 4.5.4 Crop Production
- 4.5.5 Crop Damage
- 4.5.6 Main Constraints of Crop Production

4.6 Livestock and Poultry
- 4.6.1 Feed and Fodder Shortage
- 4.6.2 Livestock/Poultry Diseases

4.7 Fisheries
- 4.7.1 Introduction
- 4.7.2 Problem and Issues
- 4.7.3 Habitat Description
- 4.7.4 Fish Production and Effort
- 4.7.5 Fish Migration
- 4.7.6 Fish Biodiversity
- 4.7.7 Fisheries Management

4.8 Ecological Resources
- 4.8.1 Bio-ecological Zone
- 4.8.2 Common Flora and Fauna
- 4.8.3 Ecosystem Services and Function

4.9 Socio Economic Condition
- 4.9.1 Socio Economic Condition
- 4.9.2 Quality of Life Indicators
- 4.9.3 Income and Poverty
- 4.9.4 Gender and Women
- 4.9.5 Common Property Resources
- 4.9.6 Conflict of Interest and Law and Order Situation
- 4.9.7 Historical, Cultural and Archaeological Sites

5 Identification and Analysis of Key Environmental Issues (Analysis shall be presented with Scenarios, Maps, Graphics, etc. for the Case of Anticipated Impacts on Baseline)
- 5.1 Environmental Sensitivity Investigation
- 5.2 Environmental Asset

2/4

3/4

III. Without obtaining approval of EIA report by the Department of Environment, the project authority shall not be allowed to conduct earth filling or any kind of physical intervention in the proposed project site and also not be able to start the physical activity of the project.
IV. This approval of the Terms of Reference (TOR) would not mean any acceptance or site clearance of the project.
V. The proposed EIA study would not establish any claim, right in favor of the proponent for getting site clearance or environmental clearance.
VI. Without obtaining Environmental Clearance, the project authority shall not be able to start the operation of the project.
VII. The project authority shall submit the EIA report along with the filled-in application for Environmental Clearance in prescribed form, the feasibility study report, the applicable Environmental Clearance fee in a treasury chalan, the applicable VAT on clearance fee in a separate treasury chalan, the No Objection Certificate (NOC) from local authority, and NOC from other relevant agencies for operational activity etc. to the Narayanganj District Office of DOE in Narayanganj with a copy to the Head Office of DOE in Dhaka.

21.06.2017

(Syed Nazmul Ahsan)
Director (Environmental Clearance)
Phone # 02-8181673

Secretary (Additional Secretary)
BEZA Executive Board
Bangladesh Economic Zone Authority (BEZA)
Prime Minister's Office
BDBL Building, Level-15,
12 Karwan Bazar, Dhaka-1212.

Copy Forwarded to:

1) PS to the Secretary, Ministry of Environment and Forests, Bangladesh Secretariat, Dhaka.
2) Director, Department of Environment, Dhaka Regional Office, Dhaka.
3) Deputy Director, Department of Environment, Narayanganj District Office, Narayanganj.
4) Assistant Director, Office of the Director General, Department of Environment, Head Office, Dhaka.

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ANNEX B- PHOTOGRAPHS OF KII, FGD & PUBLIC CONSULTATION MEETING

Consultation with BEZA

Consultation with Upazila Agriculture Department

Consultation with Upazila Primary Education Department

Consultation with DPHE

FGD with Local Community

FGD with Land owners and farmers

Public Consultation Meeting (PCM)

Public Consultation Meeting (PCM)

Public involvement in PCM

Response from BEZA at PCM

ANNEX C- PARTICIPANT LIST OF PUBLIC CONSULTATION MEETING

মতবিনিময় সভা

পরিবেশগত এবং সামাজিক প্রভাব মূল্যায়ন (ইএসআইএ)

"আড়াইহাজার অর্থনৈতিক অঞ্চল, আড়াইহাজার, নারায়ণগঞ্জ"

স্থানঃ পুরিন্দা ৩৭ নং সরকারি প্রাথমিক বিদ্যালয় (সাতগ্রাম ইউনিয়ন পরিষদ সংলগ্ন)

তারিখঃ ২২-১১-২০১৭ সময়ঃ সকাল ১০.০০ টা

Attendance Sheet (উপস্থিতির তালিকা)

