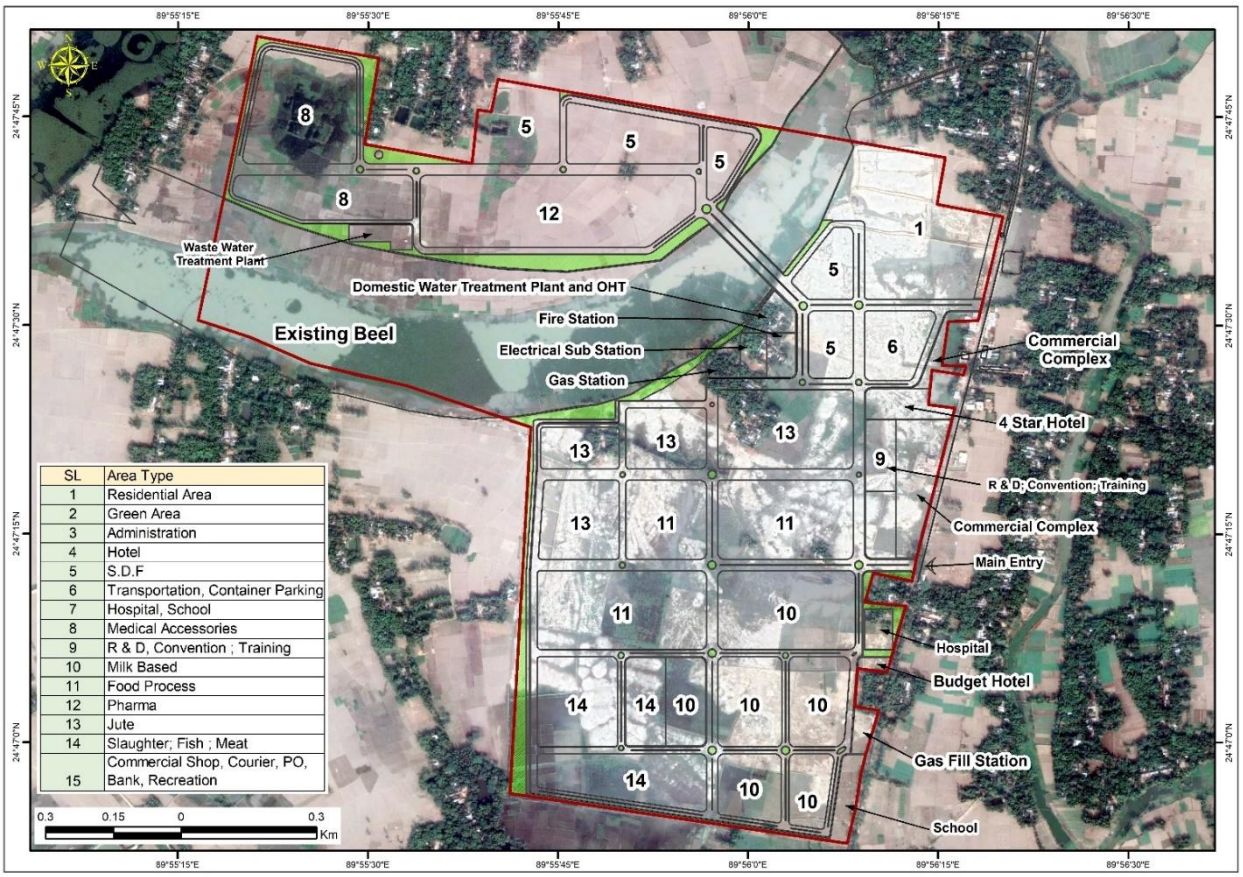
Environmental Impact Assessment
of
Jamalpur Economic Zone



SL	Area Type
1	Residential Area
2	Green Area
3	Administration
4	Hotel
5	S.D.F
6	Transportation, Container Parking
7	Hospital, School
8	Medical Accessories
9	R & D, Convention ; Training
10	Milk Based
11	Food Process
12	Pharma
13	Jute
14	Slaughter; Fish ; Meat
15	Commercial Shop, Courier, PO, Bank, Recreation

June 2019

Submitted to

Bangladesh Economic Zones Authority

Submitted by

Infrastructure Investment Facilitation Company

[In association with Shahidul Consultant]

Disclaimer

The report has been prepared by Infrastructure Investment Facilitation Company in association with Shahidul Consultant (hereinafter referred as SC), as an associate firm whereas Infrastructure Investment Facilitation Company (IIFC) was the lead firm, for complete the regulatory requirement of Department of Environment (DoE), Ministry of Environment and Forests, The People's Republic of Bangladesh. SC has undertaken a detailed environmental survey and has developed a comprehensive Environmental Impact Assessment (EIA) for Jamalpur Economic Zone. Any third party should obtain prior consent of SC before copying or reproducing, in whole or in part, the contents of this report. Furthermore, SC will not be bound to discuss, explain or reply to queries raised by any agency other than the intended recipients of this report. All information in the report is intellectual property of Jamalpur Economic Zone.

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Table of content

Abbreviation and Acronym

%	Percentages
µg	Micor gram
^{0}C	Degree Celsius
AAQM	Ambient Air Quality Monitoring
ADB	Asian Development Bank
AIDS	Acquired Immunue Defficiency Syndrome
APHA	American Public Health Association
As	Arsenic
BARC	Bangladesh Agriculture Research Council
BBS	Bangladesh Bureau of Statistics
BDT	Bangladeshi Taka
BERC	Bangladesh Energy Regulatory Commission
BEZA	Bangladesh Economic Zone Authority
BFD	Bangladesh Forest Department
BITWA	Bangladesh Inland Water Transportation Authority
BIWTA	Bangladesh Inland Water Transport Authority
BMD	Bangladesh Meteorological Department
BOD	Biochemical Oxygen Demand
BOI	Board of Investment
BPDB	Bangladesh Power Development Board
BWDB	Bangladesh Water Development Board
C_6H_5OH	Phenol
CAA	Civil Aviation Authority
Cd	Cadmium
CESR	Corporate Environmental and Social Responsibilities
CETP	Central Effluent Treatment Plant)
CFCs	Chlorofluorocarbons
CFU	Colony Forming Unit
cm	Centimeter
Cn	Cyanide
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
CP	Contracting Party
Cr	Chromium
CRC	Convention on the Rights of the Child
CSR	Corporate and Social Responsibilities
Cu	Copper
DC	District Commissioner
DDM	Department of Disaster Management
DO	Dissolved Oxygen
DOE	Department of Environment
DoF	Bangladesh Forest Department
DPHE	Department of Public Health and Engineering
EA	Environmental Assessment
EC	Electrical conductivity
EC	Electrical Conductivity
ECA	Environment Conservation Act
ECA	Ecologically Critical Areas
ECC	Environmental Clearance Certificate
ECNWRC	Executive Committee of the National Water Resources Council
ECR	Environmental Conservation Rules
EHS	Environment, Health and Safety
EIA	Environment Impact Assessment
EIA	Environmental Impact Assessment

EMMP	Environmental Monitoring and Management Plan
EMP	Environmental Management Plan
EPFIS	Equator Principle Financial Institutions
EPZ	Export Processing Zone
ERP	Emergency Response Plan
ERT	Emergency Response Team
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
ETP	Effluent Treatment Plant
EZs	Economic Zones
F	Fluoride
FC	Fecal Coliform
FDI	Foreign Direct Investment
Fe	Iron
FGDs	Focused Group Discussions
Ft.	Feet
FY	Fiscal Year
GDP	Gross Domestic Product
GoB	The Government of Bangladesh
Hg	Mercury
HIV	Human Immune deficiency Virus
IDC	Interest During Construction
IEE	Initial Environment Examination
IFC	International Finance Cooperation
ILO	International Labor Organization
IUCN	International Union for Conservation of Nature
JEZ	Jamalpur Economic Zone
kg	Kilograms
Km	Kilometer
LCC	Location Clearance Certificate
MEAs	Multilateral Environmental Agreements
mg	Miligram
mg/L	Miligram per litre
mm	Mili Meter
Mn	Manganese
MoEF	Ministry of Environment and Forests
MoFL	Ministry of Fisheries and Livestock
MOS	Ministry of Shipping
MSDS	Compilation of Material Safety Data Sheets
MT	Metric Ton
N	Nitrogen
NGOs	Non-Government Organizations
Ni	Nickel
NOC	No Objection Certificate
NOx	Nitrogen Oxides
NWMP	National Water Management Plan
NWRC	National Water Resources Council
NWRD	National Water Resources Database
O_3	Ozone
OHS	Occupational Health Safety
OPs	Operational Policies
P	Phosphorus
PAPs	Project Affected Persons
Pb	Lead
PCM	Public Consultation Meeting
PCP	Public Communications Policy
PD	Public Disclosure

PDMs	Public Disclosure Meetings
PGCB	Power Grid Company of Bangladesh
PM	Particulate Matter
PM_{10}	$(Particulate\ Matter)_{10}$
$PM_{2.5}$	$(Particulate\ Matter)_{2.5}$
PMO	Prime Minister's Office
PPE	Personal Protective Equipment
PS	Policy Statement
PSMP	Power System Master Plan
RAP	Resettlement Action Plan
S	Sulfur
Se	Selenium
SMS	Safety Management System
SO_2	Sulfur Dioxide
SO_x	Oxides of Sulfur
SPM	Suspended Particulate Matter
SPS	Safeguard Policy Statement
SS	Suspended Solids
STP	Sewage treatment plant
TC	Total Coliform
TDS	Total Dissolved Solids
ToR	Terms of Reference
TSS	Total Suspended Solids
UNEP	United Nations Environment Programme
UP	Union Parishad
VOCs	volatile organic compounds
WARPO	Water Resources and Planning Organization
WB	World Bank
WTP	Water treatment plant
WWTP	Wastewater treatment plant
Zn	Zinc

Executive Summary

The Bangladesh Economic Zone Act, 2010, has been introduced by the Government of Bangladesh to facilitate development of Economic Zones (EZs) in the potential regions of the country, aiming to boost up the country's economic development and ensure standard, eco-friendly industrial zone that would encourage more foreign investment. Under this Act, the Bangladesh Economic Zone Authority (BEZA) has been established under the Prime Minister's Office (PMO) and governed by a Board chaired by the Prime Minister. The law provides legal coverage for attracting and leveraging private investment in the development of zones as zone developers or operators, and in the provision of tailored infrastructure services, such as private provision of power, effluent treatment, etc.

In response to the commitment of the Govt. of Bangladesh, BEZA has enthusiastically planned to set up an Economic Zone named Jamalpur Economic Zone (Hereinafter "JEZ"). The planned area for the economic zone is 443 acres at Jamalpur Sadar Upazila of Jamalpur District.

Project Background

The project proponent shall develop the land and the following infrastructures:

- ✓ Processing area
- ✓ Specialized infrastructure
- ✓ Utilities
- ✓ Non-processing area

Beside the development of Economic Zone following key link projects will be implemented by government:

Table I: Key linked projects

Key Linked Projects	Implementing Agency
Land acquisition	Deputy Commissioner's office, Jamalpur
Upgradation of the road network	Roads and Highway Department, Jamalpur
Development of electrical grid line for power supply to the economic zone and an electric sub-station within the economic zone	Jamalpur Palli Bidyut Samity
Development of industrial gas pipeline network for supply to the economic zone and a gas substation within the economic zone	Titas Gas Transmission and Distribution Company
Domestic water treatment plant and water pumping station	Department of Public Health Engineering, Jamalpur
Drainage network for disposal of the treated waste water	Department of Public Health Engineering, Jamalpur
Solid waste management system	Department of Public Health Engineering, Jamalpur
City development planning	Jamalpur Municipality
Fire station establishment	Jamalpur Fire Service

For preparing the Environment Impact Assessment (EIA) report, a Terms of Reference (ToR) on the proposed Jamalpur EZ project was applied to DoE. Afterward, the ToR was approved by DoE Memo No. DoE/Ta:Dist:/Jamalpur/30.39.36.4.1078.160915 dated 19th October, 2015. A copy of the approved ToR is attached in Annex-9.

Policy, Legal and Administrative Framework

This chapter provides a description of the regulatory framework applicable to the proposed project. It highlights environmental, health & safety and social regulations with applicable permits and standards in association with the project. It broadly focuses on the:

- Legal Enforcement Agencies at National Level;
- Applicable national and local Environmental and Social Laws, Regulations and Policies;
- World Bank Environmental Safeguard Policies and expected trigger ability;
- World Bank (WB) Environmental Impact Assessment Guidelines;
- International & National Environment Standards/ Guidelines; and
- Applicable International Conventions/Protocols.

Project Location and Area

The proposed Jamalpur EZ will be developed at Jamalpur Sadar Upazila of Jamalpur District. EZ site covers an area of 443 acres. The project is approximately 178 km from Shahjalal International Airport and approximately 436 km from Chattogram port. The Joydevpur-Tangail-Jamalpur highway is adjacent to the project site.

Table II: Coordinates and surroundings of the EZ site

Side	Boundary Points	Coordinate	Object	Distance
North	Corner 01 & Corner 02	La-24°47'50.40"N Lo-89°55'21.17"E& La-24°47'37.70"N Lo-89°56'20.18"E	Homestead area	Adjacent to EZ
South	Corner 04& Corner 05	La-24°46'56.70"N Lo-89°55'41.14"E& La-24°46'53.05"N Lo-89°56'7.81"E	Paddy land	Adjacent to EZ
East	Corner 02 & Corner 05	La-24°47'37.70"N Lo-89°56'20.18"E& La-24°46'53.05"N Lo-89°56'7.81"E	Homestead area and Joydevpur-Tangail-Jamalpur Highway	Adjacent to EZ
West	Corner 01, Corner 03& Corner 04	La-24°47'50.40"N Lo-89°55'21.17"E; La-24°47'30.30"N Lo-89°55'16.56"E& La-24°46'56.70"N Lo-89°55'41.14"E	Paddy land	Adjacent to EZ
*La=Latitude, Lo=Longitude				

Figure I: Location of economic zone

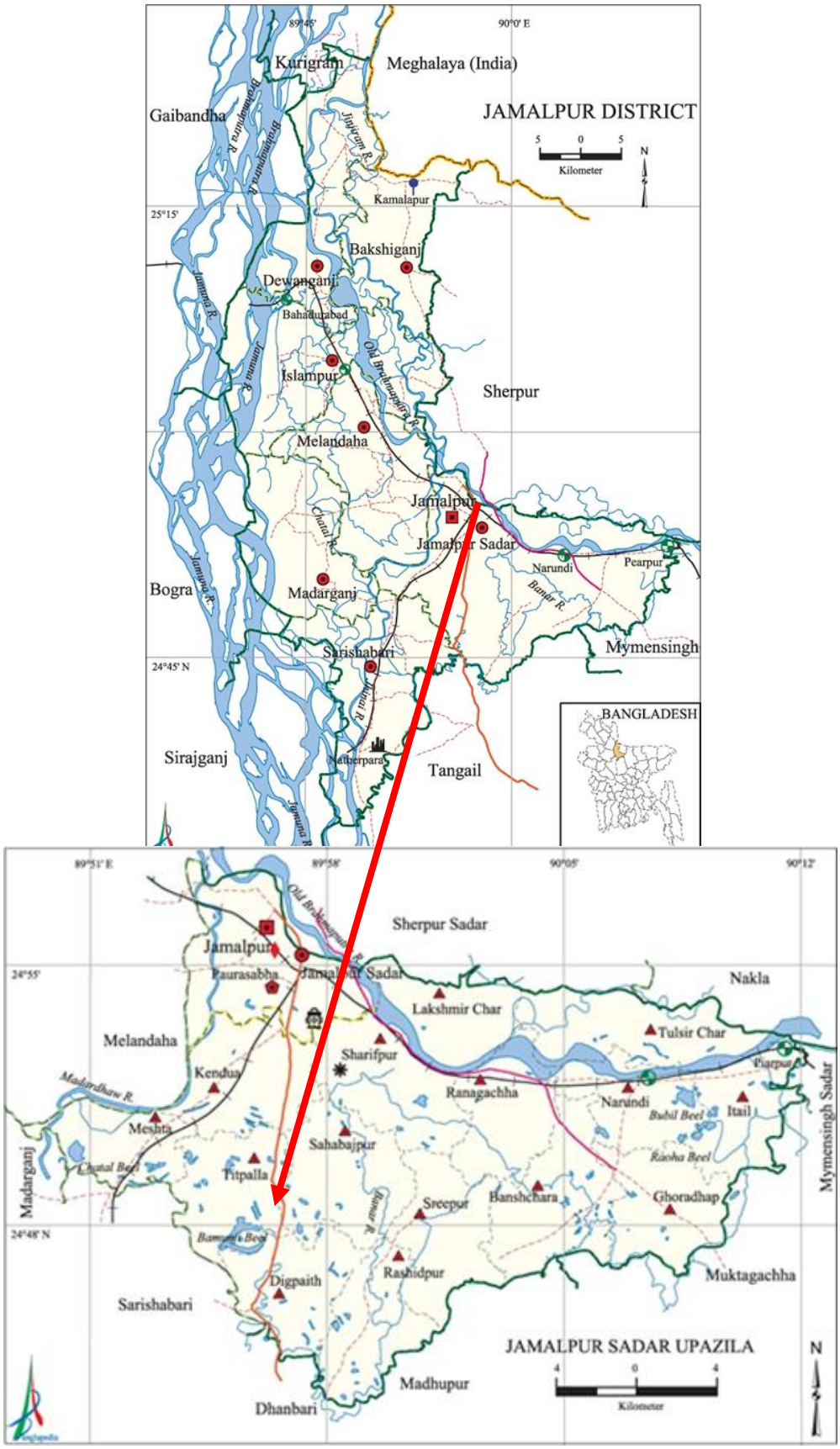
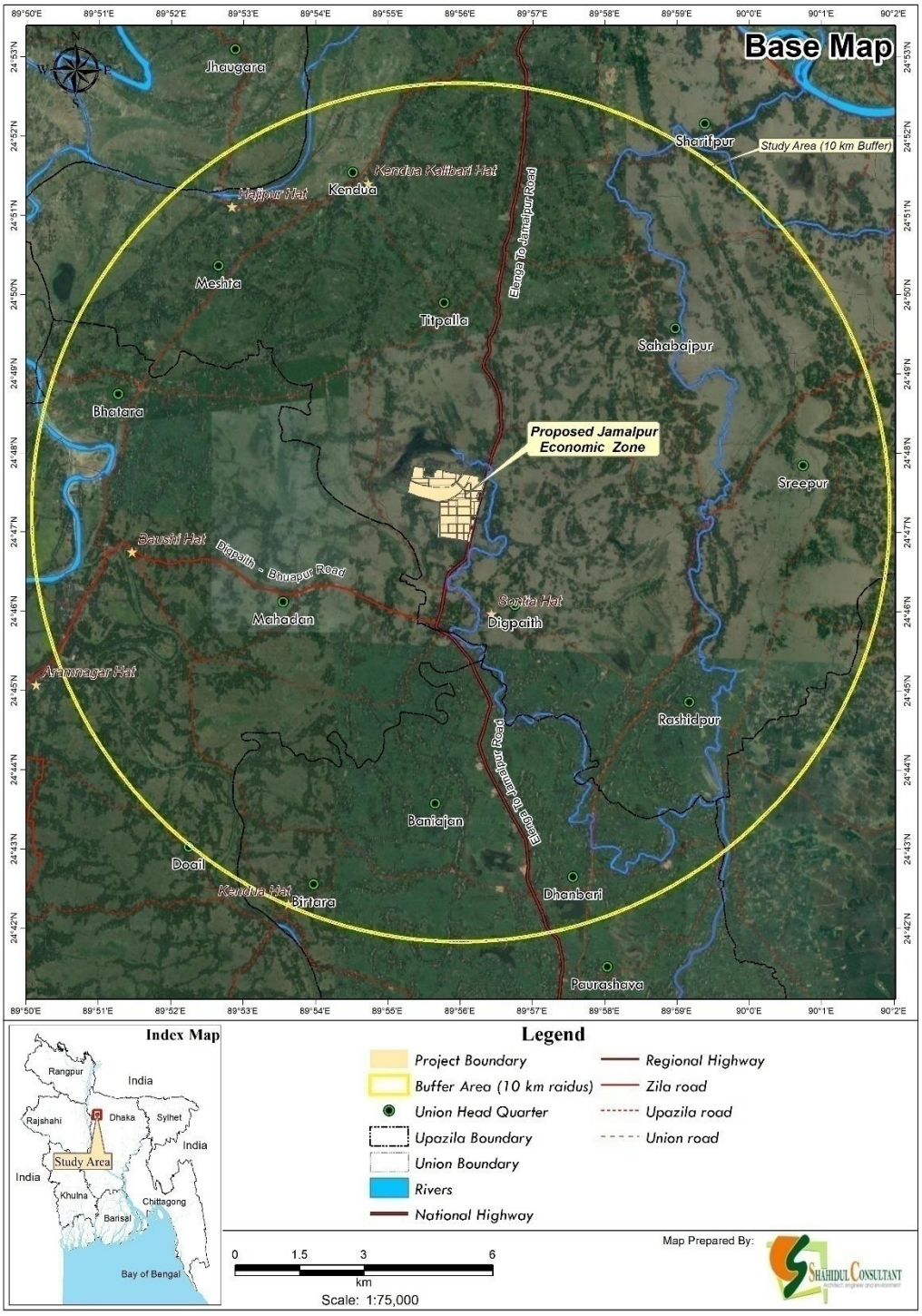


Figure II: 10 km radius map from project location



Project Description

The total area of the upcoming JEZ located at Jamalpu Sadar Upazila is about 443 acres. As per EZ Act, 2010, EZ can have following components:

- Processing Area
- Domestic Processing Area (DPA)
- Utilities
- Non-Processing Area

Post-secondary data analysis and stakeholder consultation following industries come out to be potential industries for the Jamalpur Economic Zone.

Table III: Proposed industrial sectors in Jamalpur Economic Zone

Type of Industries	Examples
Agro based industries	Jute, maize, spices, fruit and pulp, mustard oil , rice
SMEs in Jamalpur district	Soft drinks, handicrafts, fertilizers, ceramics, garments
Medical accessories & equipment sector and pharmaceutical sector	Medical equiepments, medical accessories, pharmaceutical
Cattle based industries	Leather, milk, meet
Logistics	Cold storage, warehouses, packaging

Land Use Plan for EZ

Area of the site considered for development is 443 acres. The suggested land distribution for JEZ in the master plan is:

- Industrial plots: 65%
- Residential: 0%
- Parkes and open spaces: 5%
- Common infrastructure zones: 15%
- Roads and circulation: 15%
- Total site area: 100%

The industrial plots will be allotted for industries. Common infrastructures include environmental infrastructures, social infrastructures and relevant technical infrastructures. Roads and transport area includes road, parking area, pedestrian pathway bicycle tracks etc.

Project Schedule

The proposed construction time for established JEZ is 3 years. The following table presents the implementation schedule of the project infrastructure at the proposed JEZ.

Table IV: Proposed schedule for JEZ development

Activity	Starting Date	Ending Date
Start of Construction period	1st April. 2017	31st March, 2020
Start of Revenue from the Industrial tenants	1st April, 2020	Continue
Start of debt repayment	1st April, 2020	1st April, 2027

Estimated Project Cost

The estimated project cost for the project development is BDT 209.88 core which is excluding cost of land acquisition, rehabilitation & resettlement, land filling, retaining wall with water body protection. The estimated cost for project development has been provided in the following table.

Table V: Estimated cost for project without IDC

S.NO	PARTICULARS OF ITEM	MILLION BDT
	Responsibilities of the Private Partner	
1	Road and internal network	563.28
2	Drainage piping and waste water treatment plants	276.79
3	Domestic water piping and tanks for storage	103.19
4	Storm water drainage	71.08
5	Administrative building and associated construction work	90.00
6	Bridge	550.00
7	Green area with plantation	10.00
8	Site boundary: 2 m above the fill level	144.00
9	Fire fighting	70.00

S.NO	PARTICULARS OF ITEM	MILLION BDT
10	Electrification - street lighting and power distribution	75.00
11	Gas distribution network	37.98
	Total direct project cost to developer in BDT million (a)	1,991.32
	Contingencies @ 5%	99.57
	Total cost including contingencies	2,090.88

Responsibilities of Contracting Authority:

- Rehabilitation (also resettlement if it is decided at a later stage)
- Land filling
- Retaining wall with water body protection
- Site boundary (only as required for land filling as retaining wall)

The Total Project Cost (TPC) that includes IDC and financial overheads. TPC and its phasing are presented below:

Table VI: Total Project Cost (TPC)

Capex phasing (BDT Crore)	Total cost	Y-1	Y-2	Y-3
% capex phasing		25%	45%	30%
Total development cost	**210**	52.50	94.50	63.00
Escalation	**22.2**	2.6	9.7	9.99
Preliminary expenses	**3.5**	0.9	1.57	1.05
Contingencies		-	-	-
Financing fees	**3.5**	0.9	1.57	1 .05
Total project cost (excl. IDC)	**239.2**	56.86	107.32	75.02
Upfront payment	**20**	5	7.5	10
IDC	**20.56**	100	6.2	13.40
Total project cost (incl. IDC)	**279.98**	62.84	120.99	95.94

Utilities Requirement

Proposed project requires different utilities such as- power supply, gas supply, water distribution and storage, waste water treatment, fire station etc. Descriptions of major utilities are given below:

Water Supply: Water demand for construction and operation work will be fulfill from municipal water, ground water and beel water. Collected water will be store in tanks after treatment. The nearest location viable for tapping water from for river shall be 35 to 14 km from site. JEZ would require creating pumping stations at intervals of 8 to 10 km and providing selling tank to remove silt.

Power Supply: Jamalpur Palli Bidyut Samity shall be responsible for providing power supply in JEZ. Government will install an 11 kV substation inside the economic zone to provide uninterrupted power supply to the industries. Power requirement during construction work is less than 1 MW, which will provide from exciting distribution network within 3 months of project start.

Further power supply requirement shall arise when operation phase starts. The authority will develop a 15 MW power supply line from Sarishabari sub-station within 6 months. Apart from this, a 6 MW power supply line within 1 year. Depending on the upgradation of the operation activities, a dedicated line of 30 MW will be constructed within 2 years connecting from the switching station in Beltia.

Gas Supply: A gas station will be installed inside the economic zone. 'Titas Gas Transmission and Distribution Company' will be in charge for gas connection to the EZ. Nearest available alternatives in site vicinity are Jamalpur Sadar Gas substation and Faizal More Gas substation.

Environmental and Social Baseline

The following table represents the summary of various environmental settings considering 10 km radius around JEZ.

Table VII: Existing environmental settings of the study area

Particulars	Details
Location	Jamalpur Sadar Upazila of Jamalpur District.
Total Area	443 acres.
Site Elevation	Around 17 m from MSL
Land Type	Medium land
Major Soil Type	Dark Grey Floodplain soil
Major crops	Paddy, vegetables.
Major Physiographic Units	Old Brahmaputra Flood Plain
Flooding	Tidal flood prone area.
Seismicity	Falls in the earthquake Zone-III
Nearest Airport	Proposed EZ is located at a distance of 178 km (approx.) from Shahjalal International Airport.
Nearest Railway Station	Bausi Bazar Railway Station is at distance of 11 km and Jamalpur Sadar Railway Station is at distance of 15 km
Nearest Port	Proposed EZ is located at a distance of approx. 436 km from Chattogram port.
Climatic conditions	The annual average temperature of this district varies from maximum 33.3°C to minimum 12°C.Annual average rainfall is 2174 mm.
Ecologically Critical Area	No ecologically critical areas were found within 10 km radius of the project.
Environment and Social Hotspots	Beels, homestead, vegetation, agricultural land, school, mosque etc.
Existing structure within the project area	106 household, 1 retail kiosk (temporary structure), 2 mosque and one club (temporary structure)
Major Settlement	Residential area.
Forests / National Parks	None within 10 km radius of the project.
Archaeological Site	None within 10 km radius of the project.
Major Waterbody	Bamui Beel, Bangshi River, ponds.

Identification and Analysis of Key Environmental Issues

The Checklist of potential environmental impacts of JEZ has been given in the following Tables. The negative impacts predicted in this manner were the 'unmitigated' impacts. Appropriate mitigation measures were recommended as part of this EIA, thus reducing the occurrence possibility and severity of the potentially adverse impacts.

Table VIII: Checklist of potential environmental impacts

Project phase	Actions affecting environmental resources	SEI_s without mitigation measures				Type		Comments
		None	Minor	Medium	Major	Adverse	Beneficial	
Construction phase	Land value depreciation	×					×	Land value change: Positive impact
	Loss of and displacement from homestead land	×						Displacement of 10 household: compensation provided
	Loss of and displacement from agricultural land	×						Primary economic activity to secondary activity
	Damage to nearby operation	×						No impact anticipated as no major installation
	Disruption of drainage pattern	×				×		Take care of local drainage pattern
	Encroachment into precious ecology	×						No precious ecological issues: no impact
	Runoff Erosion		×					Take care of local drainage pattern
	Worker accident		×			×		Take care by good housekeeping
	Sanitation diseases hazard		×			×		Concentration of labourers may cause unhygienic environment
	Noise/ Vibration hazard			×		×		Pilling/equipment installation may cause noise
	Traffic congestion				×	×		Regular monitoring by designated security
	Employment				×		×	Good employment opportunity
Operation phase	Encroachment into precious ecology	×						No precious ecological issues: No impact
	Depreciation of environmental aesthetics		×					Local community prefer employment generation activities
	Erosion/Silt runoff	×						Having boundary wall: no impact
	Pollution from liquid discharge		×					Preventive measure will be undertaken
	Pollution from solid wastes		×			×		No significant solid waste: No significant impact
	Air quality	×						No major impact
	Occupational health hazard			×		×		Reduce by good management practice
	Odour hazard	×						No obnoxious odor: no major impact
	Traffic congestion	×						No carrying of product
	Noise hazard		×					Moderate impact
	Employment			×			×	Good employment opportunity

Environmental and Social Impacts

Impact on Air Quality and Noise

Pre-construction Phase: Generation of dust and noise caused by the operation of heavy land filling machinery and trucks is predicted but will be limited to the surrounding area.

Construction Phase: Gaseous emissions containing PM_{10}, $PM_{2.5}$, SPM, CO, NO_X, SO_2 and lead will be released from the vehicular and construction equipment exhaust. Operation of different machineries and equipment for construction activities, running of heavy load traffic for construction materials transportation, and regular traffic movement may generate noise during construction period.

Post-Construction Phase: It is envisaged that particulate matter, sulphur dioxide, metals, VOCs, fugitive emissions and other criteria pollutants like ozone, oxides of nitrogen and carbon monoxide will be generated during industrial operations. During operation phase the noise levels may rise due to vehicular movement and industrial activities. The operation of industrial units can create vibration, but this will be limited to the adjoining area.

Impacts on Water Resources

Pre-Construction Phase: The Bamui Beel is located inside of the project area and connected with Bangshi River. Bangshi River is adjoining in the east site of the project. Since the beel and river is adjoining to the project site, effect from the earth filling activities water level and quality of the river is anticipated. JEZ will not done any activity which will affect beel or river. So, the hydrological and morphological change is not significant for the development of JEZ.

Construction Phase: JEZ will take steps to protect the bank of beel from landslide. Generally, the project area may affect by flooding by the river during monsoon season. Excess withdrawal of ground water may lead to depletion of aquifers. There is a potential for contamination of groundwater and surface water resources resulting from improper management of sewage.

Post Construction Phase: Wastewater generated from industrial operation and from the sewage to have effects. Central Sewerage Treatment Plant (CSTP) and Central Effluent Treatment Plant (CETP) shall be installed in operations phase of the project to reduce wastewater pollution in the nearby water bodies.

Impacts on Land Resources

Pre-construction Phase: The land filling may affect the topography and geology of the area around the proposed site. Filling will cause change of land types. Land filling can disrupt the natural drainage pattern and cause drainage congestion which can affect the land resource.

Construction Phase: Construction work may affect the topography and geology of the area around the proposed site. Major impacts may be arise due to operation activity are soil erosion, soil compaction, waste generation, soil contamination etc.

Post Construction Phase: 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.

Impacts on Agriculture Resources

Pre-construction Phase: Agriculture is the main economic activity in the project area. The land use of the area demarcated for the EZ is predominantly agriculture which is also evident from

the crop cultivation practices being followed in the region. Due to development of EZ, the agricultural activity will be impacted.

Construction Phase: In construction phase after land development, existing land will be converted into industrial land use with construction of infrastructure. It will require different amount of temporary construction labor and will absorb from agricultural sectors.

Post-Construction Phase: Different industries will require different amount of permanent semi-skilled and unskilled labor and will absorb from different sectors of industries. It can create scarcity of such labor and boost their wage up. Project affected community (land owners) should get job in the project with a priority basis.

Impacts on Fisheries

Pre-construction Phase: Land development work converted low lying area into flood free area, where fisheries (seasonal) habitat may reduce.

Construction Phase: During construction period construction materials may be released to the nearby beel or pond from the construction site. This may damage the fisheries ecosystem of the respective water body.

Post-Construction phase: Fish demand will be increase in project area due to migrated population. Runoff of exposed soil surfaces and drainage of waste water from industrial operation and sewage drainage into waterbody can destroy fisheries ecosystem. Appropriate protection measure from waste water contamination to water body by functioning CETP and CSTP will be established to control the pollution, save the fisheries and other aquatic resources of the project area. Appropriate monitoring system will be devised for desired standard of CETP outlet parameters.

Impacts on Ecosystem

Pre-construction Phase: The site is considered as 'no trees area', so, there is no vegetation within the zone except some herbs. Some fauna lived and depended on food from the area will lose the habitat and source of sustenance. Plantation will provide them new home and source of sustenance by the Project. The impact on flora and fauna will not be significant for this reason. Since Bamui beel located at the project site and linked to Bangshi River, any disruption to the water course can harm aquatic flora and fauna. Beside these birds depends on these beel. Their ecosystem will be disturbed due to development of the project.

Construction Phase: If construction waste does not adequately handled, flora and fauna can be affected. Segregating waste at collection, recycling and reusing waste will be promoted and non-recyclable waste will be disposed at appropriate sites according to related regulations.

Post-Construction Phase: Household waste discarded from the residence of the workers will contaminate water and soil. Moreover, hazardous waste from industries can pollute the aquatic and terrestrial eco-system. It is claimed according to the type and nature of unit industries that, no waste water or liquid waste will be generated from the EZ. If any industry produce such waste, will be treated according to the regulations of DoE before disposal. Segregating waste at collection, recycling and reusing waste will be promoted and non-recyclable waste will be disposed at appropriate sites according to related regulations. Green buffer of 10 m all around the project site will include most of the native plant species, which will significantly improve the ecology of the area. Industrial development will involve generation of emissions, effluents and

increased vehicular movements. These altogether may have overall negative impact on the eco-system of the site and the nearby areas as the air pollutant will impact the existing vegetation and avifauna in the area. If appropriate measures for preventing air, water, soil and noise pollution are taken there will be no significant impact on the eco-system of the area.

Socio-Economic Impact

Pre-construction Phase: Land acquisition is required for the development of the project.106 household will be directly affected, so resettlement is mandatory for this project. No conflicts will occur with local residence as the land was procured from residents on a willing buyer–willing seller basis. Moreover, local people should be employed for the construction works to the maximum extent possible, and any workers from other places/countries should be taught to respect local customs in order to facilitate good relationships with local people.

Construction Phase: The influx of skilled workers might put pressure on the existing resources like water supply, supply of fuel, provision of basic facilities, waste handling and sewage disposal which might create frictions between them and the resident population of the area. Local conflicts of interest may occur among employers, employees of local community, local mass people and local political leaders.

The construction phase will throw open a varied set of job opportunities for the population belonging to the study area. Direct and indirect job opportunity will be increased especially for unskilled work. Once, the proposed works commences in the construction phase, the land contributors of the project affected area should be given priority in employment (both, skilled and unskilled) opportunities that will arise. This step will help in the required capacity building of the local population as well.

Post-Construction Phase: Due to development activity resource demand will be increased for both industrial work and migrant population. But also a vast employment opportunities potentially created by the EZ will reduce poverty via increased income through various livelihood options. Beside this, the project implementation will help in developing the road accessibility and drainage facility in the area. The local population will indirectly be benefitted with the roads that will be developed in the area, thus, making movement to other areas effortless for them. This will also alternatively benefit a certain section of the local population by providing a source of employment to those that will be interested in developing and operating the local (private) transport system in the area.

Impact on Traffic

Pre-construction and Construction Phase: Due to the establishment of proposed EZ, road traffic volume will be increased significantly in the project area which may affect local community. Land traffic accidents during construction work may occur. As prevention measures for land traffic accidents, observation of traffic regulations, training and education on safe driving will be implemented.

Post-Construction Phase: Due to the establishment of proposed EZ, road traffic volume will be increased significantly in the project area which may affect local community. But local people will also get benefit due to development of road.

Community Health and Safety

Pre-construction and construction Phase: Public safety, particularly of pedestrians and children can be threatened during construction activities. Improper health and safety (H&S) policy maintained at the site may lead to outbreak of different diseases to the surrounding communities through the sick construction workers.