No. নং	Name (নাম)	Occupation (পেশা)	Age (বয়স)	Sex (লিঙ্গ)	Mobile No/ (মোবাইল নম্বর)	Signature (স্বাক্ষর)
১.	মোঃ মনিরুজ্জামান	[illegible]		পুরুষ	01712-628360	[illegible]
২	মো: আব্দুল কাদের খান	[illegible]		পুরুষ	01716681457	[illegible] 22/11/17
৩.	সুরাইয়া খান	UNO		মহিলা	01768042194	[illegible]
৪.	সাহিদা মোকাররম	চেয়ারম্যান [illegible]		মহিলা	01732186264	[illegible] 22.11.17
৫	মো: মনসুর রহমান	[illegible]		পুরুষ	01769402147	[illegible]
৬	এম. এ. রফিক	[illegible]		পুরুষ	01798-331647	[illegible]
৭	[illegible] মেহজাবীন	এল. এ. ও নারায়ণগঞ্জ		মহিলা	01716097777	[illegible] 22/11/2017
৮	[illegible] মাহমুদ	চেয়ারম্যান সাতগ্রাম ইউ.পি		পুরুষ	01713517107	[illegible] 22-11-2017
৯	[illegible]	[illegible]		মহিলা	[illegible]	[illegible]
১০/	মোঃ আবদুল্লাহ আল মামুন	এ. এস. পি		পুরুষ	01713-374577	[illegible]
১১/	মো: নাজমুল হোসেন	EQMS		পুরুষ	01673821812	[illegible]

মতবিনিময় সভা

পরিবেশগত এবং সামাজিক প্রভাব মূল্যায়ন (ইএসআইএ)

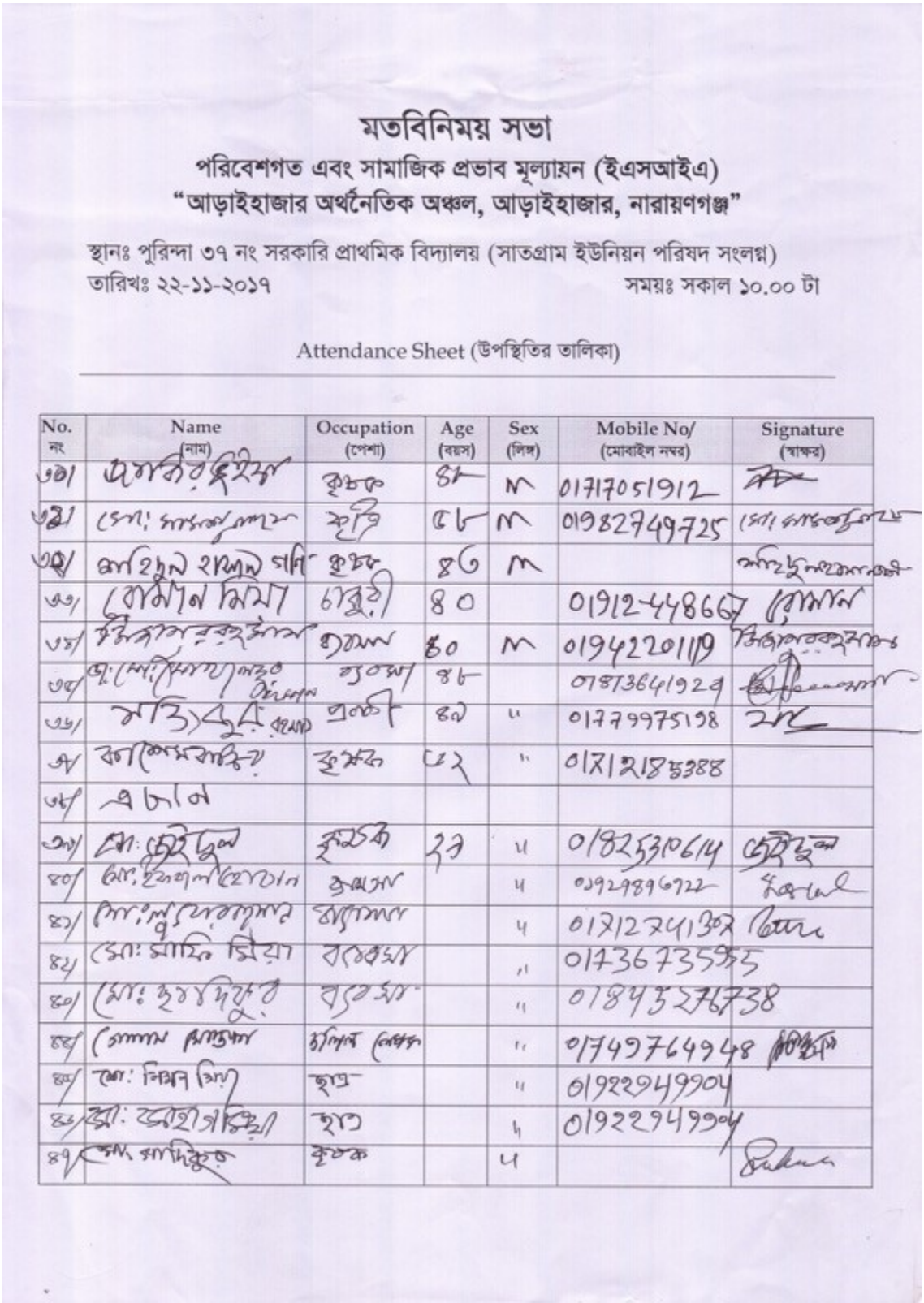
"আড়াইহাজার অর্থনৈতিক অঞ্চল, আড়াইহাজার, নারায়ণগঞ্জ"