Post-Construction Phase: Due to project activity some possibility of third party accidents with residents near the construction site will be arise. With the inflow of migrant workers and their interaction with the local population, health issues among the local community might emerge. If proper waste management and effluent discharge system does not maintain, local people will be affected. Beside these, excessive air emission or noise generation will be also affected local community.

Impacts on Occupational Health and Safety

Pre-construction and construction Phase: The lack of adequate mitigation measures on the health and safety of the workers will result in accidents and injuries leading to loss of life or property.

Post-Construction Phase: The workers who work inside the factory face occupational health hazard due to different operational processes. Safe and good occupational health status of the employees and workers is important for not only the persons working in the plant, but also for the better plant operation and maintenance.

Emergency Response

Any emergency situation may be arising due to manmade activity (e.g. chemical spillage, fire etc.) or natural cause (e.g. earthquake, land slide, cyclone etc.).

Sanitation and Disease Vectors

Potential sanitation and impacts from disease need to be controlled by maintaining hygienic conditions in the EZ area throughout the operational phase as well during construction by implementing appropriate social and health programs for the project.

Impacts due to Climate Change

The climate change impacts can lead to change in weather conditions, which may increase the vulnerability of site to floods.

Cumulative Impacts

The cumulative impacts of the development of EZ will be both negative and positive. After the development of proposed industries in the EZ, the individual emissions and effluent discharge may be within permissible limits, the cumulative effect of the emission or effluent discharge of different industrial units may lead to deterioration of overall air and water quality in the region. The vehicular movement will also impact the air quality of the region. However, the cumulative beneficial impacts are higher.

Public Consultation and Disclosure

Consultation Outcomes

The stakeholders expressed that the development of the Economic Zone will bring social and economic development in the region providing permanent source of income for the PAPs and also to other nearby residential settlements. The land owners were inquisitive of the proposed

plan, land acquisition process, whether proper compensation will be provided and whether local residents whose agricultural lands will be impacted be provided any alternative means of employment. The stakeholders sought that the payment of compensation and other rehabilitation measures be completed before the start of any work. They also expressed their desire to hold consultations across the project lifecycle and not just at the initiation phase.

The community perceives that the project will help in increasing better connectivity, promote better and sustained employment opportunities, better service facilities, and better conveyance. They also demand to prioritize the local in terms of giving any employment opportunity; they also wanted local resource based development which will indirectly help the local community. Another aspiration of the community was that to complete the work in time so that it doesn't takes any long time to get the benefit of the project. Apprehensions raised by the community include loss of agricultural lands, loss of house and settlement options for few people putting up within the site area, amount and time for the compensations, factors which will determine the compensation, if resettlement happens what would be the likely location.

Further, the analysis of the key positive impacts, apprehensions and perceived negative impacts and the suggestions/recommendations as documented during stakeholder consultations are detailed in below table.

Table IX: Positive impacts perceived by the stakeholders

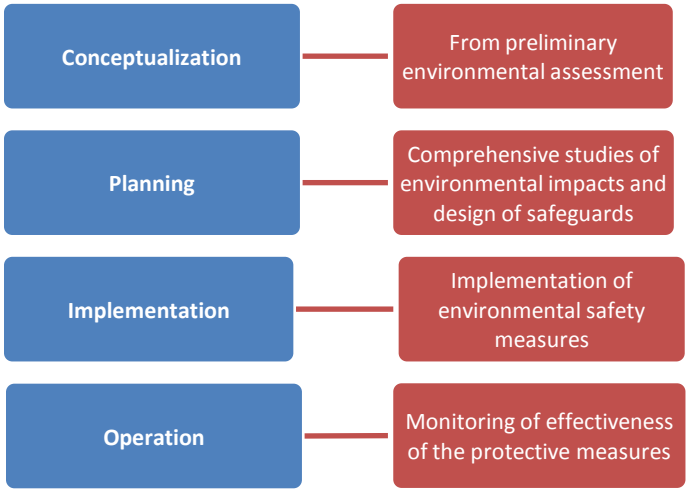
Positive impacts perceived by the stakeholders	Negative impacts
• Increase in direct and indirect employment opportunities for both the genders.	• Loss of homesteads.
• Provision of enhanced basic amenities.	• Impact on agricultural land.
• Facilitate improved access to market centers, educational institutions, healthcare facilities, and offices etc.	• The stakeholders expressed their apprehensions regarding the degradation of the waterbodies (bill) for collecting soil.
• The cumulative positive impacts of the project will result in increased mobility, employment generation, and above all better economic integration of the area with the major market and trade centers within and outside the districts.	
• Local people will get the chance to increase their business like hotels, grocery shops in the surrounding place of the project and can make benefit from that. Because after the project there will be a lot of people will be visiting this place for their work purpose in the economic zone.	Possibility of waterlogging problems in the surrounding area. But if proper steps can be taken it can be reduced.

Environmental Management Plan and Monitoring Indicators

Environmental Management Plan (EMP) is a site-specific plan developed to ensure that all necessary measures including mitigation and monitoring activities are identified and implemented in order to preserve and protect the environment and to avoid and manage the negative impacts of the project and comply with environmental legislation. The primary objective of the EMP is to provide a guideline for proper management and monitoring of the identified environmental and other impacts due to the project and to offer document to the implementers for accomplishing the institutional requirements of the authority. It will identify the residual impacts and unavoidable impact and its management. As GoB is committed to ensure sound environmental condition, preparation and execution of EMP is mandatory for preparation, implementation and monitoring of environmental protection measures during and after commissioning of the project. EMP indicates how various measures are proposed to be

undertaken during different phases of the project including cost components. It consists of various steps including:

Figure III: Different steps of EMP



The project proponent will be responsible for accomplishing the proposed safety measures mentioned in the proposed EMP. Following are major issues discussed under Environmental Management Plan

- Mitigation measures for identified environmental and social impacts;
- Enhancement plan, contingency plan, compensation plan;
- Environmental monitoring plan;
- Training and documentation

The EMP for JEZ has been prepared based upon optimum and reasonable costs that are needed for mitigation measures on a "least-cost" basis. Activities that needs to be carried out for the environmental management and monitoring of the proposed EZ could be divided into two phases: during construction phase, and during operation phase.

Detail Environmental Management Plan, Environmental Monitoring Plan and Budget for Environmental Monitoring is mentioned in Chapter 6, 8 and 9 respectively.

Emergency Response Plan & Disaster Impact Assessment

Onsite Emergency or disaster is an unpleasant sudden event of such a magnitude which may cause extensive damage to life and property. It is important for every industry to have a well-documented Emergency Plan to meet any major untoward incident or disaster. In view of this, JEZ should follow some activity and roles & responsibilities of key personnel to manage the emergencies.

Recommendations

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

- Construction activities for the development of project facilities should be started after obtaining environment clearance certificate from DoE.

- Proposed EMP and EMoP should be implemented strictly during construction and operation phase of the project.
- JEZ should install and maintain CETP and CSTP for the treatment of waste water and maintain `zero' discharge provision for minimizing water pollution.
- National 3R Strategy for Waste Management (Reduce, Reuse, Recycle) should be followed for the management of solid waste.
- Development of a green belt surrounding the area should be considered with due importance.
- Rain water harvesting should be carried out to reduce the pressure on surface and ground water resources.
- Roof top of all infrastructures should be managed for the purpose of harvesting rain water, photovoltaic solar energy and gardening.
- All infrastructures should be built based on the seismic design consideration to avoid potential hazard risk.
- To avoid hazard due to any disaster, warning system, emergency evacuation system, construction of ground floor at an elevated level, provision of emergency equipment should be considered.
- Safety Management guideline for workers should be strictly followed to minimize occupational health hazards.
- Proper training of environmental management, health and safety should be given to project management unit in both construction and operation phase.
- Eligible local people should be considered on priority basis that will be helpful for minimizing the socio-economic disruption.
- The JEZ should be applied the concept of ''Corporate Environmental and Social Responsibilities (CESR)'' in order to hold the responsibility for the JEZ's actions and encourage a significant positive impact through its activities on the environment, consumers, employees, communities, stakeholders and all other members of the society.
- Before development, separate environment impact assessment study should be carried out by individual industries proposed to be developed in the EZ.

1 Introduction

1.1 Prelude

The economy of Bangladesh has come a long way since the country achieved its independence in 1971. Bangladesh has steadily increased its average decadal growth rate over the last 40 years. The decline in population growth rate has resulted in the growth in per capita income as well. The Bangladesh economy is charging towards record growth figure for the second consecutive year, driven by double-digit growth in manufacturing and construction sectors.

Bangladesh Economic Zone Act, 2010, has been introduced by the Government of Bangladesh to facilitate development of Economic Zones (EZs) in the potential regions of the country, aiming to boost up the country's economic development and ensure standard, eco-friendly industrial zone that would encourage more foreign investment. Under this Act, the Bangladesh Economic Zone Authority (BEZA) has been established under the Prime Minister's Office (PMO) and governed by a Board chaired by the Prime Minister. The law provides legal coverage for attracting and leveraging private investment in the development of zones as zone developers or operators, and in the provision of tailored infrastructure services, such as private provision of power, effluent treatment, etc.

BEZAs objective is therefore to maximize the potential direct and indirect impacts through a more modern, generalized regime of EZs. The Government through BEZA has launched an effort to develop a new EZ paradigm for Bangladesh; drawing from numerous successful examples from around the world as well as Bangladesh's own positive experience with the EPZ model. The expectation is that more spill over will be harnessed by local firms from foreign direct investment (FDI), additional investments will be encouraged within value chains, more local produce will be procured and better linkages established between firms and educational institutions. A faster adaption to international environmental and social practices in the private sector should also be encouraged through the new EZ policy.

1.2 Project Background

The project proponent shall develop the land and the following infrastructures:

- Processing area
- Specialized infrastructure
- Utilities
- Non-processing area

Beside the development of Economic Zone following key link projects will be implemented by government:

Table 1.1: Key linked projects

Key Linked Projects	Implementing Agency
Land acquisition	Deputy Commissioner's office, Jamalpur
Upgradation of the road network	Roads and Highway Department, Jamalpur
Development of electrical grid line for power supply to the economic zone and an electric sub-station within the economic zone	Jamalpur Palli Bidyut Samity
Development of industrial gas pipeline network for supply to the economic zone and a gas substation within the economic zone	Titas Gas Transmission and Distribution Company
Domestic water treatment plant and water pumping station	Department of Public Health Engineering, Jamalpur
Drainage network for disposal of the treated waste water	Department of Public Health Engineering, Jamalpur
Solid waste management system	Department of Public Health Engineering, Jamalpur
City development planning	Jamalpur Municipality
Fire station establishment	Jamalpur Fire Service

Industrial area development will be planned by prospective developers on later stage. BEZA has appointed Shahidul Consultant, a fastest growing research based environmental and management consultancy firm, to provide transaction advisory services for this project including Environment and Social Impact Assessment study.

For preparing the Environment Impact Assessment (EIA) report, a Terms of Reference (ToR) on the proposed Jamalpur EZ project was applied to DoE. Afterward, the ToR was approved by DoE Memo No. DoE/Ta:Dist:/Jamalpur/30.39.36.4.1078.160915 dated 19thOctober, 2015. A copy of the approved ToR is attached in Annex-9.

1.3 Project Description

The proposed Jamalpur EZ will be developed as four (04) zone such as processing area, specialized infrastructure, utilities and non-processing area. Total area of the EZ is about 443 acres. Brief description of each zone is given below:

- **Domestic processing area**
  - ✓ Industrial plots
- **Specialized infrastructure**
  - ✓ Warehouse
  - ✓ Truck lay bay/ Parking area
  - ✓ Container yard
  - ✓ Q.A & Q.C lab
  - ✓ R&D facility
  - ✓ Training center
  - ✓ Roads & Culverts
  - ✓ Bridge
- **Utilities**

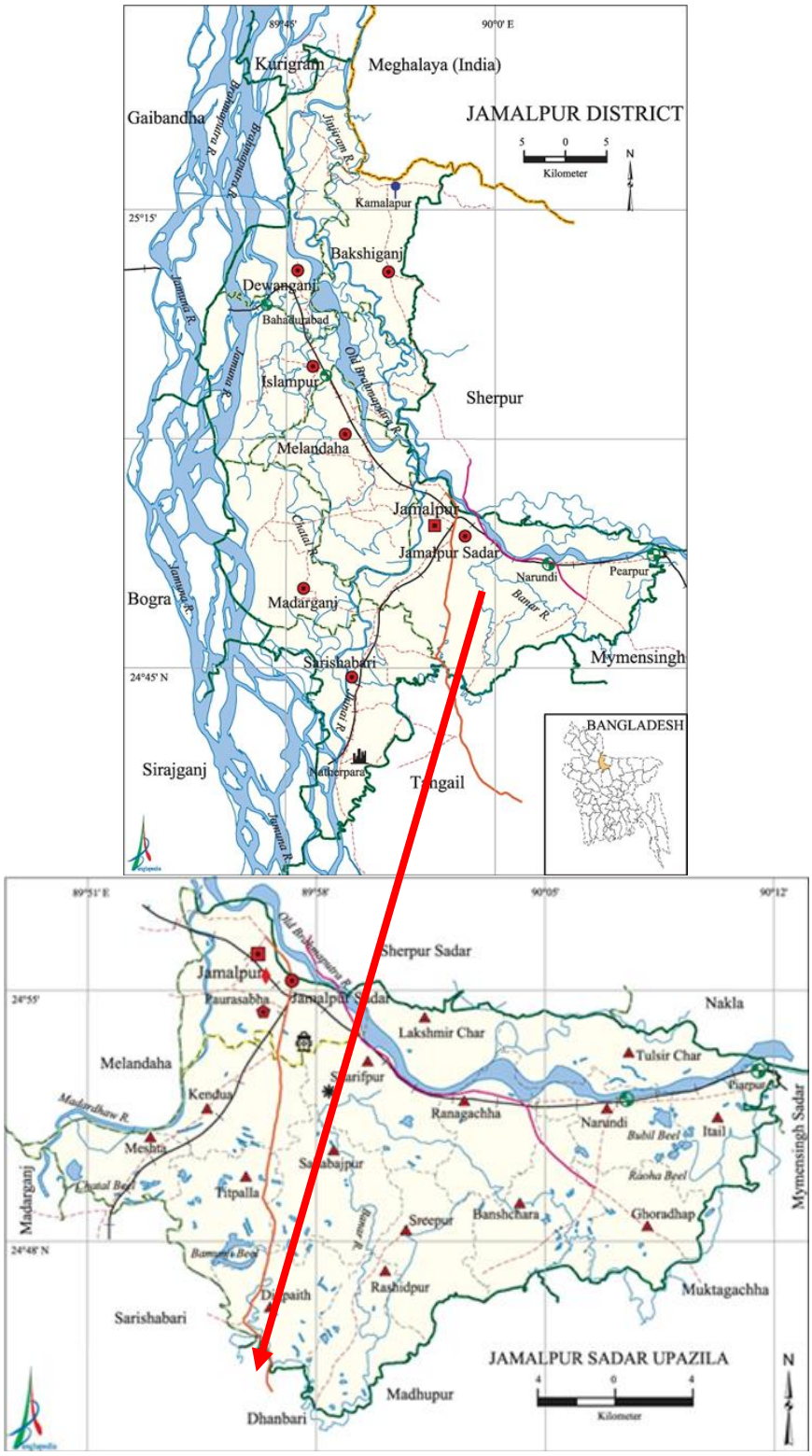
- ✓ Gas Substation & administration office of supplying agency
- ✓ Water pump station
- ✓ Power Substation
- ✓ Construction of utility duct along the roads / utility corridors
- ✓ Gas Pipeline network installation
- ✓ Water distribution network installation within EZ
- ✓ Power distribution network installation within EZ
- ✓ Fiber optic cable network installation
- ✓ Sewerage Treatment Plant (STP)
- ✓ Waste water treatment plant (WWTP)
- ✓ Solid Waste Management
- ✓ Fire station
- ✓ Fire Protection System including dedicated water storage tanks, piping network and other necessary compliances as per international standards
- ✓ Common Industrial Effluent Treatment Plant (Not to be installed)
- ✓ Public amenities including Street Lighting, Road side water sheds, rest rooms and other necessary amenities within site
- ✓ Green & open space
- ✓ Rain Water Harvesting system
- ✓ Shuttle services inside the EZ including depot for the shuttles
- ✓ Small kiosks / coffee shops within the EZ area

- **Non-processing area**
  - ✓ Entrance plaza - at each entry point
  - ✓ Admin block
  - ✓ Security surveillance set up
  - ✓ Investors club
  - ✓ Crèche
  - ✓ School
  - ✓ Hospital / Health Care
  - ✓ Hotels
  - ✓ Retail
  - ✓ Convention Center
  - ✓ Recreation
  - ✓ Gas filling station
  - ✓ Compound wall

1.4 Description of the Project Site

The proposed Jamalpur EZ will be developed at Jamalpur Sadar Upazila of Jamalpur District. EZ site covers an area of 443 acres. The project is approximately 178 km from Shahjalal International Airport and approximately 436 km from Chattogram port. The Joydevpur-Tangail-Jamalpurhighway is adjacent to the project site.

Figure 1.1: Location map of the project site



Source: Banglapedia, 2019

1.5 Rationale for the Proposed Project

Bangladesh is primarily an agricultural economy with close to 50% of the labor 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 garments and textile industries and comprise of 52% share of total exports in Bangladesh making it the world's second largest garment manufacturer.

Bangladesh also 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 EPZ model, new EZ 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 EZ 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.

1.6 Need of the Study

The proposed project comprises of development of processing area, specialized infrastructure area, utility and non-processing area etc. which approximate area is about 443 acre. Proposed industries for JEZ are agro based industries, SMEs, health care industries, cattle based and logistics. This development work will required filling and leveling works, construction of industry buildings within site, boundary wall, internal road network development etc.

The project attracts the applicability of Environment Conservation Act (ECA), 1995 & Environmental Conservation Rules, 1997. The proposed project is classified under red category as per Environmental Conservation Rules, 1997. Thus, it is required to carry out EIA study for the proposed Project as per ECA, 1995 & Environmental Conservation Rules (ECR), 1997 and obtain approval of DoE before taking up any construction activity at the proposed site.

1.7 Scope of the Study

The EIA process ensures that environmental issues are raised when a project or plan is first discussed and that all concerns are addressed as a project gains momentum through to implementation. Recommendations made by the EIA may necessitate the redesign of some project components, require further studies, and suggest changes

which alter the economic viability of the project or cause a delay in project implementation. To be of most benefit it is essential that an environmental assessment is carried out to determine significant impacts early in the project cycle so that recommendations can be built into the design and cost-benefit analysis without causing major delays or increased design costs. To be effective once implementation has commenced, the EIA should lead to a mechanism whereby adequate monitoring is undertaken to realize environmental management. An important output from the EIA process should be the delineation of enabling mechanisms for such effective management. To carry out the EIA a series of steps have been conducted. These steps are outlined below and the techniques more commonly used in EIA are described in some detail in the following sections.

1.8 Methodology of the Study

A wide range of environmental issues including physical, chemical, biological, socio-economic, cultural, landscape values are considered in the EIA processes using methods and techniques to quantify or to qualify those changes to identify the problems, assess negative impacts and recommending integrated environmental management plan for anticipation and mitigation of the potentially harmful or adverse changes and finally ensuring the proposed measures through monitoring and evaluation of the whole EIA process by auditing.

Since identification of the probable adverse impact on surrounding socio-cultural and environmental situation including its magnitude, geographical extension of that impact, duration and frequency, the degree of reversibility, auditing probability of occurrence are critical for, all the issues were addressed in the current EIA study. Assessment of the probability of occurrence of a significant impact was also carried out.

The objectives of methodologies were as follows:

- To understand the nature and location of the project and possible alternatives;
- To identify factors of analysis and assessment objectives;
- Preliminary identification of impacts and scoping;
- Baseline studies and evolution in the absence of project;
- Prediction and assessment of impacts and alternatives;
- Comparison of mitigation monitoring and impacts management.

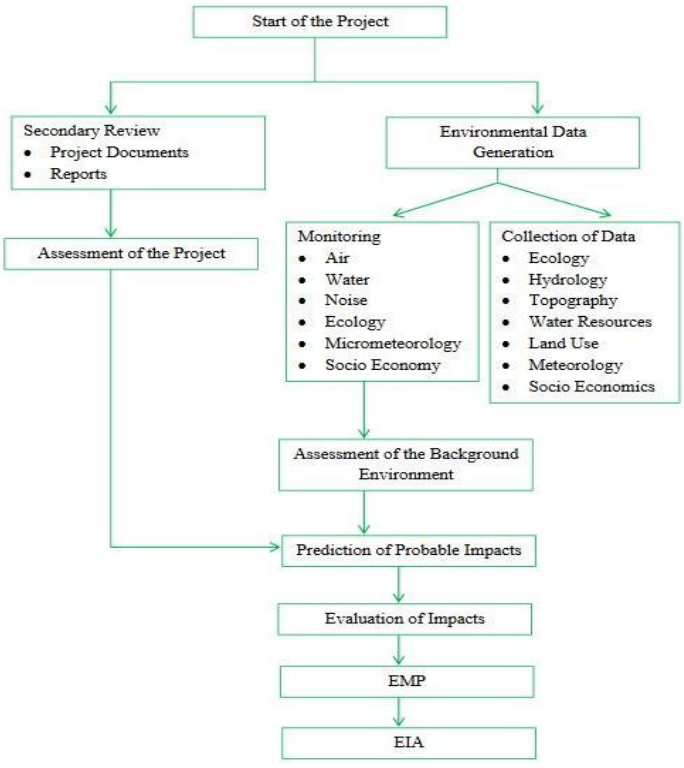
For the purpose of environmental assessment, the area within 10 km radial zone of the proposed project has been studied and classified as study area. The 10 km radius map is given in Chapter 3& 4.

Following steps and methodology have been adopted for the EIA study:

- Review previous studies;
- Harmonization of environmental safeguard requirements of the government and co-financiers;

- Scoping, baseline environmental quality monitoring survey and development of the terms of reference for the EIA study;
- Screening of environmental impacts including soil, water, atmosphere, flora & fauna as well as social impacts including resources, recreation, cultural and prioritization;
- Expert consultations with scientific and professional community;
- Public consultation with affected population, local Government bodies, public representatives, NGOs and business communities to introduce the project components and anticipated impacts; Focus group discussions in project area;
- Prediction of impacts and prepare mitigation measures by field investigation, data analysis, and mathematical modeling;
- Integration of environment with engineer's planning and social concerns;
- Preparation of Draft and Updated EIA Reports, Environmental Management and Monitoring plan and Initial Environmental Examination (IEE)/ Community Environmental Management Plan;
- Present Draft EIA Report in Stakeholder and Public Consultation Meetings for Public Disclosure;
- Submit Final EIA Report and EMMP incorporating comments of DoE for Approval;
- Implement EMMP during construction and operation and maintenance (O/M) stages;
- Environmental auditing by assessing EIA process and feedback to future EIA Study.

Figure 1.2: Process of Environmental Impact Assessment (EIA)



1.9 Limitation of the Study

The present EIA Report has been prepared based on the field investigations/assessment, and secondary data from data collected from Department of Public Health and Engineering (DPHE), Department of Environment (DoE), Department of disaster management (DDM), Bangladesh Meteorological Department (BMD), Bangladesh Water Development Board (BWDB), 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. Since offsite facilities are proposed to be developed by BEZA, required information essential for EA are available. The onsite (industrial area detailed planning will be carried out by prospective private developer) information are available limited to feasibility assessment.

1.10 ToR Compliance Matrix

The EIA study has been conducted in accordance with the ToR approved by DoE. The approved TOR is presented in Annex-9. Table below presents the point-wise compliance of the approved ToR.

Table 1.2: Compliance of TOR points

	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	EIA study has been carried out in line with the ToR Approved by DoE and WB guidelines
II	The EIA Report should be prepared in accordance with following indicative outlines:	Agreed
1	Executive Summary	Provided in the report
2	Introduction: (background, brief description, rationale of the project, scope of study, methodology, limitations, EIA Team and references)	Refer Chapter 1
3	Legislative, regulation and policy consideration (covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared)	Refer Chapter 2
4	Project Description	Refer Chapter 3
i.	Introduction	Section 3.1
ii.	Project objective	Section 3.2
iii.	Project options	Section 3.3
iv.	Interventions under selected options	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

	ToR Point	Compliance
vi.	Project schedule: The phase and timing for development of the project	Section 3.6
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	Section 3.7
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 3.8
ix.	Project plan, design, standard, specification, quantification etc.	Section 3.9
5	Environmental and Social Baseline	Refer Chapter 4
5.1	Meteorology	Section 4.1
5.1.1	Temperature	Section 4.1.1
5.1.2	Humidity	Section 4.1.2
5.1.3	Rainfall	Section 4.1.3
5.1.4	Evaporation	Section 4.1.4
5.1.5	Wind Speed	Section 4.1.5
5.1.6	Sunshine hours	Section 4.1.6
5.2	Air Quality and Noise	Section 4.2
5.2.1	Ambient Air Quality of the Project Site with Respect to Standards of ECR, 1997	Section 4.2.1
5.2.2	Ambient Noise Level of the Project Site with Respect to Noise Pollution (Control) Rules, 2006	Section 4.2.2
5.2.3	Air pollutants and noise sources from existing and known sources	Section 4.2.3
5.3	Water Resources	Section 4.3
5.3.1	Surface Water System	Section 4.3.1
5.3.2	Tropical cyclones and Tidal Flooding	Section 4.3.2
5.3.3	Salinity	Section 4.3.3
5.3.4	Drainage Congestion and Water Logging	Section 4.3.4
5.3.5	Erosion and Sedimentation	Section 4.3.5
5.3.6	River Morphology	Section 4.3.6
5.3.7	Navigation	Section 4.3.7
5.3.8	Ground Water System	Section 4.3.8
5.4	Land Resources	Section 4.5
5.4.1	Agro ecological Regions	Section 4.5.1
5.4.2	Land Types	Section 4.5.2
5.4.3	Soil Texture	Section 4.5.3
5.4.4	Land Use	Section 4.5.4
5.5	Agriculture Resources	Section 4.6

	ToR Point	Compliance
5.5.1	Farming Practice	Section 4.6.1
5.5.2	Cropping Pattern and Intensity	Section 4.6.2
5.5.3	Cropped Area	Section 4.6.4
5.5.4	Crop Production	Section 4.6.5
5.5.5	Crop Damage	Section 4.6.6
5.5.6	Main Constraints of Crop Production	Section 4.6.8
5.6	Livestock and Poultry	Section 4.7
5.6.1	Feed and Fodder Shortage	Section 4.7.2
5.6.2	Livestock/Poultry Diseases	Section 4.7.3
5.7	Fisheries	Section 4.8
5.7.1	Introduction	Section 4.8.1
5.7.2	Problem and Issues	Section 4.8.2
5.7.3	Habitat Description	Section 4.8.3
5.7.4	Fish Production and Effort	Section 4.8.4&4.8.5
5.7.5	Fish Migration	Section 4.8.6
5.7.6	Fish Biodiversity	Section 4.8.7
5.7.7	Fisheries Management	Section 4.8.8
5.8	Ecological Resources	Section 4.9
5.8.1	Bio-ecological Zone/Protected Areas	Section 4.9.1
5.8.2	Common Flora and Fauna	Section 4.9.2
5.8.3	Ecosystem Services and Function	Section 4.9.3
5.9	Socio Economic Condition	Section 4.10
6	Identification and Analysis of Key Environmental Issues (Analysis shall be presented with Scenarios, Maps, Graphics, etc. for the Case of Anticipated Impacts on Baseline)	Refer Chapter 5
6.1	Environmental Sensitivity Investigation	Section 5.1
6.2	Environmental Asset	Section 5.2
6.3	Environmental Hot Spots	Section 5.3
6.4	Likely Beneficial Impacts	Section 5.4
6.5	Community Recommendations	Section 5.5
6.6	Alternate Analysis	Section 5.6
7	Environmental and Social Impacts	Refer Chapter 6
7.1	Introduction	Section 6.1
7.2	Impact on Air Quality and Noise	Section 6.2`
7.2.1	Pre-construction Phase	Section 6.2.1
7.2.2	Construction Phase	Section 6.2.2
7.2.3	Post-construction Phase	Section 6.2.3
7.3	Impact on Water Resources	Section 6.3
7.3.1	Pre-construction Phase	Section 6.3.1
7.3.2	Construction Phase	Section 6.3.2

	ToR Point	Compliance
7.3.2	Post-construction Phase	Section 6.3.2
7.4	Impact on Land Resources	Section 6.4
7.4.1	Pre-construction Phase	Section 6.4.1
7.4.2	Construction Phase	Section 6.4.2
7.4.3	Post-construction Phase	Section 6.4.3
7.5	Impact on Agriculture Resource	Section 6.5
7.5.1	Pre-construction Phase	Section 6.5.1
7.5.2	Construction Phase	Section 6.5.2
7.5.3	Post-construction Phase	Section 6.5.3
7.6	Impact on Fisheries	Section 6.6
7.6.1	Pre-construction Phase	Section 6.6.1
7.6.2	Construction Phase	Section 6.6.2
7.6.3	Post-construction Phase	Section 6.6.3
7.7	Impact on Ecosystem	Section 6.7
7.7.1	Pre-construction Phase	Section 6.7.1
7.7.2	Construction Phase	Section 6.7.2
7.7.3	Post-construction Phase	Section 6.7.3
7.8	Socio Economic Impact	Section 6.8
7.8.1	Pre-construction Phase	Section 6.8.1
7.8.2	Construction Phase	Section 6.8.2
7.8.3	Post-construction Phase	Section 6.8.3
8	Public Consultation and Disclosure	Refer Chapter 7
8.1	Introduction	Section 7.1
8.2	Objectives of Public Consultation and Disclosure Meeting	Section 7.1
8.3	Approach and Methodology of Public Consultation and Disclosure Meeting	Section 7.1
8.4	Public Consultation Meetings (PCMs)	Section 7.1
8.5	Public Disclosure Meetings (PDMs)	Section 7.1
9	Environmental Management Plan and Monitoring Indicators	Refer Chapter 8
9.1	Introduction	Section 8.1
9.2	Mitigation Plan	Section 8.2
9.3	Enhancement Plan	Section 8.3
9.4	Contingency Plan	Section 8.4
9.5	Compensation Plan	Section 8.5
9.6	Monitoring Plan	Section 8.6
9.7	Monitoring Indicators	Section 8.7
10	Cost Estimation for Environmental Mitigation Measures and Monitoring	Refer Chapter 9
11.	Conclusions and Recommendations	Refer Chapter 11

	ToR Point	Compliance
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 report along with the Feasibility Study Report, the applicable fee in a treasury challan, No Objection Certificate (NOC) from the local authority, NOC from Forest Department (if it is required in case of cutting any forested plant, private or public), NOC from concerned authority for cutting/razing/dressing of hill or hilly land (if it is required) and NOC from other relevant agencies for operational activity etc. to the Tangail District Office of DoE with a copy to the Head Office of DoE in Dhaka.	Agreed

1.11 EIA Team

A multidisciplinary team of professionals having experience of conducting Environment & Social Impact Assessment studies for Industrial parks, Industrial cluster, Special Economic Zones, DTA, Economic Zones, Area development, Industrial Corridors etc. were involved in carrying out EIA study for this project. Details of the professionals are given in the Table below:

Table 1.3: EIA team

	Name of the Professionals	Area of Expertise	Position Assigned
1.	Dr. Tauhid-ur Rahman	Environment and Social Impact Assessment & Environment Management Plan	Team Leader-cum-Environmental Expert
2.	Enggr. Md. Shahidul Karim	Land Use, Planning and Architecture	Urban Planner
3.	Md. Shofiul Islam	Environmental and Social Management Framework	Environmental Expert
4.	Md. Mahbub Kabir	Geo-spatial & Remote Sensing, Water, soil/sediment and air quality.	GIS and Laboratory Expert
5.	Sultana Afroze	Social Impact Assessment (SIA)	SIA expert
6.	Sadia Afrin	Ecology, Biodiversity and Environment	Biodiversity Expert

1.12 Structure of the Report

This EIA report has been prepared strictly following the report structure as per TOR. The EIA report contains project features, baseline environmental conditions, assessment of environmental impacts, and formulation of mitigation measures along with environmental management and monitoring plan. The report includes the following chapters:

Executive Summary
The chapter provides the brief summary of the EIA report.

Chapter 1: Introduction
This chapter provides background information of the project background, rationale for the proposed project, scope and methodology adopted for EIA study, limitations of the study, TOR compliance matrix, details of the EIA team, structure of the report and references.

Chapter 2: Legislative, Regulation and Policy Consideration
This chapter deals with the details of the potential legal, administrative, planning and policy framework which have been used in the preparation of the EIA Report.

Chapter 3: Project Description
This chapter presents the details of the project, project objectives and options, interventions under selected options and activities, project area of influence, project activities, existing infrastructure in and around the site, project schedule and resources and utilities demand.

Chapter 4: Environmental and Social Baseline
This Chapter describes the baseline environmental conditions around the project site for various environmental attributes, in the project area of influence which is termed as the study area. Topography, soil, water, meteorology, air, noise, land constitute the physical environment, whereas flora and fauna constitute the biological environment.

Chapter 5: Identification and Analysis of Key Environmental Issues
This chapter identifies and details the key environmental issues related to the project.

Chapter 6: Environmental and Social Impact
This chapter details the impacts due to the project activities and suggestive mitigation measures

Chapter 7: Public Consultations and Disclosure
This Chapter provides details for the public consultation meetings in study area and the outcomes of public consultations

Chapter 8: Environmental 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 of EMP
This chapter provides the tentative cost for the implementation of EMP

Chapter 10: Emergency Response Plan & Disaster Impact assessment

This chapter concludes details disaster management plan for various emergency situations and responsibilities to manage them.

Chapter 11: 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.

1.13 References

List of secondary data used for carrying out EIA study and preparation of EIA report is given at the following table.

Table 1.4: Reference used for EIA study

	Reference
Government Departments	
1.	Bangladesh Economic Zone Authority
2.	Department of Public Health and Engineering
3.	Department of Environment
4.	Bangladesh Meteorological Department
5.	Bangladesh Forest Research Institute
6.	Bangladesh Bureau of Statistics
7.	Geological survey of Bangladesh
8.	Bangladesh Water Development Board
9.	Department of Disaster Management
10.	Jamalpur Sadar Upazila office
Journals/ Books	
1.	APHA. (1998). Standard methods for the examination of water and wastewater. 20th ed. American Public Health Association. Washington, D.C.
2.	Bangladesh Bureau of Statistics. (2011). District Statistics of Jamalpur. Ministry of Planning. Government of the People's Republic of Bangladesh.
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7.	Banglapedia. (2019). Saline soil map of Bangladesh. Retrieved from http://en.banglapedia.org/index.php?title=Saline_Soil
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	http://en.banglapedia.org/index.php?title=Bangladesh_Soil
9.	Meteoblue. Retrieved from https://www.meteoblue.com/en/weather/forecast/modelclimate/24.79N89.934E16_Asia%2FDhaka
10.	Tectonic map of Bangladesh. Retrieved from http://en.banglapedia.org/index.php?title=Tectonic_Framework
Website	
1.	Banglapedia
2.	Google maps
3.	Google earth imageries
Others	
1.	Site visits
2.	Initial Site Assessment Reports
3.	WB General EHS Guidelines
4.	WB Operational Policies

2 Legislative, Regulation and Policy Considerations

2.1 Policy, Legal and Administrative Framework

This chapter provides a description of the regulatory framework applicable to the proposed project. It highlights environmental, health & safety and social regulations with applicable permits and standards in association with the project. It broadly focuses on the:

- Legal Enforcement Agencies at National Level;
- Applicable national and local Environmental and Social Laws, Regulations and Policies;
- International & National Environment Standards/ Guidelines; and
- Applicable International Conventions/Protocols.

2.2 Legal Enforcement Agencies

The responsibility of formulation, implementation and modification of national level environmental laws in Bangladesh lies with the Ministry of Environment and Forests(MoEF). The Department of Environment (DoE) established under the Environmental Pollution Control Ordinance, 1977 which functions under the MoEF. It is responsible for carrying out the purposes and provisions of the Environment Conservation Act, 1995 as amended till 2010 (hereinafter referred as ECA) which is the umbrella legislation regulating environmental issues in the country. A brief description of the relevant legal enforcement agencies has been described in the Table below.