স্থানঃ পুরিন্দা ৩৭ নং সরকারি প্রাথমিক বিদ্যালয় (সাতগ্রাম ইউনিয়ন পরিষদ সংলগ্ন)

তারিখঃ ২২-১১-২০১৭ সময়ঃ সকাল ১০.০০ টা

Attendance Sheet (উপস্থিতির তালিকা)

No. নং	Name (নাম)	Occupation (পেশা)	Age (বয়স)	Sex (লিঙ্গ)	Mobile No/ (মোবাইল নম্বর)	Signature (স্বাক্ষর)
১২	মো: নাদিম	চাকরী	২৮	পুরুষ	01869830367	[illegible]
১৩	মো: শাহিন খান	[illegible]	২৫	পুরুষ	01939360562	[illegible]
১৪	মো: [illegible] মিয়া	[illegible]	৫৫	পুরুষ	01716167151	[illegible]
১৫	মো: হান্নান মিয়া	কৃষক	৬৫	পুরুষ	01711331907	[illegible]
১৬	হাবিবুর রহমান	কৃষক	৭০	পুরুষ	—	
১৭	মো: শাহআলম	শিক্ষক	৪৬	পুরুষ	—	[illegible]
১৮	মামুন মীর	কাজী	৩৭	পুরুষ	01818305852	[illegible]
১৯	মো: শাহজাহান মিয়া	কৃষি	৭৪	পুরুষ	[illegible]	মো: শাহজাহান
২০	মো: গোলাম মোস্তফা	চাকরি	৫৭	পুরুষ	০১৭৬৩২৬৭৮০২	[illegible]
২১	মো: মনসুর রহমান	চাকরি	৫৬	পুরুষ	০১৭৬৯৪০২১৪৭	[illegible]
২২	মো: আব্দুস ছালেক	চাকরী	৪৮	পুরুষ	০১৭১১২৭৪২৬[illegible]	[illegible]
২৩	হাজী আব্দুল হক	কৃষি	৭০	পুরুষ	০১৭৩২০৬৭৮৭৭	মো: হক
২৪	আব্দুল মালেক	ব্যবসা	৪৯	পুরুষ	[illegible]	মো: মালেক
২৫	মো: বশির মিয়া	কৃষি	৫৯		01836876003	[illegible]
২৬	মো: [illegible]	ব্যবসা	৪	পুরুষ	01727504972	[illegible]
২৭	মো: আনোয়ার হোসেন	চাকরী	৪৫	পুরুষ	01988349119	[illegible]
২৮	মুহাম্মদ শাহ জালাল	কর্মকর্তা ([illegible])	৩২			[illegible]
২৯	মো: মোহাম্মদ হোসেন	ব্যবসা	৩৭	পুরুষ	01711-102518	[illegible]



মতবিনিময় সভা

পরিবেশগত এবং সামাজিক প্রভাব মূল্যায়ন (ইএসআইএ)

"আড়াইহাজার অর্থনৈতিক অঞ্চল, আড়াইহাজার, নারায়ণগঞ্জ"

স্থানঃ পুরিন্দা ৩৭ নং সরকারি প্রাথমিক বিদ্যালয় (সাতগ্রাম ইউনিয়ন পরিষদ সংলগ্ন)

তারিখঃ ২২-১১-২০১৭ সময়ঃ সকাল ১০.০০ টা

Attendance Sheet (উপস্থিতির তালিকা)