Table 2.1: Relevant legal enforcement agencies and their functions

	Agency	Functions
1	Ministry of Environment & Forests (MoEF)	The MoEF is the nodal agency in the administrative structure of the Central Government, for the planning, promotion, co-ordination and overseeing the implementation of environmental and forestry programs. It oversees all environmental matters in the country and is a permanent member of the Executive Committee of the National Economic Council. It plays a pivotal role as a participant of the United Nations Environment Programs (UNEP). Its principal activities include: • Conservation & survey of flora, fauna, forests and wildlife; • Prevention and control of pollution; and • Forestation & regeneration of degraded areas and protection of environment in the frame work of legislations.
2	Department of Environment (DoE)	An Environment Pollution Control Board was setup under the Environmental Pollution Control Ordinance, 1977. It underwent a series of subsequent restructuring and was finally renamed as Department of Environment in 1989. It is headed by a Director General appointed by the Government. The DoE through its head, divisional and district level offices conducts the following principal activities: • Advising the Government to avoid such manufacturing processes, commodities and substances which are likely to cause environmental pollution; • Advisory and issuing directions to the concerned person regarding the

	Agency	Functions
		environmentally sound use, storage, transportation, import and export of a hazardous substance or its components; • Conducting inquiries and research activities on conservation, improvement and pollution of the environment and rendering assistance to any other authority/organization regarding the same; • Collection and publication of information about environmental pollution; • Conducting programs for observation of drinking water quality and issuing directives if necessary for adherence to drinking water quality standards; • Formulation of environmental guidelines; • Prescribing and modifying environmental quality standards pertaining to air, water, noise, vehicular emissions etc.; • Issuing Location Clearance and Environmental Clearance Certificates to projects; • Implementation of provisions of ECA and rules made there under.
3	Bangladesh Forest Department (BFD)	It was established under the MoEF and is responsible for identifying and declaring of certain areas as reserved or protected or private forest lands. It implements the provisions of Forest Act, 1927 and National Forestry Policy, 1994. It's also responsible for wildlife preservation and protection through implementation of Wildlife (Preservation & Security) Act, 2012.
4	Bangladesh Economic Zones Authority (BEZA)	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.
5	Water Resources and Planning Organization (WARPO)	It was established under the Water Resources Planning Act, 1992. Its core functions include: • Monitoring the implementation of National Water Management Plan (NWMP); • Upkeep of water resource assessments; • Maintenance, updating and dissemination of the National Water Resources Database (NWRD) and MIS; • Secretariat to the National Water Resources Council (NWRC) and the Executive Committee of the National Water Resources Council (ECNWRC); • Responding to the NWRC/ECNWRC requests for information and advice; • Periodic update of the NWMP; • Assisting other agencies in planning, monitoring, studies and investigations; • Adhoc advice on policy, strategy, institutional and legal issues; • Laying down effluent discharge standards into river in consultation with DoE; and • Special studies and research as required.
6	Ministry of Shipping (MoS)	The Ministry of Shipping encompasses within its fold shipping and port sectors which also oversee the safety and environmental matters and the regulatory aspects of maritime shipping. It is responsible for: • Development and maintenance of waterways, inland water transport,

	Agency	Functions
		ports, ocean shipping, development and expansion of physical infrastructural facilities, etc. • Managing and maintaining inland, island and inter island ferry-boat and shipping services; • Formulation and implementation of act, rules and policies regarding the aforementioned issues.
7	Bangladesh Inland Water Transport Authority (BIWTA)	It was setup in 1958 under the provisions of East Pakistan Inland Water Transport Authority Ordinance 1958. Its specific functions include: • Carry out river conservancy works; • Disseminate navigational and meteorological information including publication of river charts; • Draw up programmers of dredging requirements and priorities for efficient maintenance of existing navigable waterways and for resuscitation of dead or dying rivers, channels, or canals, including development of new channels and canals for navigation; and • Develop, maintain and operate inland river ports, landing/ferry Ghats and terminal facilities in such ports or Ghats.
8	Ministry of Fisheries and Livestock (MoFL)	The main functions of the MoFL include: • Preservation of fisheries resources; • Fulfilling the requirement of animal protein through proper management and planned development; • Increasing socio-economic conditions of fishermen; • Creating employment opportunities for rural unemployed and landless people; • Expanding foreign exchange earnings by exporting fish and fishery products; • Developing innovative technologies through research for fisheries development and preservation; and • Protection of fishes through implementation of Protection and Conservation of Fish Act, 1950 as amended till date.
9	Bangladesh Power Development Board (BPDB)	It is a statutory body created in May 1, 1972 and is responsible for major portion of generation and distribution of electricity mainly in urban areas except Dhaka and West Zone of the country. It has undertaken a massive capacity expansion plan to add about 10500 MW generation capacities in next 5 years to achieve 24000 MW Capacity according to Power System Master Plan (PSMP) 2021.
10	Bangladesh Energy Regulatory Commission (BERC)	It was established under the Bangladesh Energy Regulatory Commission Act, 2003. Some of its key functions include: • Issue, cancel, amend and determine conditions of licenses, exemption of licenses and determine the conditions to be followed by such exempted persons; • Regulation of generation, storage, supply, and transmission of energy; • Determine tariff for electricity distribution etc.; • Ensure control of environmental standard of energy under existing laws; • Extend co-operation and advice to the Government, if necessary, regarding electricity generation, transmission, marketing, supply, distribution and storage of energy.
11	Ministry of Labor and	It was established with following objectives: • Creation of employment opportunity;

	Agency	Functions
	Employment (MoLE)	• Creation of semi-skilled and skilled manpower; • Enhancement of productivity of factories by creating friendly working environment between workers & employers; • Ensuring welfare of workers in different industrial areas; • Implementation of labor laws; • Fixing up minimum wages of labor; and • Ensuring justice through Labor Court. It has been divided into four departments, viz: • Directorate of Labor • Chief Inspector of Factory and Establishment • Minimum Wages Board • Labor Appeal Tribunal
12	Ministry of Law and Parliamentary Affairs	This ministry is divided in to the Law and Justice Division and the Parliamentary Affairs Division for functional purposes. The Law and Justice Division of the Ministry of Law, Justice and Parliamentary Affairs has the responsibility of providing legal advisory services to other ministries, divisions, departments, and organizations of the Government. The parliamentary affairs division is assisted by the law commission and the human rights commission and its main function lies in formulating, scrutinizing and preparing legislations. When needed, it provides legal opinions and translations for other ministries.
13	Ministry of Land	The ministry of land is in charge of land administration, management and development for the overall growth of the nation. The Ministry manages Government owned lands, vested properties and abandoned properties. It is responsible for the collection of land development tax, land surveying and record keeping and updating. Land Acquisition and requisition fall under the responsibilities of this ministry.
14	Board of Investment (BOI), Bangladesh	The Board of Investment was established in 1989 by the Investment Board Act. The specific functions of board are: • Implementation of all provisions as lay down under The Investment Board Act, 1989. • To promote domestic and foreign investment as well to enhance international competitiveness of Bangladesh; • To identify the hindrance of investment and provide necessary facilities and assistance in the establishment of industries.
15	Civil Aviation Authority (CAA), Bangladesh	The Government of the People's Republic of Bangladesh formed Civil Aviation Authority, Bangladesh in the year of 1985. The main functions of CAA are: • It is responsible for registration of aircrafts and issues license to each personnel responsible for flight operations; • To regulate air traffic and provides facilities and services for aeronautical telecommunications and air navigation; • The authority is responsible for construction, maintenance and development of airports and aerodromes.
16	Union Parishad	Union Parishad (UP) currently is the only elected statutory local government body for the rural Bangladesh. A UP consists of a chairman and twelve members. They are elected on the basis of adult franchise. Each UP has a full-time Secretary, appointed by the Deputy Commissioner (DC). The functions of UP are:

	Agency	Functions
		• Maintenance of law and order and conduction of censuses of all kinds. • Registration of births, deaths, blind people, beggars and destitute. • Planning and implementation of development schemes in the field of agriculture, forestry, fisheries, livestock, education, health, small and micro enterprises, communications, irrigation and flood control. • Protection and maintenance of public property such as roads, bridges, canals, embankments, markets, telephones and electricity lines.

2.3 Applicable Environmental and Social Laws, Regulations and Policies

The relevant Acts and Rules pertaining to the project have been summarized in the Table below.

Table 2.2: Applicable environmental, health and safety and social laws, regulations and policies

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
National Environment Policy, 1992 and ActionPlan It sets out the framework for establishment of legislations related to 15 sectors including environment, water, agriculture, water resources development, forest & wildlife, fisheries etc. The key provisions of the policy are: • Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) of all new public and private sector industrial projects are mandatory. • Adoption of corrective measures by polluting industries in phases. • Prevention of land erosion, and environmentally sound management of newly accreted land. • Conservation of wildlife, bio-diversity, forest, fisheries and livestock.	Ministry of Environment and Forests, Bangladesh Department of Environment, Bangladesh	JEZ should ensure that project activities comply with the provisions made under the policy and the legislations made there under for implementing the same.
National Environmental Policy, 2018 According to the fifth amended of the constitution of the people's Republic of Bangladesh environment, biodiversity conservation and development has been taken as the main principles to govern the state. For this purpose it has included in article 18 (a) that state will conserve and developed the environment for the present and future citizen and will also ensure the security of the national resources, biodiversity, wetland, forest and conserve the wildlife.	Ministry of Environment and Forests, Bangladesh Department of Environment, Bangladesh	JEZ should ensure that project activities comply with the provisions made under the policy and the legislations made there under for implementing the same.
National Environmental Management Action Plan (NEMAP), 1995	-	JEZ should ensure that project activities comply with the provisions made under this

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
The National Environmental Management Action Plan (NEMAP, 1995) identifies the main national environmental issues, including those related to the water sector. The main water related national concerns include flood damage, riverbank erosion, environmental degradation of water bodies, increased water pollution, shortage of irrigation water and drainage congestion, various specific regional concerns are also identified.		action plan.
The Environment Conservation Act, 1995as amended till October 5, 2010 (hereinafter referred as ECA) **The Environment Conservation Rules, 1997** as amended till February 16, 2002 (hereinafter referred as ECR) The salient features of the Act are as follows: • A Department of Environment (DoE) to be established subsidiary to the MoEF to exercise the provisions of the Act. • The Government of Bangladesh (GoB) will declare Ecologically Critical Areas (ECA) and specify the activities or processes that cannot be initiated or continued in an ECA. • An industrial unit/Project cannot be established without obtaining an Environmental Clearance Certificate (ECC) from the Director General of DoE. • Publication of environmental guidelines related to environmental pollution control and mitigation, conservation and improvement of the environment. • Prescription of rules for implementing the provisions of the Act. The provisions under the ECR are summarized as follows: The industries for the purpose of obtaining ECC have been classified into the following 4 categories based on their site and impact on the environment: • Green • Orange –A • Orange – B • Red The list of industries falling under each category has been annexed in the Schedule–I to the ECR. • For proposed industries falling under the Orange-A & B and Red categories, a Location Clearance Certificate (LCC) needs to be obtained from DoE prior to the issuance of ECC.	Ministry of Environment and Forests, Bangladesh Department of Environment, Bangladesh	The proposed project being an Economic Zone which falls under the Red category as classified under Schedule-I of the ECR. JEZshall ensure compliance with the applicable provisions of the Act and the Rules made there under. JEZ shall ensure that Location Clearance Certificate (LCC) for the proposed project site is obtained. Furthermore, JEZ shall apply for the Environmental Clearance Certificate (ECC) in the requisite manner along with prescribed documents. The EIA to be submitted along with ECC application shall be as per the ToR provided by the DoE. JEZ shall ensure that pollutant emissions/discharges from various sources etc. during project activities are well within the standards prescribed in the Schedules 2-12 of the ECR 1997. Some of the standards have been revised by the DoE viz. • Ambient Air Quality standard • Vehicular Emission standards • Ambient Noise Standards ***The various applicable standards have been provided in***

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
• The project entrepreneur shall apply for ECC in prescribed form along with prescribed documents and application fees. • ECC (for Red category) will be valid for 1 year from the issuance date and shall be renewed at least 30 days prior to expiry. • Various environmental quality standards pertaining to air, water, sound, odor etc. have been laid down in the schedules attached to the Act. • Emissions and waste discharge standards have been laid down in Schedules 9-11. The person in charge of facility/unit shall notify the Director General, DoE in case of pollutant emission/discharge in excess of prescribed standards or where there is a possibility of the same.		***subsequent sections. Compliance to such standards shall be* ensured by JEZ.**
Environmental Court Act, 2000 The law is related to the establishment of a court of justice for the environmental pollution crime and the crime related to it.	–	JEZ should ensure that project activities comply with the provisions made under this act.
Environmental Court Act, 2010 This is the amendment of the Environment Court Law, 2000. For accelerating the justice for environmental pollution crime this law has been amended.	-	JEZ should ensure that project activities comply with the provisions made under this act.
The Bangladesh Economic Zones Act, 2010 This act is make provisions for the establishment of economic zones in all potential areas including backward and underdeveloped regions and development, operation, management and control thereof including the matters ancillary there with a view to encouraging rapid economic development through increase and diversification of industry, employment, production and export.	Bangladesh Economic Zones Authority	JEZ should ensure that project activities comply with the provisions made under this act.
National Industrial Policy, 2010 The policy aims to ensure the industrialization process is compliant with internationally agreed environment, health, and safety and labor standards. The government will ensure assistance for creating alternative employment, keeping the socio-economic backdrop in mind, for any privatization proposal.	Ministries of Industries	JEZ shall ensure that the proposed project is registered as prescribed by the Act.
Investment Board Act (1989) Board of Investment, established under this act, is the principal private investment promotion and facilitation agency of Bangladesh which is responsible for implementation of provisions of	Board of Investment (BOI), Bangladesh	JEZ shall ensures that the proposed project is registered as prescribed by the Act.

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
above said policy. Under the provision of this act as per Schedule 11, All industries established in non-governmental sectors licensed by the Board shall be registered in the prescribed manner. As per Schedule 15 of this act, any industrial undertaking licensed transgresses any provision of this Act or of any rule made there under or breaks any condition relating to the license, the Board may, in such manner as may be prescribed, cancel the license of the industrial undertaking.		
National Water Policy, 1999 Endorsed by the GoB in 1999, the National Water Policy (NWP) aims to provide guidance to the major players in water sector for ensuring optimal development and management of water. According to the policy, all agencies and departments entrusted with water resource management responsibilities (regulation, planning, construction, operation, and maintenance) are required to enhance environmental amenities and ensure that environmental resources are protected and restored in executing their tasks. The policy has several clauses related to water resource development projects for ensuring environmental protection. Some of the relevant clauses are: • Clause 4.5b: Planning and feasibility studies of all projects will follow the Guidelines for project Assessment, the Guidelines for People's Participation (GPP), the Guidelines for Environmental Impact Assessment, and all other instructions that may be issued from time to time by the Government. • Clause 4.9b: Measures will be taken to minimize disruption to the natural aquatic environment in streams and water channels. • Clause 4.9e: Water development plans will not interrupt fish movement and will make adequate provisions in control structures for allowing fish migration and breeding. • Clause 4.10a: Water development projects should cause minimal disruption to navigation and, where necessary, adequate mitigation measures should be taken. • Clause 4.12a: Give full consideration to environmental protection, restoration and enhancement measures consistent with National Environmental Management	Bangladesh Water Development Board (BWDB)	JEZ shall ensure compliance with this policy.

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
Action Plan (NEMAP) and the National Water Management Plan (NWMP). • Clause 4.12b: Adhere to a formal environment impact assessment (EIA) process, as set out in EIA guidelines and manuals for water sector projects, in each water resources development project or rehabilitation program of size and scope specified by the Government from time to time. • Clause 4.12c: Ensure adequate upland flow in water channels to preserve the coastal estuary ecosystem threatened by intrusion of salinity from the sea. • Clause 4.13b: Only those water related projects will be taken up for execution that will not interfere with aquatic characteristics of those water bodies.		
National Water Management Plan, 2001 (Approved in 2004) The objectives of the Plan are listed below: • To operationalize directives given in National Water Policy and to do in accordance with the Government approved Development Strategy. • To address issues related to harnessing and development of all forms of surface and ground water and management of these resources in an efficient and equitable manner. • Consultation and participation with the direct beneficiaries in the hand over and development of water schemes.	Water Resource Planning Organization (WARPO)	JEZ shall ensure compliance with this policy.
Bangladesh Water Act, 2013 The key features of the Act are: • A National Water Resources Council (NWRC) to be established for implementing the provisions of the Act • A National Water Policy shall be adopted by the Council addressing the following issues: a) Purpose and sectors of water use b) Affordability of water users c) Actual cost of water abstraction and distribution d) Financial ability and backwardness of water users of any group thereof e) Water demand and supply f) Any other issues considered relevant by GoB. • An Executive Committee of the Council shall	Water Resource Planning Organization (WARPO)	This Act was implemented in 2013 and the NWRC and Executive Committee are yet to be formulated. Upon formation of the aforementioned bodies, water stress areas and related provisions may be prescribed. JEZ shall ensure compliance with legal requirements under such provisions if applicable.

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
be established or ensuring efficient performance of the Council. • The GoB can declare certain areas as Water Stress Areas for the protection of water sources or aquifers. • Water zone demarcation (industrial, agricultural, brackish water aquaculture and hatchery water zones) through gazette notification and issuance of protection order for efficient water management in such zones. • Declaration of flood control zone and its management. • Restriction on abstraction of total water from any water source.		
Ground Water Management Ordinance, 1985 As per the provisions as per schedule 5 of this act, no tube well shall be installed in any place without a license granted by the Union Parishad. Also, no application shall be entertained by the Union Parishad unless it is accompanied by such fee as may be prescribed under the requirements of this ordinance.	Ministry of Environment and Forests, Bangladesh	JEZshould ensure that no tube-well shall be installed in any place without a license granted by the Union Parishad. JEZ should furnish the following information: • The aquifer condition of the soil where the tube-well is to be installed; • The distance of the nearest existing tube-well; • The area likely to be benefited by the tube-well; • The likely effect on the existing tube-wells including tube wells used for domestic purpose; • The suitability of the site for installation of the tube-well; and • The conditions on which a license, if any, may be granted.
The National Fisheries Policy, 1999 The objectives of the fisheries policy are: • Enhancement of the fisheries production; • Poverty alleviation through creation of self-employment and improvement of socio-economic conditions of the fishermen; • Fulfilling the demand for animal protein; • Achieve economic growth through earning foreign currency by exporting fish and fisheries products; and • Maintain ecological balance, conserve	Ministry of Fisheries and Livestock (MoFL)	JEZ shall ensure that during project operation, no untreated effluent is disposed into the water body. The treated effluent shall also meet the standards stipulated under the ECR.