No. নং	Name (নাম)	Occupation (পেশা)	Age (বয়স)	Sex (লিঙ্গ)	Mobile No/ (মোবাইল নম্বর)	Signature (স্বাক্ষর)
৩১	[illegible]	কৃষক	৪৮	M	01717051912	
৩২	[illegible]	কৃষি	৫৮	M	01982749725	
৩৩	[illegible]	কৃষক	৪৩	M		
৩৪	[illegible]	চাকুরী	৪০		01912-448667	
৩৫	[illegible]	ব্যবসা	৪০	M	01942201119	
৩৬	[illegible]	ব্যবসা	৪৮		01873641924	
৩৭	[illegible]	চাকরি	৪৩	"	01779975198	
৩৮	[illegible]	কৃষক	৫২	"	01721218[illegible]388	
৩৯	[illegible]					
৪০	[illegible]	কৃষক	২৭	"	01825310614	
৪১	[illegible]	ব্যবসা		"	01924896722	
৪২	[illegible]	ব্যবসা		"	01712741302	
৪৩	[illegible]	ব্যবসা		"	01736735[illegible]5	
৪৪	[illegible]	ব্যবসা		"	01843276738	
৪৫	[illegible]	শিক্ষক		"	01749764948	
৪৬	[illegible]	ছাত্র		"	01922949904	
৪৭	[illegible]	ছাত্র		"	01922949904	
৪৮	[illegible]	কৃষক		"		

No. নং	Name (নাম)	Occupation (পেশা)	Age (বয়স)	Sex (লিঙ্গ)	Mobile No/ (মোবাইল নম্বর)	Signature (স্বাক্ষর)
৪৮/	মো: ফারুক ভুইয়া	বেকার	45	পুরুষ	01937035184	ফারুক
৪৯/	নূর রহিম			পুরুষ		
৫০/	আবু তাহের মিয়া	BUSSNESS.	48	MALE	01799-429249	আবু তাহের
৫১/	আলমগীর চৌধুরী	SERVICE	40	MALE	01595-026734	Alamgir
৫২/	আনোয়ার	ব্যবসা	50	পুরুষ	017752৪৬৫৭	আনোয়ার
৫৩/	মোঃ নাসির উদ্দিন	কৃষক	৪৫	পুরুষ	0179375596২	নাসির
৫৪/	মো: মাসুদ রানা			পুরুষ		
৫৫/	আ: রহমান মো:			পুরুষ	01715 ৪২৩৫২	
৫৬/	মো: রফিজ উদ্দিন	সদস্য আড় ইউনিয়ন	৬০	পুরুষ	01763775982	রফিজ
৫৭/	আল - মামুন	শিক্ষক	২১	পুরুষ	01716184040	[illegible]
৫৮/	মেহেদী হাসান	শিক্ষক	২৪	পুরুষ	01675735316	[illegible]
৫৯/	মোস্তাফিজুর-	ব্যবসা	৬৫	পুরুষ	01746659340	মোস্তাফিজুর
৬০/	মোশারফ ভান্ডারি	ব্যবসা	৩৫	পুরুষ	01714205892	মোশারফ
					বাবুল	
৬১/	বাদল	ব্যবসা	8৮	পুরুষ	01840937০২	[illegible]
৬২/	বিল্লাল হাসান	ব্যবসা	৫২	পুরুষ	01814870397	[illegible]
৬৩/	মনজুর	ব্যবসা	82	পুরুষ	01924723০২	Manjur
৬৪/	মো: আনোয়ার হোসেন	বর্গাচাষী	60	পুরুষ	01929829৫৭	Anwar
৬৫/	মো: মশিউর রহমান	অবসরপ্রাপ্ত শিক্ষক	৬৫	পুরুষ	01৭৩৩৪৩২০৫৬	[illegible]
৬৬/	মো: আমীর হোসেন	ব্যবসা	২৭	পুরুষ	01911-289821	[illegible]
৬৭/	মো: নূর আমিন	ব্যবসা	৫৪	পুরুষ	01830423039	
৬৮/	মো: সিরাজুল ইসলাম	কৃষি	৫৬	"	01779623937	মো: সিরাজুল ই
৬৯/	মো: মান্নান মিয়া	ব্যবসা	8৫	পুরুষ	01711276888	[illegible]
৭০/	মোঃ হানিফ	উপসহকারী কৃষি অফিসার	৫৫	"	01858818449	Hanif

No. নং	Name (নাম)	Occupation (পেশা)	Age (বয়স)	Sex (লিঙ্গ)	Mobile No/ (মোবাইল নম্বর)	Signature (স্বাক্ষর)
৭১/	মো: মাহবুব	ব্যবসা	৬৬	পুরুষ	01927002312	মাহবুব
৭২/	[illegible]	বাবুর্চি	৩৯	"	01779122985	
৭৩/	[illegible]	ব্যবসা	৪৫	"	01716347746	Johal
৭৪/	মো: [illegible] মিয়া	ব্যবসা	৬৬	"	01716500719	[illegible]
৭৫/	মো: [illegible]	ব্যবসায়	৫৮	"	01611338822	[illegible]
৭৬/	আবু জোনাব	ব্যবসা	৭০	"	01937043519	আবু জোনা
৭৭/	মো: মাহবুব	ব্যবসা	৪৬	"	01868469171	মাহবুব
৭৮/	নাসির আহমেদ	কৃষি কাজ	৬০	"	01715600743	নাসির
৭৯/	মো: [illegible]	ব্যবসা	৩৬	"	01914873849	[illegible]
৮০/	মো: [illegible]	ব্যবসায়ী	৬৬	"	018670421	
৮১/	মো: [illegible]	কৃষি	৪২	"	01782845293	[illegible]
৮২/	[illegible]	ঐ	৪৫	"	01750870786	
৮৩/	বাবুল	ড্রাইভার	৪৭	"	01732772064	বাবুল
৮৪/	মো: শফিকুর রহমান	ব্যবসা	৬২	"	01818469399	শফিক
৮৫/	রোমান মিয়া	চাকুরী	৪০	"	01912-448667	রোমান
৮৬/	[illegible]	ব্যবসা	৫	"	01836787428	[illegible]
৮৭/	সাব্বির	ছাত্র	৬২	"	01833629293	সাব্বির
৮৮/	[illegible]	ছাত্র	৩৬	"	01913-173434	[illegible]
৮৯/	মো: [illegible]	[illegible]	৫৫	"	01849424224	[illegible]
৯০/	মো: [illegible]	[illegible]	৩৫	"	01725510768	[illegible]
৯১/	মাসুদ	কৃষি	২৭	পুরুষ	01914557118	[illegible]
৯২/	[illegible]	কৃষি	৪২	"	01715740264	[illegible]
৯৩/	[illegible]	কৃষি	৪০	"	01768726490	[illegible]
৯৪/	মো: [illegible] মিয়া	কৃষি	৫২	"	01721499824	[illegible]
৯৫/	মো: [illegible]	কৃষি	৫২	"	0172688247	

ANNEX D- NEWSPAPER ADVERTISEMENT

বিজ্ঞপ্তি

আড়াইহাজার অর্থনৈতিক অঞ্চল এর পরিবেশ ও সামাজিক বিষয়ে মতবিনিময় সভা

বাংলাদেশ অর্থনৈতিক অঞ্চল কর্তৃপক্ষ (বেজা), প্রধানমন্ত্রীর কার্যালয়- এর উদ্যোগে জাপান আন্তর্জাতিক সহযোগিতা (জাইকা)-এর আর্থিক সহায়তায় ঢাকা-সিলেট মহাসড়ক সংলগ্ন পাঁচরুখি ও পাঁচগাঁও মৌজায় আড়াইহাজার উপজেলাধীন নারায়ণগঞ্জ জেলায় আড়াইহাজার অর্থনৈতিক অঞ্চল প্রতিষ্ঠা করার জন্য প্রকল্প গ্রহণ করা হয়েছে।

এ প্রকল্পের জনমত যাচাইয়ে আগামী ২২ নভেম্বর সকাল ১০.০০টায় সাতগ্রাম ইউনিয়ন পরিষদে জনসাধারণের অংশগ্রহণে মতবিনিময় সভা অনুষ্ঠিত হবে। উক্ত সভায় আপনাদের সদয় উপস্থিতি কামনা করছি।

কর্তৃপক্ষ
বাংলাদেশ অর্থনৈতিক অঞ্চল কর্তৃপক্ষ (বেজা)
প্রধানমন্ত্রীর কার্যালয়
১১১, বীর উত্তম সি আর দত্ত রোড, ঢাকা

দে/স-০৪/১৭ (৪x২)

ANNEX E- PRESENTATION MATERIAL AND HANDOUTS

পরিবেশগত এবং সামাজিক প্রভাব মূল্যায়ন (ইএসআইএ)
"আড়াইহাজার অর্থনৈতিক অঞ্চল, আড়াইহাজার, নারায়ণগঞ্জ"

বাংলাদেশ অর্থনৈতিক অঞ্চল কর্তৃপক্ষ
(বেজা)

জাপান আন্তর্জাতিক সহযোগিতা সংস্থা দ্বারা নিযুক্ত পরামর্শদাতা
জাপান ডেভেলপমেন্ট ইনস্টিটিউট
ইকিউএমএস কনসালটিং লিমিটেড