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
biodiversity, ensure public health and provide recreational facilities The policy broadly aims at fisheries development, regulation of aquaculture, biodiversity conservation and formulation of laws to ban the disposal of any untreated industrial effluents into the water bodies.	Department of Fisheries (DoF)	
Protection and Conservation of Fish Act, 1950 as amended through February 16, 1995 This Act was promulgated for conservation of fish in Bangladesh and their protection against indiscriminate fishing, poisoning due to industrial effluent disposal into the water, oil spills, etc.	Ministry of Environment and Forests, Bangladesh Department of Fisheries	JEZ shall ensure compliance with provisions mandated under this Act.
Protection and Conservation of Fish Rules, 1985 The Rules were prescribed under the provisions of Protection and Conservation of Fish Act. It provides the regulations for prohibition of fishing during certain periods, licenses for catching fishes, prevention of fish destruction due to explosives and industrial effluent disposal etc.	Ministry of Environment and Forests, Bangladesh Department of Fisheries	JEZ shall ensure that untreated effluent is not disposed into the water body. The treated effluent shall comply with the discharge standards stipulated under the ECR.
National Agriculture Policy, 1999 The overall objective of the National Agriculture Policy is to make the nation self-sufficient in food through increasing production of all crops including cereals and ensure a dependable food security system for all. Although the policy does not emphasize the coastal zone separately, all specific objectives are applicable to the development of coastal zone agriculture. The policy particularly stressed on minor irrigation capturing tidal water in reservoirs in coastal areas and research on the development of improved varieties and technologies for cultivation in coastal, hilly, water-logged and salinity affected areas. The policy also recognizes that adequate measures should be taken to reduce water-logging, salinity and provide irrigation facilities for crop production.	-	The proposed project is expected to contribute to achieve the objectives of the agriculture policy.
National Land Use Policy (MoL, 2001) The National Land Use Policy (NLUP), enacted in 2001, aims at managing land use effectively to support trends in accelerated urbanization, industrialization and diversification of development activities. The NLUP urges that increasing the land area of the country may be not possible through artificial land reclamation process, which is cost-effective only in the long run. Therefore, land use planning should be based on the existing and available land	-	The proposed JEZ will be designed in accordance with this strategy and will comply with the mentioned requirements.

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
resources. The policy suggests establishing land data banks where, among others, information on accreted riverine and coastal chars will be maintained. Among the 28 policy statements of NLUP, the following are relevant to coastal area: • Forests declared by the Ministry of Environment and Forests will remain as forest lands; • Reclassification of forest lands will be prevented; and • Effective green belts will be created all along the coast.		
National Livestock Development Policy, 2007 The National Livestock Development Policy (NLDP) has been prepared to address the key challenges and opportunity for a comprehensive sustainable development of the livestock sub-sector by creating an enabling policy framework. Among 60 or more policy statements, the following two policy statements address the coastal zone: • Specific areas will be identified to implement programs for fattening of cattle and livestock. For this purpose, the Chittagong Hill Tracts, the coastal areas and the islands will be included under the fattening of livestock and cattle program. • Special programs will be taken up for the production of grass in the Chittagong Hill-tracts and the coastal areas.	-	As livestock is one of the key assets in livelihoods, and protection of livestock from flood should be emphasized along with security of human life. The proposed JEZ interventions will contribute to the safety of livestock and thus increase livestock productivity.
Standing Orders on Disaster, 2010 The Standing Orders on Disaster is designed to enhance capacity at all tiers of government administrative and social structures for coping with and recovering from disasters. The document contains guidelines for construction, management, maintenance and use of cyclone shelter center. Accordingly, to the guideline, geographical information system (GIS) technology will be applied at the planning stage to select the location of cyclone shelter considering habitation, communication facilities, and distance from the nearest cyclone center. The advice of the concerned District Committee is to be obtained before final decision. The cyclone shelters should have easier communication facilities so that in times of distress delay does not occur to go there. For this reason, the road communication from the cyclone shelters should not only link up with city or main road but also with neighboring village areas. Provision of emergency water, food and	-	JEZ will provide better communication facilities, which is crucial for emergency response to disasters.

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
sanitation and shelter space for livestock during period should also be kept in view for future construction of shelters.		
National Adaptation Program of Action (NAPA) In 2005, the Ministry of Environment, Forest AND Climate Change (MoEF), Government of the People's Republic of Bangladesh has prepared the National Adaptation Program of Action (NAPA) for Bangladesh, as a response to the decision of the Seventh Session of the Conference of the Parties (COP7) of the United Nations Framework Convention on Climate Change (UNFCCC). The basic approach to NAPA preparation was along with the sustainable development goals and objectives of the country where it has recognized the necessity of addressing climate change and environmental issue and natural resource management. The NAPA is the beginning of a long journey to address adverse impacts of climate change including variability and extreme events and to promote sustainable development of the country. There are 15 adaptation strategies suggested to address adverse effects of climate change. Among the 15 adaptation strategies the following strategies address the coastal region for reducing climate change induced vulnerability. • Reduction of climate change hazards through coastal afforestation with community participation. • Providing drinking water to coastal communities to combat enhanced salinity due to sea level rise. • Construction of flood shelter, and information and assistance centre to cope with enhanced recurrent floods in major floodplains • Promotion of research on drought, flood and saline tolerant varieties of crops to facilitate adaptation in future. • Promoting adaptation to coastal crop agriculture to combat increased salinity. • Promoting adaptation to coastal fisheries through culture of salt tolerant fish special in coastal areas of Bangladesh.	-	The proposed project will broadly contribute toward achieving the aims and objectives of the climate change adaptation strategies.
Bangladesh Climate Change Strategy and Action Plan (BCCSAP), 2009 The Government of Bangladesh has prepared the Bangladesh Climate Change Strategy and Action Plan (BCCSAP), 2009. The BCCSAP is built	-	The proposed project with compliance within action plan.

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
on six pillars: (i) food security, social safety and health; (ii) comprehensive disaster management; (iii) infrastructure; (iv) research and knowledge management; (v) mitigation and low carbon development; and (vi) capacity building. Five programs have been suggested related to improvement of the water management infrastructures in coastal areas of Bangladesh under pillar 3 (Infrastructure) of BCCSAP, including: • Repair and maintenance of existing flood embankments; • Repair and maintenance of existing coastal polders • Improvement of urban drainage; • Planning, design and construction of river training works; • Planning, design and implementation of resuscitation of the network of rivers and khals through dredging and de-siltation work.		
The Building and Construction Act, 1952 • As per Section 3A of this act, no owner or occupier of a building shall, without obtaining previous permission from the Authorized Officer or the Committee uses the building for the purpose other than that mentioned in the sanction. • All the construction, re-construction works to be undertaken as per terms or conditions prescribed.	Authorized Officer or Committee	JEZ shall ensure that no building or tank shall be constructed without prior permission from the Authorized Officer or Committee of the area.
The Vehicle Act, 1927 • As per section 4 of this act, no owner or person in charge of a vehicle shall allow any person under the age of eighteen years to drive the same in any public place. • As per section 7, no person shall drive a vehicle in a public place unless he is licensed in the prescribed manner. • Every vehicle must possess a valid registration certificate as per section 11 of this act.	Bangladesh Road Transport Authority	JEZ shall ensure that every vehicle possess a certification of registration as required under this act.
The Motor Vehicle Ordinance Act, 1983 (as modified on November, 1990) • As per section 3 of the ordinance, no person shall drive a motor vehicle in any public place unless he holds an effective driving license. • No person under the age of eighteen years shall drive a motor vehicle in any public	Bangladesh Road Transport Authority	JEZ shall ensure that no person shall drive a motor vehicle in any public place unless he holds an effective driving license issued to him authorizing him to drive the vehicle.

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
place.		
Fatal Accidents Act, 1855 This Act was promulgated to provide compensation to families for loss occasioned by the death of a person caused by actionable wrong. The company will be liable to pay compensation in case of death of any worker/employee or damages in case death has not ensued but such circumstances could have resulted in death.	Ministry of Labor and Employment	JEZ shall ensure compliance to the Rules.
Bangladesh Labor Act, 2006 (as amended through July 22, 2013). The provisions prescribed under chapters pertaining to occupational health and safety, and compensations due to accidents are entailed below. **Chapter V: Health and Hygiene** The chapter deals with provisions regarding cleanliness of the any facility, drinking water supply, ventilation, lighting, dust bean and spittoons, etc. **Chapter VI: Safety** This chapter addresses the issues regarding safety of building and machinery, precautions in case of fire, fencing of machinery, works on or near machinery in motion, hoists and lifts protection of eyes, explosive or inflammable dust/gas, etc. **Chapter VII: Special Provisions related to Health, Hygiene and Safety** This chapter deals with provisions to be taken in case of hazardous operations, notice to be given in accidents, notice of certain dangerous occurrences and diseases etc. **Chapter VIII: Welfare** This chapter prescribes the provisions to be facilitated in the facility regarding first-aid appliances, safety record books, washing facilities, canteens, shelters, rooms for children, etc. This Act consolidates and amends the laws relating to employment of labor, relations between workers and employers, determination of minimum wages, payment of wages and compensation for injuries to workers, formation of trade unions, rising and settlement of industrial disputes, health, safety, welfare and working conditions of workers, apprenticeship and matters connected therewith. The provisions prescribed under chapters pertaining to labor benefits and entitlements are	Ministry of Labor and Employment	JEZ shall ensure that all conditions provided in chapters V, VI, VII and VIII of the Act, pertaining to Health, hygiene safety and welfare are met in accordance with the amended act. During the construction and operation phases of the proposed project, JEZ shall ensure the facilitation of the following provisions: • Management of workers under service rules as approved by the Chief Inspector. • Provision of Letter of Appointment and ID card (with photograph) for each and every worker. • Maintenance of Service Book with the requisite details. • Retrenchment Policy and conditions of re-employment of retrenched workers, termination of employment etc. • Provisions regarding gratuity, provident fund and other payments at the time of retirement of workers. • Any adolescent employed in any dangerous operation shall be in possession of Certificate of Fitness issued by a registered medical practitioner. • Maternity benefits shall be paid as stipulated in the Act. • Cleanliness of the facility through washing, painting and varnishing etc. for ensuring hygiene.

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
as follows: • Conditions of Service and Employment • Employment of Adolescent • Maternity Benefit • Working Hours and Leave • Wages and Payment • Workmen's Compensation for Injury by Accidents • Trade Unions and Industrial Relations		• Ventilation and removal dusts and fumes through adequate number of exhaust systems. • Adequate number of drinking water facilities equipped with cooling systems at convenient places in the unit. All such places shall be legibly marked 'Drinking water' in Bangla. • Separate and adequate number of latrines and urinals for men and women. They shall be maintained in a clean and sanitary condition at all times with suitable detergents and disinfectants. • Leave policy stating the working hours and the number of leaves the workers are entitled to under the provisions of the Act. • Compensation/wages shall be stated in the Letter of Appointment given to the workers/employees. • JEZ shall ensure that there is no policy restricting the association of workers'/trade unions. • Workmen's Compensation Policy stating the compensation to be meted out in case of injury due to accidents. • Safety of EZ workers engaged in loading and unloading of industries as per prescribed provisions.
Bangladesh Factories Act, 1965 As per section 6 of the Act, the occupier shall furnish some information to Chief Inspector at least fifteen days before he begins to occupy or use any premises as a factory. As per Section 8, the plans and specifications must be approved by Chief Inspector. Provisions for cleanliness, disposal of effluents, ventilation, lightning, latrines and urinals have been described in Chapter II of the Act. Chapter IV and V prescribe provisions for safety and welfare of the workers.	Chief Inspector of the Area	JEZ shall ensure that approval for plan and specifications has been procured from Chief Inspector of area. JEZ ensures that provisions as prescribed in chapters II, III and IV are complied with.
National Child Labor Elimination Policy, 2010	Ministry of	During all stages concerning

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
The National Child Labor Elimination Policy 2010 has been adopted to provide a framework towards eradicating all forms of child labor by 2015. The policy defines and lays guidelines for underage workers, regulation of their working hours, wages, nutrition needs, mental health, education and overall work environment. As per the policy, a child is a person under the age of 14. A person between the ages of 14 and 18 is an adolescent, and should be granted special amendments, if compelled to work due to poor economic status. The policy also entails that a child may not be employed as a regular employee, not be made to work in hazardous settings, provided breaks more frequent than those for regular employees and have enough time left for study.	Labor and Employment Ministry of Women and Child Welfare	employment of labor, JEZ should take the policy as a guidance document for following ethical practices at workplace, in dealing with adolescent workers, if at all.
Children's Act, 2013 (Act No. 24 of 2013). The Act implements the Nation's ratification to the UN Convention on the Rights of the Child (CRC), and replaces The Children's Act of 1974. The main components of the act are as follows: • The Act changes the legal definition of a child from being a person under the age of 14 to one under the age of 18. • It enforces the national authorities to establish Child Welfare Boards in each district, besides one at the national level. • It criminalizes any kind of cruelty inflicted on children while they are working in both the formal and informal sectors. • The Act further prescribes stricter punishments for using or exploiting children in begging, in brothels, and in carrying drugs, arms, or other illegal commodities.	Ministry of Law, Justice and Parliamentary Affairs. District commissioner's Office.	JEZ must ensure that at through all stages of construction and operation, no juvenile (children between ages 14 and 18) are engaged on site.
The Acquisition and Requisition of Immovable Property Ordinance, 1982 The ordinance consolidates and amends the laws relating to acquisition and requisition of immovable property by the government. It lays down the procedures and conditions for acquisition of land and other immovable properties such as common property resources (wells, places of worship, burial grounds, etc.). As per Section 8 of this ordinance, the amount of compensation to be determined taking into consideration market value and decision of Deputy Commissioner.	Ministry of Land, Bangladesh	There is total 443 acres of land comprising government and private landJEZ shall ensure the compliance with provisions of this ordinance relating to compensation.
The Bangladesh Inland Water Transport Corporation Order, 1972 (President's Order) This ordinance has been established for the	Bangladesh Inland Water Transportation	JEZ should ensure the compliance with provisions of the orders.

Summary of Applicable legislation/ Policy	Agency Responsible	Applicable Permit and Requirements
provision of a Corporation for the purpose of operation, promotion and development of coastal and inland shipping and water transport services.	Authority (BITWA)	
The Civil Aviation Authority Ordinance, 1985 As per section 11 of the ordinance, only Civil Aviation Authority have control over: • All the civil airports and aerodromes in Bangladesh including their planning, construction, operation and maintenance; • All air routes in Bangladesh; • Air space management of civil airports and aerodromes.	Civil Aviation Authority, Bangladesh	JEZ shall ensure compliance with rules made under this ordinance.
Bangladesh Biodiversity Act, 2017 To ensure biodiversity conservation and sustainable utilization of its components, to distribute benefits and fair share obtained from the livestock and related information this act has been composed.	Department of Environment, Bangladesh	JEZ shall ensure the compliance with provisions of this ordinance
Bangladesh Biological Protection Rules, 2012 According to the conferred power of the government in Article 20 of Bangladesh Environment Conservation Act, 1995 this rules have been formulated.	Department of Environment, Bangladesh	JEZ should ensure the compliance with provisions of the orders.
Biosafety Guidelines of Bangladesh This guideline is intended to be source of information, guidelines, policies and procedures that will enable and encourage those working in the field of biological environment, so that they can work safely and reduce or eliminate the potential for exposure to biological hazard.	Ministry of Environment and Forests, Bangladesh Department of Environment, Bangladesh	JEZ should ensure the compliance with provisions of this guideline.
Rules for Corrosive Material (Control) responsible for Ozone Layer Depletion, 2004 Prohibition of producing, imports, exports, exchange, purchase selletc.of corrosive materials responsible for ozone layer depletion.	Ministry of Environment and Forests, Bangladesh Department of Environment, Bangladesh	JEZ should ensure the compliance with provisions of this guideline.
Sound pollution (control) Rules, 2006 Determine the area of sound pollution; determine the sound pollution standard, prohibition to excess use of sound, provide information about sound pollution etc. are included in these rules.	Traffic control department. Department of Environment, Bangladesh	JEZ should ensure the compliance with provisions of the orders.

The key permits required to be obtained by JEZ for the construction and operations of the proposed Economic Zone are set out in the Table below.

Table 2.3: Key permits required to be obtained by JEZ

Permit	Permitting Authority	Relevant Legislation	Role of Permit
Permission for construction of a Building (construction of buildings)	Authorized Officer or Committee	The Building and Construction Act, 1952	Authorization to construct the proposed project
Location Clearance Certificate (for establishing the project)	Director General, DoE	Environment Conservation Rules, 1997	Authorization to construct the proposed project
Environmental Clearance Certificate	DoE, Bangladesh	Environment Conservation Rules, 1997	Authorization to set up the plant with limited environmental effects of development and operation of the proposed project.
Permit for establishment of Economic Zone	Bangladesh Economic Zones Authority (BEZA)	Bangladesh Economic Zones Act, 2010	Permit from BEZA itself to be procured for erection of Zone
Installation of a tube - well	Ministry of Environment and Forests, Bangladesh Union/ Upazila Parishad	Ground Water Management Ordinance, 1985	Installation of tube in any place
No Objection Certificate from Union Parishad	Union/ Upazila Parishad	Environment Conservation Rules, 1997	A consent in form of NOC from respective Union Parishad
Approval of Plans and registration of the proposed project	Chief Inspector	The Factories Act, 1965	Approval of plans and specifications of the project

2.4 World Bank's Operational Policies and Guidelines

The World Bank follows an operational policy statement (updated in February, 2011), which stipulates that all operations are carried out in an environmentally responsible manner and that projects must comply with all local environment legal obligations and appropriate World Bank guidelines . The World Bank sets out its procedures and policies with regard to conducting environmental assessments on Operational Policy 4.1: Environmental Assessment (October, 1991) and its updates and other pertinent Guidelines.

2.5 Applicability

World Bank Environmental and Social Safeguard Policies provide ten (10) potential issues that may need to be considered in an EIA, depending on the specific

characteristics of each project. Table below summarizes the expected applicability of the potential Safeguard Policies for JEZ.

Table 2.4: Potential World Bank environmental safeguard policies and applicability to project

Safeguard Policy	Requirement	Policy Triggered	Applicability/ Compliance
Environment Assessment (OP 4.1)	The Bank requires environmental assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus to improve decision making.	Yes	This policy applies to all projects requiring a Category (A) Environmental Assessment under OP 4.1. All environmental and social aspects included in the proposed Project are adequately examined. The project is likely to have significant potential adverse environmental risks & impacts in its area of influence regarding the natural environment, water, land, human health and safety.
Natural Habitats (OP 4.4)	The Bank requires borrowers to incorporate into their development and environmental strategies analyses of any major natural habitat issues, including identification of important natural habitat sites, the ecological functions they perform, the degree of threat to the sites, priorities for conservation, and associated recurrent-funding and capacity-building needs.	Yes	Ecological study including floral and faunal diversity has been conducted.
Pest Management (OP 4.9)	In appraising a project that will involve pest management, the Bank assesses the capacity of the country's regulatory framework and institutions to promote and support safe, effective, and environmentally sound pest management. As necessary, the Bank and the borrower incorporate in the project components to strengthen such capacity.	No	Project proponent will ensure that the requirements of the operational policy will be adhered to during procurement of pesticides for the project.
Involuntary Resettlement (OP 4.12)	World Bank recognizes that Involuntary resettlement may cause severe long-term hardship, impoverishment, and environmental damage unless appropriate measures are carefully planned and carried out.	No	The land required for the project has been purchased through negotiated settlements on 'willing buyer-willing seller' through compensation for land acquisition basis between landowners and JEZ. As the land purchase was registered with the land registrar

Safeguard Policy	Requirement	Policy Triggered	Applicability/ Compliance
			of the locality and the sale deed requires a witness of a local person from the area, the land purchase process has reportedly been transparent.
Indigenous People (OP 4.10)	The Bank recognizes that the identities and cultures of indigenous peoples are inextricably linked to the lands on which they live and the natural resources on which they depend. Hence, A project proposed for Bank financing must be screened for presence of indigenous people.	No	Census records and public consultations indicate that there are no indigenous populations in the study area.
Forests (OP 4.36)	If a project involves significant conversion or degradation of natural forests or related natural habitats that the Bank determines are not critical, and the Bank determines that there are no feasible alternatives to the project and its siting, and comprehensive analysis demonstrates that overall benefits from the project substantially Outweigh the environmental costs; the Bank may finance the project provided that it incorporates appropriate mitigation measures.	No	The proposed project does not comprise any kind of forest land.
Physical Cultural Resources (OP 4.11)	The borrower needs to addresses impacts on physical cultural resources in projects proposed for Bank financing, as an integral part of the environmental assessment (EA) process.	No	No such tangible forms of cultural heritage or objects were found within the project area.
Safety of Dams (OP 4.37)	When the Bank finances a project that includes the construction of a new dam, it requires that the dam be designed and its construction supervised by experienced and competent professionals.	No	The project involves the protection of beel.
Project in Disputed Areas (OP 7.60)	Projects in disputed areas may affect the relations between the Bank and its borrowers, and between the claimants to the disputed area. Therefore, the Bank will only finance projects in disputed areas when either there is no	No	The proposed project is not situated in a disputed area. Any component likely to be financed as part of the project is not situated in a disputed area.

Safeguard Policy	Requirement	Policy Triggered	Applicability/ Compliance
	objection from the other claimant to the disputed area, or when the special circumstances of the case support Bank financing, notwithstanding the objection.		
Projects on International Waterways (OP 7.50)	The Bank recognizes that the cooperation and goodwill of riparian is essential for the efficient use and protection of the waterway. Therefore, it attaches great importance to riparian's making appropriate agreements or arrangements for these purposes for the entire waterway or any part thereof.	No	BangshiRiver is not a recognized international waterway. Also, there is no water abstraction issue in this project.

2.5.1 Categorization of Projects

The Bank screens the private sector activity in order to determine the nature and extent of the environmental and social assessment needed, based on the type, location, sensitivity, and scale of the activity, as well as the nature and magnitude of its potential impacts. This screening also identifies any additional information required to complete the Bank's environmental and social review and determine whether to support the activity. The private sector activity is categorized by the Bank as Category A, B, C, depending on the nature of the activity and financing mechanism, as follows:

Table 2.5: World Bank's categorization for projects

Category	Justification
Category A	Business activities with potential significant adverse environmental or social risks and/or impacts that is diverse, irreversible, or unprecedented.
Category B	Business activities with potential limited adverse environmental or social risks and/or impacts that are few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures.
Category C	Business activities with minimal or no adverse environmental or social risks and/or impacts.
Category FI	Business activities that involve investment of Bank funds through a financial intermediary, in sub projects that may result in adverse environmental impacts.

Box 1: Applicability for World Bank Project Categorization

Since the proposed project is an Economic Zone aimed to establish different export oriented industries which will have impacts both in its construction and operation phase, the project is classified as a Category A project as per the Bank's categorization system. As per the information requirements, the applicant i.e., JEZ is required to submit the following documents along with the financing application:

- *EIA report is to be prepared which will examines the project's potential negative and positive environmental impacts, compares them with those of feasible alternatives (including the "without project" situation), and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse*

impacts and improve environmental performance.

- *Public consultations with project-affected groups and local non-governmental organizations (NGOs) about the project's environmental aspects is to be undertaken at least twice; once during preparation of the Terms of Reference (ToR) for the EIA (Scoping), and also after the draft EIA has been prepared.*
- *The draft EA report is to be made available at a public place accessible to project-affected groups and local NGOs.*
- *EMP and/or Action Plans demonstrating the set of mitigation, monitoring, and institutional measures to be taken during implementation and operation to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels.*

2.5.2 Applicability of IFC Performance Standards

The IFC Performance Standards stipulates that any proposed project shall meet the following requirements throughout the life of an investment by IFC or other relevant financial institution:

- *Performance Standard 1:* Assessment and Management of Environmental and Social Risks and Impacts;
- *Performance Standard 2:* Labour and Working Conditions;
- *Performance Standard 3:* Resource Efficiency and Pollution Prevention;
- *Performance Standard 4:* Community Health, Safety, and Security;
- *Performance Standard 5:* Land Acquisition and Involuntary Resettlement;
- *Performance Standard 6:* Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- *Performance Standard 7:* Indigenous Peoples; and
- *Performance Standard 8:* Cultural Heritage

These performance standards and guidelines provide ways and means to identify impacts and affected stakeholders and lay down processes for management and mitigation of adverse impacts.

Performance Standard (PS) 1: Assessment and Management of Environmental and Social Risks and Impacts

PS 1 establishes the importance of:

- Integrated assessment to identify the environmental and social impacts, risks, and opportunities of Projects;
- Effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them;
- The project proponent's management of environmental and social performance throughout the life of the project;

- PS 1 is applicable to all projects and associated facilities having environmental and/or social risks and/or impacts. Some of the key environmental and social impacts that the proposed project can be associated with:
- Disposal of dredged material (particularly if the sediments are contaminated and accumulation of hazardous materials;
- Emission of dust from dry bulk material storage and handling facilities;
- Management of solid waste generating and hazardous material;
- Land acquisition and possible resettlement of local population; and
- Loss of livelihood of local population due to project operations etc.

Box 2: Applicability to PS1

PS 1 is applicable for the project and an Environmental and Social Impact Assessment (EIA) study needs to be conducted prior to the commencement of the project. JEZ also needs to develop and implement an Environmental and Social Management System (ESMS) to manage the identified risks associated with its operations during construction and operation phase of the project.

Performance Standard 2: Labour and Working Conditions

PS 2 recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers. The objectives of the PS 2 are:

- To promote the fair treatment, non-discrimination, and equal opportunity of workers;
- To establish, maintain, and improve the worker-management relationship;
- To promote compliance with national employment and labor laws;
- To protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain;
- To promote safe and healthy working conditions, and the health of workers; and
- To avoid the use of forced labor.

The applicability of PS 2 will be more important during the construction phase as operation phase will have lesser number of staff. This PS covers not only the main plant employees, but all employees/workers, even indirect workers working through contractors. Migrant workers will be engaged for the project and they will be provided accommodation in labour camps. Hence, standards pertaining to campsites will be applicable.

Box 3: Applicability to PS2

PS 2 are applicable to the project and JEZ shall ensure provision of adequate facilities such as access to clean water, sanitary facilities and other necessary facilities at the construction sites. JEZ shall ensure measures to prevent child labor, forced labor, and discrimination is strictly implemented. Freedom of association and collective bargaining shall be provided. Wages, work hours and other benefits shall be regulated as per the

national labor and employment laws.

Performance Standard 3: Resource Efficiency and Pollution Prevention

The PS 3 outlines approach to pollution prevention and abatement in line with internationally disseminated technologies and practices with the following objectives:

- Avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from activities; and
- Promote the reduction of emissions that contribute to climate change.

Box 4: Applicability to PS3

The impacts and risks associated with the generation, use, storage, release, and/or disposal of pollutants has been assessed as part of this EIA. JEZ shall ensure implementation of the mitigation measures provided in the ESMP. JEZ shall also ensure that pollution control measures are planned and implemented right from the project conception stage. Practices like minimal release of waste/emissions, safe disposal of waste, waste water management etc. shall be considered prior to each project phase. PS 3 is therefore applicable for the proposed project.

Performance Standard 4: Community Health, Safety and Security

PS 4 recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. Its main stress is to ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the affected Communities.

Box 5: Applicability to PS4

The Applicability of this PS has been extended to construction as well as operational phases of the project. It will be associated with unloading and loading of activities of different industries, movement of vehicles, noise generation, etc. Community health and safety consideration related to the project has been addressed while assessing the environmental and social risks and impacts. Security staff will be engaged form local community whereas labor engaged will be both local as well as migrant.

A stakeholder engagement process has been formulated as a part of community engagement requirements consistent with the requirements of PS 1 including the informed consultation and participation process of Affected Communities. It will also include dissemination of information pertaining to security arrangements to workers and community. Also, JEZ will construct and operate the structural elements of the project in accordance with GIIP taking into consideration safety risks to the affected community.

Performance Standard 5: Land Acquisition and Involuntary Resettlement

PS 5 recognizes that project related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Its main aim is to anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by providing compensation for loss of assets at replacement cost and ensuring that resettlement

activities are implemented with appropriate disclosure of information, consultation, and the informed participation of affected persons and community.

Box 6: Applicability to PS5

A portion of land required for the project has been purchased through negotiated settlements between landowners and JEZ's land procurement representatives. The land procurement has not resulted in loss of livelihood of the landowners since the land was not being used for any economic activities by the villagers prior to sale (as the land was treated as less agricultural land considering single season crop). There has also not been any physical displacement or resettlement as none of the procured lands were inhabited. Thus PS5 will not be applicable.

Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

PS6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. This standard is aimed to promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.

Box 7: Applicability to PS6

The proposed project will involve discharge of various type of wastewater generating from the production activities of different industries like sewage, effluent chemical water etc. This poses risk to aquatic species (especially fishes) present in adjacent beel and river.

JEZ shall ensure that the discharge of waste water will be undertaken only after suitable treatment of the waste and the limit of the parameters have to be within the standards prescribed by applicable national laws and international guidelines whichever of the two is more stringent. It shall ensure that indiscriminate fishing is prohibited in the project area as mandated by the national laws. PS 6 will be applicable in addressing the aforementioned issues and managing the risks posed by such project operations.

The details of this PS have been detailed out in the EIA study, while implementation of the actions necessary to meet the requirements of this PS shall be managed through the suggested mitigation measures. The operation phase of the proposed project shall ensure protection of fauna and flora of the site and surroundings.

Performance Standard 7: Indigenous Peoples

PS 7 recognizes Indigenous Peoples as social groups with identities that are distinct from mainstream groups in national societies and are often among the most marginalized and vulnerable segments of the population. In many cases, their economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development.

Box 8: Applicability to PS7

Census records and public consultations indicate that there are no indigenous populations in the study area. Thus, PS 7 shall not be applicable to this project.

Performance Standard 8: Cultural Heritage

PS 8 recognizes the importance of cultural heritage for current and future generations. Consistent with the Convention concerning the Protection of the World Cultural and Natural Heritage, this Performance Standard aims to ensure that clients protect cultural heritage in the course of their project activities. In addition, the requirements of this Performance Standard on a project's use of cultural heritage are based in part on standards set by the Convention on biological diversity.

Box 9: Applicability to PS8

This PS is applicable when tangible forms of cultural heritage, unique natural features or tangible objects that embody cultural values and certain instances of intangible forms of culture are impacted or are proposed to be used for commercial purposes. No such tangible forms of cultural heritage or objects were found in the project area. Hence this PS is not applicable to the proposed project.

2.6 Applicable World Bank Group EHS Guidelines

The Equator Principle III requires follow up of the environmental, health and safety requirements as per the following guidelines released by International Finance Cooperation (IFC) on 30thApril, 2007. These guidelines ensure that the projects are developed in a manner that is socially responsible and reflects sound environmental management practices. EHS considerations into the site selection and plant design processes should be considered in order to maximize the range of options available to prevent and control potential negative impacts.

1. Environmental, Health, and Safety General Guidelines;
2. Environmental, Health, and Safety Guidelines for Ports, Harbors and Terminals;
3. Environmental, Health, and Safety Guidelines for Shipping.

The key requirements stated in the EHS guidelines have been discussed in the Table below.

Table 2.6: Key requirements as per EHS guidelines of IFC

	Relevant Requirements as Stated in EHS Guidelines
1.	**Air Emissions**
A.	***Combustion Sources***
a)	Combustion sources are characterized by the release of air pollutants typically associated with the combustion of fossil fuels, such as nitrogen oxides (NO_X), sulfur dioxide (SO_2), carbon monoxide (CO), and particulate matter (PM), as well as other air pollutants including certain volatile organic compounds (VOCs) and metals that may also be associated with a wide range of industrial activities.
b)	The stack height for all point sources of emissions, whether 'significant' or not, should be designed according to GIIP to avoid excessive ground level concentrations due to downwash, wakes, and eddy effects and to ensure reasonable diffusion to minimize impacts.
c)	Avoiding installation of firefighting or refrigeration systems contain chlorofluorocarbons (CFCs), in accordance with applicable phase-out requirements.
B.	***Volatile Organic Compounds***

	Relevant Requirements as Stated in EHS Guidelines
a)	Substitution of less volatile substances, such as aqueous solvents.
b)	Collection of vapors through air extractors and subsequent treatment of gas stream by removing VOCs with control devices such as condensers or activated carbon absorption.
c)	Collection of vapors through air extractors and subsequent treatment with destructive control devices such as: • Catalytic Incinerators: Used to reduce VOCs from process exhaust gases exiting paint spray booths, ovens, and other process operations. • Thermal Incinerators: Used to control VOC levels in a gas stream by passing the stream through a combustion chamber where the VOCs are burned in air at temperatures between 700^0 C to $1,300^0$ C. • Enclosed Oxidizing Flares: Used to convert VOCs into CO_2 and H_2O by way of direct combustion.
d)	Use of floating roofs on storage tanks to reduce the opportunity for volatilization by eliminating the headspace present in conventional storage tanks.
C.	***Dust***
a)	Use of dust control methods, such as covers, water suppression, or increased moisture content for open materials storage piles, or controls, including air extraction and treatment through a baghouse or cyclone for material handling sources, such as conveyors and bins.
b)	Use of water suppression for control of loose materials on paved or unpaved road surfaces. Oil and oil by-products is not a recommended method to control road dust. Examples of additional control options for unpaved roads.
2.	**Wastewater**
A.	***Discharge to Surface Water***
a)	Process wastewater treatment standards consistent with applicable Industry Sector EHS Guidelines. Projects for which there are no industry-specific guidelines should reference the effluent quality guidelines of an industry sector with suitably analogous processes and effluents.
b)	Compliance with national or local standards for sanitary wastewater discharges or, in their absence, the indicative guideline values applicable to sanitary wastewater discharges.
c)	Temperature of wastewater prior to discharge does not result in an increase greater than 3°C of ambient temperature at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use and assimilative capacity among other considerations.
B.	***Discharge to Sanitary Sewer Systems***
a)	Meet the pre-treatment and monitoring requirements of the sewer treatment system into which it discharges.
b)	Not interfere, directly or indirectly, with the operation and maintenance of the collection and treatment systems, or pose a risk to worker health and safety, or adversely impact characteristics of residuals from wastewater treatment operations.
c)	Be discharged into municipal or centralized wastewater treatment systems that have adequate capacity to meet local regulatory requirements for treatment of wastewater generated from the project. Pre-treatment of wastewater to meet regulatory requirements before discharge from the project site is required if the municipal or centralized wastewater treatment system receiving wastewater from the project does not have adequate capacity to maintain regulatory compliance.
C.	***Septic Systems***
a)	Properly designed and installed in accordance with local regulations and guidance to prevent

	Relevant Requirements as Stated in EHS Guidelines
	any hazard to public health or contamination of land, surface or groundwater.
b)	Well maintained to allow effective operation.
c)	Installed in areas with sufficient soil percolation for the design wastewater loading rate.
d)	Installed in areas of stable soils that are nearly level, well drained, and permeable, with enough separation between the drain field and the groundwater table or other receiving waters.
3.	**Wastewater Management**
A.	***Industrial Wastewater***
a)	The design and operation of the selected wastewater treatment technologies should avoid uncontrolled air emissions of volatile chemicals from wastewaters. Residuals from industrial wastewater treatment operations should be disposed in compliance with local regulatory requirements, in the absence of which disposal has to be consistent with protection of public health and safety, and conservation and long term sustainability of water and land resources.
B.	***Wastewater from Utilities Operations***
a)	Use of heat recovery methods (also energy efficiency improvements) or other cooling methods to reduce the temperature of heated water prior to discharge to ensure the discharge water temperature does not result in an increase greater than 3°C of ambient temperature at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity among other considerations.
b)	Minimizing use of antifouling and corrosion inhibiting chemicals by ensuring appropriate depth of water intake and use of screens. Least hazardous alternatives should be used with regards to toxicity, biodegradability, bioavailability, and bioaccumulation potential. Dose applied should accord with local regulatory requirements and manufacturer recommendations.
c)	Testing for residual biocides and other pollutants of concern should be conducted to determine the need for dose adjustments or treatment of cooling water prior to discharge.
C.	***Storm water Management***
a)	Storm water should be separated from process and sanitary wastewater streams in order to reduce the volume of wastewater to be treated prior to discharge.
b)	Surface runoff from process areas or potential sources of contamination should be prevented.
c)	Where this approach is not practical, runoff from process and storage areas should be segregated from potentially less contaminated runoff.
d)	Runoff from areas without potential sources of contamination should be minimized (e.g. by minimizing the area of impermeable surfaces) and the peak discharge rate should be reduced (e.g. by using vegetated swales and retention ponds).
e)	Where storm water treatment is deemed necessary to protect the quality of receiving water bodies, priority should be given to managing and treating the first flush of storm water runoff where the majority of potential contaminants tend to be present.
f)	When water quality criteria allow, storm water should be managed as a resource, either for groundwater recharge or for meeting water needs at the facility;
g)	Oil water separators and grease traps should be installed and maintained as appropriate at refueling facilities, workshops, parking areas, fuel storage and containment areas.
h)	Sludge from storm water catchments or collection and treatment systems may contain elevated levels of pollutants and should be disposed in compliance with local regulatory requirements, in the absence of which disposal has to be consistent with protection of public health and safety, and conservation and long term sustainability of water and land resources.
D.	***Sanitary Wastewater***
a)	Segregation of wastewater streams to ensure compatibility with selected treatment option