২২ নভেম্বর ২০১৭

1

সূচীপত্র

2

১। পটভূমি

বেজা এবং আড়াইহাজার অর্থনৈতিক অঞ্চল

বেজা

- বাংলাদেশ অর্থনৈতিক অঞ্চল কর্তৃপক্ষ (বেজা) আনুষ্ঠানিকভাবে ২০১০ সালের আইন দ্বারা সরকার কর্তৃক প্রতিষ্ঠিত হয়।
- বেজার লক্ষ্য হলো পিছিয়ে থাকা এবং নিম্নগামী অঞ্চলসহ সকল সম্ভাব্য এলাকায় অর্থনৈতিক অঞ্চল প্রতিষ্ঠার মাধ্যমে শিল্প, কর্মসংস্থান, উৎপাদন ও রপ্তানি বৃদ্ধির এবং বৈচিত্রতার মাধ্যমে দ্রুত অর্থনৈতিক উন্নয়নকে উৎসাহিত করা।
- বেজা প্রধানমন্ত্রীর কার্যালয় (পিএমও) -এর সাথে সংযুক্ত এবং বাংলাদেশে অর্থনৈতিক অঞ্চল স্থাপন ও পরিচালনার জন্য নিযুক্ত।

আড়াইহাজার অর্থনৈতিক অঞ্চল

আরাইহাজার অর্থনৈতিক অঞ্চল বেজা কর্তৃক প্রতিষ্ঠা করা হবে এবং জাইকার (জাপান আন্তর্জাতিক সহযোগিতা সংস্থা) পক্ষ হইতে অর্থায়ন করা হবে।

3

১। পটভূমি

জাইকার সাতটি নীতিমালা

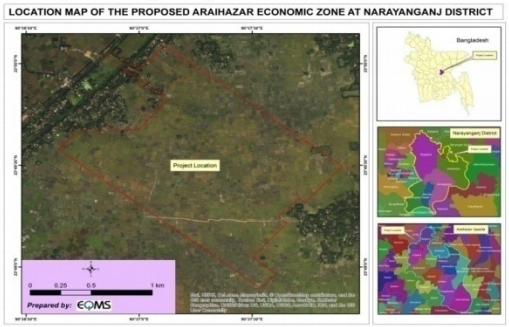
- বিস্তৃত পরিসরে প্রভাব নিরূপণ করতে হবে
- প্রাথমিক পর্যায়ে পরিবেশ ও সামাজিক গুরুত্ত নির্ণয়
- জবাবদিহিতার জন্য দায়বদ্ধ
- অংশীদারদের অংশগ্রহণ
- তথ্য প্রকাশ
- সাংগঠনিক ক্ষমতা বৃদ্ধিকরণ
- তাৎক্ষণিক প্রচেষ্টা

4

২। প্রকল্পের বৈশিষ্ট্য

প্রকল্পের অবস্থান

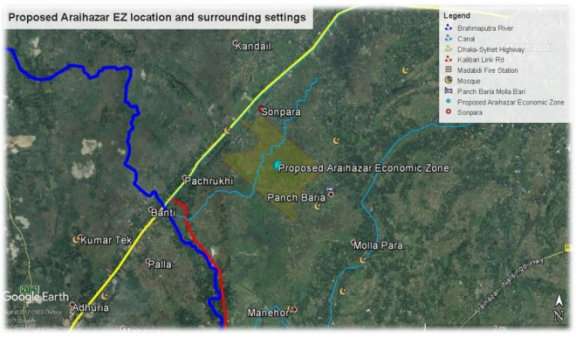
অবস্থানঃ সাতগ্রাম এবং দুপতারা ইউনিয়ন, ঢাকা-সিলেট মহাসড়কের সংলগ্ন আড়াইহাজার উপজেলার অধীনে অবস্থিত। মোট জমি (প্রথম ধাপ) = প্রায় ৪৯১ একর।



5

২। প্রকল্পের বৈশিষ্ট্য

প্রকল্পের অবস্থান এবং পার্শ্ববর্তী স্থাপনা



6

২। প্রকল্পের বৈশিষ্ট্য

অর্থনৈতিক অঞ্চল জন্য মৌলিক অবকাঠামো

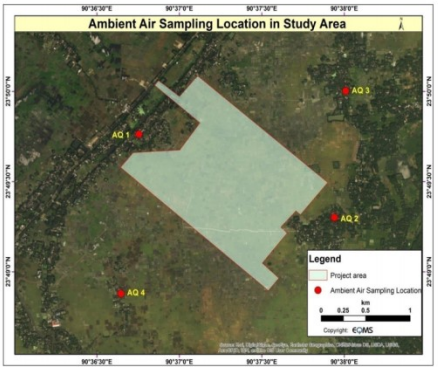
【 অভ্যন্তরীণ অবকাঠামো 】
- -অর্থনৈতিক অঞ্চলের জন্যে নির্বাচিত স্থানে ভূমি উন্নয়ন পরিকল্পনা
- -বৃষ্টির পানি নিষ্কাশন ব্যবস্থা (নিষ্কাশন খাল সহ)
- -পানি সরবরাহ পরিকল্পনা (ভূগর্ভস্থ পানি এবং / অথবা ভূপৃষ্ঠ পানি বিবেচনা করা হবে)

【 বাহ্যিক অবকাঠামো 】
- -প্রবেশের রাস্তা
- -বিদ্যুৎ উৎপাদন, প্রেরণ এবং বিতরণের জন্য পরিকল্পনা
- -যোগাযোগব্যবস্থার পরিকল্পনা
- -গ্যাস সরবরাহ পরিকল্পনা
- -পার্শ্ববর্তী এলাকায় রাস্তাগুলির জন্য পরিকল্পনা

7

৩। পরিবেশের গুণমান নিরীক্ষা

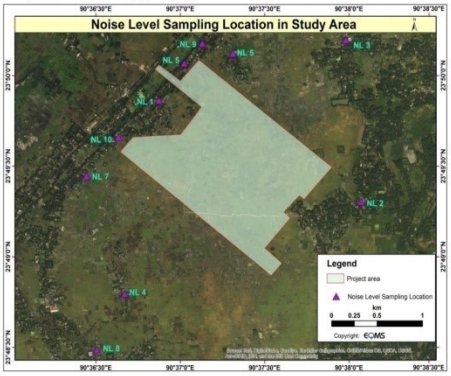
বায়ুর নমুনা পরীক্ষার স্থানসমূহ



8

৩। পরিবেশের গুণমান নিরীক্ষা

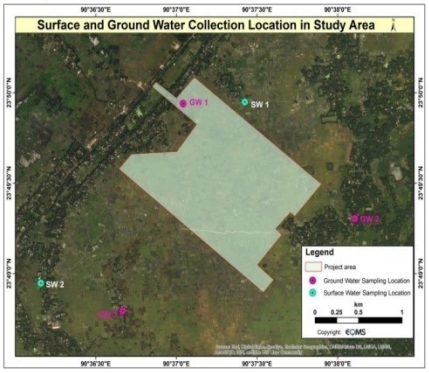
শব্দের নমুনা পরীক্ষার স্থানসমূহ



9

৩। পরিবেশের গুণমান নিরীক্ষা

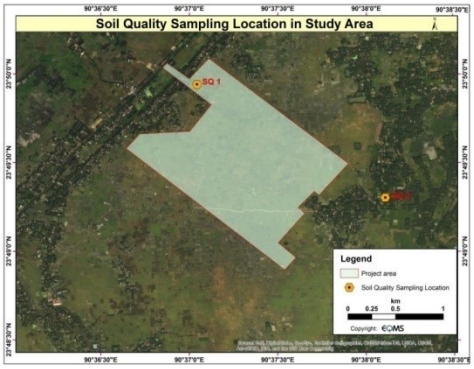
ভূগর্ভস্থ এবং ভূপৃষ্ঠ পানির নমুনা পরীক্ষার স্থানসমূহ



10

৩। পরিবেশের গুণমান নিরীক্ষা

মাটির নমুনা পরীক্ষার স্থানসমূহ



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৪। ভূমি অধিগ্রহণ এবং সামাজিক জরিপ

- পুনর্বাসিত পরিবারের উপর জরিপ
- ভূমি ক্ষতিগ্রস্তদের উপর জরিপ
  - ➢ জেলা প্রশাসক দ্বারা ভূমি মূল্য নির্ধারণ
  - ➢ জেলা প্রশাসক দ্বারা সম্পত্তি মূল্য নির্ধারণ (যদি থাকে)
  - ➢ কৃষি সম্প্রসারণ অধিদপ্তর দ্বারা ফসলের মূল্য নির্ধারণ (যদি থাকে)
  - ➢ পরামর্শক প্রতিষ্ঠান দ্বারা জরিপ সম্পন্ন (ইকিউএমএস)
- ২ কি.মি. ব্যাসার্ধ এলাকায় সামাজিক অর্থনৈতিক জরিপ (ইকিউএমএস)
- বিশেষ শ্রেণীর জনসাধারণের সাথে আলোচনা (ইকিউএমএস)

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৫। পরিবেশগত ও সামাজিক প্রভাব মূল্যায়ন

পরিবেশগত প্রভাব

- বায়ু দূষণ
- শব্দ ও কম্পন
- পানি দূষণ
- মাটি দূষণ
- মাটি ক্ষয়
- জীববৈচিত্র্য
- কৃষি
- মৎস্য
- বৈশ্বিক উষ্ণতা

পরিবেশ অধিদপ্তর (ডিওই) থেকে অনুমোদন প্রাপ্ত

সামাজিক প্রভাব

- অনৈচ্ছিক পুনর্বাসন
- জীবন ও জীবিকা
- ঝুকিপূর্ণ শ্রেণী
- স্থানীয় সংঘাত
- শিশু অধিকার
- এইডস/এইচআইভি ঝুকি
- পেশাগত স্বাস্থ্য ও নিরাপত্তা
- সামাজিক স্বাস্থ্য ও নিরাপত্তা
- আপদকালীন ঝুকি

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৬। অনুশীলন পরিকল্পনা

পরিকল্পনা সূচি	বিষয়
	ইএসআইএ
২২ নভেম্বের ২০১৭	• ১ম ইএসআইএ মতবিনিময় সভা (চলমান সভা)
ডিসেম্বের ২০১৭	• ২য় ইএসআইএ মতবিনিময় সভা
ডিসেম্বের ২০১৭	• ২য় মতবিনিময় সভার মতামত অনুযায়ী ইএসআইএ সংশোধন • সংশোধিত ইএসআইএ পর্যালোচনার জন্যে বেজায় প্রেরণ

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৭। জনসাধারণের মতামত

জনসাধারণের মতামত

৩০ মিনিট

সর্বোচ্চ ২ টি মন্তব্য /প্রতি জন

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ধন্যবাদ

BANGLADESH ECONOMIC ZONES AUTHORITY

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ANNEX F- ADMINISTRATIVE APPROVAL OF LAND ACQUISTION FOR ARAIHAZAR ECONOMIC ZONE

ডায়েরী নং ঃ...৮৭৭.....
তারিখ ঃ২২/৩/১৭.....

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
প্রধানমন্ত্রীর কার্যালয়

পুরাতন সংসদ ভবন
ঢাকা

পত্র সংখ্যা ০৩.০৬৮.০১৮.০৯.০০.০৪.২০১৭- ১৬৭

তারিখ ০৫ চৈত্র, ১৪২৩ বঃ
১৯ মার্চ, ২০১৭ খ্রিঃ

বিষয়ঃ আড়াইহাজার অর্থনৈতিক অঞ্চল, নারায়নগঞ্জ এর অন্তর্ভুক্ত সরকারি খাস জমি দীর্ঘমেয়াদী বন্দোবস্ত এবং ব্যক্তিমালিকানাধীন জমি অধিগ্রহণের প্রশাসনিক অনুমোদন প্রদান।

সূত্রঃ বেজা'র ১৯/০১/২০১৭ তারিখের ০৩.৭৫৯.০১৪.২৭.০০.০৩১.২০১৫-১৪৭ নং স্মারক।

উপর্যুক্ত বিষয় ও সূত্রে বর্ণিত পত্রে বাংলাদেশ অর্থনৈতিক অঞ্চল কর্তৃপক্ষ (বেজা) কর্তৃক আড়াইহাজার অর্থনৈতিক অঞ্চল, নারায়নগঞ্জ প্রতিষ্ঠার জন্য মোট ১০১০.৯০ একর জমির মধ্যে খাস ১০.১৮ একর জমি বন্দোবস্ত এবং ব্যক্তিমালিকানাধীন ৯৯৯.৯১৫০ একর জমি অধিগ্রহণ করার প্রশাসনিক অনুমোদন প্রদানের জন্য প্রস্তাব করা হয়েছে। কিন্তু "অর্থনৈতিক অঞ্চল স্থাপনের নিমিত্ত ভূমি অধিগ্রহণ প্রকল্প (আড়াইহাজার, নায়ারনগঞ্জ ও মিরসরাই অর্থনৈতিক অঞ্চল)" প্রকল্পের ডিপিপিতে ভূমির পরিমাণ ৯৯১.৪৮ একর উল্লেখ করা হয়েছে। এ বিষয়ে স্পষ্টীকরণের জন্য নির্দেশক্রমে অনুরোধ করা হলো।

(নাফিউল হাসান)
পরিচালক-১
ফোনঃ ৯১৩৭৮৫০
E-mail: dir1@pmo.gov.bd

নির্বাহী চেয়ারম্যান
বাংলাদেশ অর্থনৈতিক অঞ্চল কর্তৃপক্ষ
বিডিবিএল ভবন
কাওরান বাজার, ঢাকা।