	Relevant Requirements as Stated in EHS Guidelines
	(e.g. septic system which can only accept domestic sewage).
b)	Segregation and pre-treatment of oil and grease containing effluents (e.g. use of a grease trap) prior to discharge into sewer systems.
c)	If sewage from the industrial facility is to be discharged to surface water, treatment to meet national or local standards for sanitary wastewater discharges or, in their absence, the indicative guideline values applicable to sanitary wastewater discharges.
d)	If sewage from the industrial facility is to be discharged to either a septic system, or where land is used as part of the treatment system, treatment to meet applicable national or local standards for sanitary wastewater discharges is required.
e)	Sludge from sanitary wastewater treatment systems should be disposed in compliance with local regulatory requirements, in the absence of which disposal has to be consistent with protection of public health and safety, and conservation and long term sustainability of water and land resources.
4.	**Water Conservation**
A.	***Process Water Reuse and Recycling***
a)	*Washing Machines:* Many washing machines use large quantities of hot water. Use can increase as nozzles become enlarged due to repeated cleaning and/or wear. Monitor machine water use, compare with specification, and replace nozzles when water and heat use reach levels warranting such work.
b)	*Water reuse:* Common water reuse applications include counter current rinsing, for example in multi-stage washing and rinsing processes, or reusing waste water from one process for another with less exacting water requirements. For example, using bleaching rinse water for textile washing, or bottle-washer rinse water for bottle crate washing, or even washing the floor. More sophisticated reuse projects requiring treatment of water before reuse are also sometimes practical.
c)	*Water jets/sprays:* If processes use water jets or sprays (e.g. to keep conveyors clean or to cool product) review the accuracy of the spray pattern to prevent unnecessary water loss.
d)	*Flow control optimization:* Industrial processes sometimes require the use of tanks, which are refilled to control losses. It is often possible to reduce the rate of water supply to such tanks, and sometimes to reduce tank levels to reduce spillage. If the process uses water cooling sprays, it may be possible to reduce flow while maintaining cooling performance. Testing can determine the optimum balance. If hoses are used in cleaning, use flow controls to restrict wasteful water flow. Consider the use of high pressure, low volume cleaning systems rather than using large volumes of water sprayed from hosepipes. Using flow timers and limit switches to control water use. Using 'clean-up' practices rather than hosing down.
B.	***Water Cooling Systems***
a)	Use of closed circuit cooling systems with cooling towers rather than once-through cooling systems.
b)	Limiting condenser or cooling tower blow down to the minimum required to prevent unacceptable accumulation of dissolved solids.
c)	Use of air cooling rather than evaporative cooling, although this may increase electricity use in the cooling system.
d)	Use of treated waste water for cooling towers.
e)	Reusing/recycling cooling tower blow down.
B.	***Water Heating Systems***
a)	Repair of steam and condensate leaks and repair of all failed steam traps.
b)	Return of condensate to the boiler house, and use of heat exchangers (with condensate return)

	Relevant Requirements as Stated in EHS Guidelines
	rather than direct steam injection where process permits.
c)	Flash steam recovery.
d)	Minimizing boiler blow down consistent with maintaining acceptably low dissolved solids in boiler water. Use of reverse osmosis boiler feed water treatment substantially reduces the need for boiler blow down.
e)	Minimizing desecrator heating.
5.	**Hazardous Materials Management**
A.	***General Hazardous Materials Management***
a)	Use of dedicated fittings, pipes, and hoses specific to materials in tanks (e.g., all acids use one type of connection, all caustics use another), and maintaining procedures to prevent addition of hazardous materials to incorrect tanks.
b)	Use of transfer equipment that is compatible and suitable for the characteristics of the materials transferred and designed to ensure safe transfer.
c)	Regular inspection, maintenance and repair of fittings, pipes and hoses.
d)	Provision of secondary containment, drip trays or other overflow and drip containment measures, for hazardous materials containers at connection points or other possible overflow points.
B.	***Management of Major Hazards***
a)	Process Safety Information: Procedures should be prepared for each hazardous material and include: – Compilation of Material Safety Data Sheets (MSDS) – Identification of maximum intended inventories and safe upper/lower parameters – Documentation of equipment specifications and of codes and standards used to design, build and operate the process
b)	Operating Procedures: SOPs should be prepared for each step of all processes or operations within the project (e.g., initial startup, normal operations, temporary operations, emergency shutdown, emergency operations, normal shutdown, and start-up following a normal or emergency shutdown or major change). These SOPs should include special considerations for Mazmats used in the process or operations (e.g. temperature control to prevent emissions of a volatile hazardous chemical; diversion of gaseous discharges of hazardous pollutants from the process to a temporary storage tank in case of emergency).
6.	**Noise**
a.	Sitting facilities with consideration of distances from the noise sources to the receptors (e.g., residential receptors, schools, hospitals, religious places) to the extent possible.
b.	Use of noise control techniques such as: using acoustic machine enclosures; selecting structures according to their noise isolation effect to envelop the building; using mufflers or silencers in intake and exhaust channels; using sound-absorptive materials in walls and ceilings; using vibration isolators and flexible connections (e.g., helical steel springs and rubber elements).
c.	Identify and mark high noise areas and require that personal noise protecting gear is used all the time when working in such high noise areas (typically areas with noise levels >85 dBA).
d.	Noise monitoring may be carried out for the purposes of establishing the existing ambient noise levels in the area of the proposed or existing facility, or for verifying operational phase noise levels.
7.	**Biodiversity**
a.	Special consideration for areas of high biodiversity value or those required for the survival of

	Relevant Requirements as Stated in EHS Guidelines
	critically endangered or endangered flora and fauna is to be given.
c.	Cleaning or repair of ballast tanks should be equipped with adequate reception facilities able to prevent the introduction of invasive species.
8.	**Occupational Health and Safety**
i.	***Physical Hazards***
a.	Separation of people from vehicles and making vehicle passageways one-way, to the extent practical.
b.	Constructing the areas to be: of adequate strength to support the heaviest expected loads; level, or with only a slight slope; free from holes, cracks, depressions, unnecessary curbs, or other raised objects; continuous; and skid resistant.
d.	Avoiding placing cargo on or allowing passage of vehicles over, any hatch cover that is not of adequate strength for that purpose.
e.	Clearly marking (indicating its own weight) all lifting beams and frames, vacuum lifting, or magnetic lifting device and every other item of loose gear weighing more than 100 kilograms (kg).
f.	Inspecting disposable pallets and similar disposable devices before use and avoiding re-use of such disposable devices.
g.	Equipping lifting appliances with means of emergency escape from the driver's cabin and a safe means for the removal of an injured or ill driver.
h.	Risk of free fall of materials should be minimized by installing telescoping arm loaders and conveyors.
i.	Materials handling operations should follow a simple, linear layout to reduce the need for multiple transfer points.
j.	Ensuring all seafarers is trained to manage the types of hazards applicable to their assigned responsibilities.
k.	Regular inspection and maintenance of decks areas, including railings, catwalks, stairs, and other walking areas to prevent the existence of cracks, worn or missing parts, and other falling and tripping hazards.
l.	Decks and gratings should be kept clear of grease, garbage, and ice to avoid risk of slipping, and any spillage should be cleaned up immediately.
m.	Installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area.
n.	Use of fall prevention devices, including safety belt and lanyard travel limiting devices to prevent access to fall hazard area.
ii.	***Chemical Hazards***
a.	Consider generation of ammonia on site from urea or use of aqueous ammonia in place of pure liquefied ammonia;
b.	Consider use of sodium hypochlorite in place of gaseous chlorine.
c.	Implementation of engineering and administrative control measures to avoid or minimize the release of hazardous substances into the work environment keeping the level of exposure below internationally established or recognized limits.
d.	Communicating chemical hazards to workers through labeling and marking according to national and internationally recognized requirements and standards.
e.	Training workers in the use of the available information (such as MSDSs), safe work practices, and appropriate use of PPE.
f.	Implementation of smoking and naked light regulations during materials transfers activities

	Relevant Requirements as Stated in EHS Guidelines
	and hot work permits during ship maintenance.
g.	Proper tank cleaning and venting, and operation, maintenance and inspection of inert gas systems
h.	Be equipped with fire extinguishing devices and self-closing doors and constructed of materials made to withstand flame impingement for a moderate period of time.
i.	Workers who are required to handle corrosive, oxidizing, or reactive chemicals should be provided with specialized training and provided with, and wear, appropriate PPE (gloves, apron, splash suits, etc.).
iii.	***Confined Spaces***
a.	Engineering measures should be implemented to eliminate, to the degree feasible, the existence and adverse character of confined spaces.
b.	Permit-required confined spaces should be provided with permanent safety measures for venting, monitoring, and rescue operations, to the extent possible.
c.	Access hatches should accommodate 90% of the worker population with adjustments for tools and protective clothing.
d.	Mechanical equipment in the space should be disconnected, de-energized, locked-out, and braced, as appropriate.
e.	Appropriate training in confined space hazard control, atmospheric testing, use of the necessary PPE, as well as the serviceability and integrity of the PPE should be verified.
iv.	***Community Health and Safety***
a.	Operators should implement a Safety Management System (SMS) able to effectively identify and correct unsafe conditions.
c.	The Safety Management System should include comprehensive emergency preparedness and response plans that provide a coordinated response based on the port and community resources required to manage the nature and severity of the emergency event.
d.	Visual impacts, including excessive background illumination, should be prevented during the port planning process or managed during operations through the installation of natural visual barriers such as vegetation or light shades, as applicable.
e.	Fire suppression and control includes all automatic and manual fire protection installations.

2.7 Asian Development Bank (ADB) Safeguard Principles and Policies

2.7.1 Safeguard Policy Statement (SPS), 2009

Built upon the three previous safeguard policies on the Involuntary Resettlement Policy (1995), the Policy on Indigenous Peoples (1998) and the Environment Policy (2002), the Safeguard Policy Statement was approved in 2009. The safeguard policies are operational policies that seek to avoid, minimize or mitigate adverse environmental and social impacts including protecting the rights of those likely to be affected or marginalized by the developmental process. ADB's safeguard policy framework consists of three operational policies on the environment, indigenous peoples and involuntary resettlement. A brief detail of all three operational policies have been mentioned below:

Environmental Safeguard: This safeguard is meant to ensure the environmental soundness and sustainability of projects and to support the integration of environmental considerations into the project decision making process.

Box 10: Applicability to Environmental Safeguards

The proposed project is an establishment of Economic Zone with an area of 443acres and is likely to have significant environmental impacts during construction and operation phase. The impacts and risks associated with the generation, use, storage, release, and/or disposal of pollutants has been assessed as part of this EIA and appropriate mitigation measures have been proposed. Practices like minimal release of waste/emissions, safe disposal of waste, waste water management etc. shall be considered prior to each project phase. The Environmental Safeguard is thus applicable to the proposed project.

Involuntary Resettlement Safeguard: This safeguard has been placed in order to avoid involuntary resettlement whenever possible; to minimize involuntary resettlement by exploring project and design alternatives; to enhance, or at least restore, the livelihoods of all displaced persons in real terms relative to pre-project levels; and to improve the standards of living of the displaced poor and other vulnerable groups.

Box 11: Applicability to Involuntary Resettlement Safeguards

The land required for the proposed EZ is not developed area and agricultural activity is found.
The sale of land has been undertaken directly on a 'willing buyer-willing seller' basis by JEZ *with the landowners. Hence, as no physical and economic displacement in terms of involuntary acquisition of land and involuntary restrictions on land use is triggered, the Involuntary Resettlement Safeguard is not applicable for the proposed project.*

Indigenous Peoples Safeguard: This safeguard looks at designing and implementing projects in a way that fosters full respect for Indigenous Peoples' identity, dignity, human rights, livelihood systems and cultural uniqueness as defined by the Indigenous Peoples themselves so that they receive culturally appropriate social and economic benefits; do not suffer adverse impacts as a result of projects; and participate actively in projects that affect them.

Box 12: Applicability to Indigenous Peoples Safeguards

The proposed project area does not report any indigenous tribes, minorities or aboriginals. Hence the Indigenous Peoples Safeguard and the requirements there under are not applicable for this project.

Information, Consultation and Disclosure: Consultation and participation are essential in achieving the safeguard policy objectives. This implies that there is a need for prior and informed consultation with affected persons and communities in the context of safeguard planning and for continued consultation during project implementation to identify and help address safeguard issues that may arise. The consultation process begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle. It provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people and is undertaken in an atmosphere free of intimidation or coercion. In addition, it is gender inclusive and responsive and tailored to the needs of disadvantaged and vulnerable

groups and enables the incorporation of all relevant views of affected people and other stakeholders into decision making.

ADB requires the borrowers/clients to engage with communities, groups or people affected by proposed projects and with civil society through information disclosure, consultation and informed participation in a manner commensurate with the risks to and impacts on affected communities. For projects with significant adverse environmental, involuntary resettlement or Indigenous Peoples impacts, ADB project teams will participate in consultation activities to understand the concerns of affected people and ensure that such concerns are addressed in project design and safeguard plans.

A series of consultations were carried out with the land sellers, community and other (direct and indirect) stakeholders involved in the proposed project by JEZ and Consultants. Details pertaining to the consultation process are provided in relevant section of this report.

2.7.2 Social Protection Strategy, 2001

ADB has designed a set of policies and programs for social protection in 2001, that is, to reduce poverty and vulnerability by promoting efficient labor markets, diminishing people's exposure to risks, and enhancing their capacity to protect themselves against hazards and interruption/loss of income. The basic aim of the Social Protection Strategy (SPS) is to assist individuals to break the cycle of poverty and enhance the quality of growth through adequate and developed social protection systems in the member countries of ADB. The type of risks covered through the SPS may be economic, environment or social/governance related.

The proposed project shall ensure that the requirements of the ADB's SPS are complied with. Priority shall be given to any identified vulnerable groups. Based on the gender analysis and status of women in the project area, measures for ensuring their overall development shall be taken up by the project proponent. JEZ shall comply with applicable labor laws in relation to the project. JEZ shall also take the following measures to comply with the core labor standards[1] for the ADB financed portion of the project;

a) Carry out its activities consistent with the intent of ensuring legally permissible equal opportunity, fair treatment and non-discrimination in relation to recruitment and hiring, compensation, working conditions and terms of employment for its workers (including prohibiting any form of discrimination against women during hiring and providing equal work for equal pay for men and women engaged by the Borrower);

[1]The core labor standards are the elimination of all forms of forced or compulsory labor; the abolition of child labor; elimination of discrimination in respect of employment and occupation; and freedom of association and the effective recognition of the right to collective bargaining, as per the relevant conventions of the International Labor Organization.

b) Not restrict its workers from developing a legally permissible means of expressing their grievances and protecting their rights regarding working conditions and terms of employment;

c) Engage contractors and other providers of goods and services:

i. Who do not employ child labor[1] or forced labor[2] ;

ii. Who have appropriate management systems that will allow them to operate in a manner which is consistent with the intent of (A) ensuring legally permissible equal opportunity and fair treatment and non-discrimination for their workers, and (B) not restricting their workers from developing a legally permissible means of expressing their grievances and protecting their rights regarding working conditions and terms of employment; and

iii. Whose subcontracts contain provisions which are consistent with paragraphs (i)& (ii) above.

2.7.3 Public Communications Policy 2011

The Public Communications Policy (PCP) of ADB, originally formulated in 2005 and revised in 2011, is aimed at promoting improved access to information about ADB's operations related to fund projects. It endorses greater transparency and accountability to stakeholders involved in a project. The PCP establishes the disclosure requirements for documents and information related to projects. It mandates project related documents normally produced during the project cycle to be posted on the web.

2.7.4 Categorization of Projects

As part of its review of a project's expected social and environmental impacts, ADB uses a classification system. This classification is used to reflect the significance of potential environmental impacts understood as a result of the client's impact assessment and to establish ADB's safeguard requirements. The categories used by ADB are:

- Category A Projects: Projects which are likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented.
- Category B Projects: Projects with potential adverse environmental impacts that are less in number, generally site-specific, mostly reversible and readily addressed through mitigation measures.
- Category C Projects: Projects with minimal or no adverse environmental impacts.
- Category FI Projects: Projects which involve investment of ADB funds to or through a financial investment.

[1]Child labor means the employment of children whose age is below the statutory minimum age of employment in the relevant country, or employment of children in contravention of International LaborOrganization Convention No. 138 'Minimum Age Convention" (www.ilo.org)

[2]Forced labor means all work or services not voluntarily performed, that is, extracted from individuals under threat of force or penalty

Box 13: Applicability for ADB Project Categorization

Since the proposed project is an establishment of Economic Zone with an area of 443acreswhich will have impacts both in its construction and operation phase, the project is classified as a 'Category A' project as per the Bank's categorization system based on Environmental Safeguards. Categorization of the project as per Involuntary Resettlement and Indigenous Peoples is 'Category C'.

2.8 Equator Principle Financial Institutions (EPFIS) Guidelines

Equator Principles are a set of principles aiming towards promotion of responsible environmental stewardship and socially responsible development, including fulfilling responsibility to respect human rights by undertaking due diligence.

Principle 1: Review and Categorization

Using categorization, the EPFI's environmental and social due diligence is commensurate with the nature, scale and stage of the project, and with the level of environmental and social risks and impacts. The categories are:

Category A – Projects with potential significant adverse environmental and social risks and/or impacts those are diverse, irreversible or unprecedented;

Category B – Projects with potential limited adverse environmental and social risks and/or impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures; and

Category C – Projects with minimal or no adverse environmental and social risks and/or impacts.

Principle 2: Environmental and Social Assessment

For all Category A and Category B projects, the EPFI will require the client to conduct an Assessment process to address, to the EPFI's satisfaction, the relevant environmental impacts of the proposed project. The Assessment Documentation should propose measures to minimize, mitigate, and offset adverse impacts in a manner relevant and appropriate to the nature and scale of the proposed project.

Principle 3: Applicable Environmental and Social Standards

The Assessment process should, in the first instance, address compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues. Bangladesh being a Non-Designated Country, the Assessment process evaluates compliance with the then applicable IFC Performance Standards on Environmental and Social Sustainability (Performance Standards) and the World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines).

Principle 4: Environmental and Social Management System and Equator Principles Action Plan

For all Category A and Category B projects, the EPFI will require the client to develop or maintain an Environmental and Social Management System (ESMS). Further, an Environmental and Social Management Plan (ESMP) will be prepared by the client to

address issues raised in the Assessment process and incorporate actions required to comply with the applicable standards.

Principle 5: Stakeholder Engagement

The EPFI will require the client to demonstrate effective Stakeholder Engagement as an on-going process in a structured and culturally appropriate manner for all Category A and Category B projects. The client will conduct an Informed Consultation and Participation process. The consultation process will be tailored to the risks and impacts of the project; the project's phase of development; the language preferences of the Affected Communities; their decision-making processes; and the needs of disadvantaged and vulnerable groups.

To facilitate Stakeholder Engagement, the client will, commensurate to the project's risks and impacts, make the appropriate Assessment Documentation readily available to the Affected Communities, and where relevant Other Stakeholders, in the local language and in a culturally appropriate manner.

Principle 6: Grievance Mechanism

For all Category A and, as appropriate, Category B projects, the EPFI will require the client, as part of the ESMS, to establish a grievance mechanism designed to receive and facilitate resolution of concerns and grievances about the project's environmental and social performance.

Principle 7: Independent Review

For all Category A and, as appropriate, Category B projects, an Independent Environmental and Social Consultant, not directly associated with the client, will carry out an Independent Review of the Assessment Documentation including the ESMPs, the ESMS, and the Stakeholder Engagement process documentation in order to assist the EPFI's due diligence, and assess Equator Principles compliance.

Principle 8: Covenants

For all Category A and Category B projects, the client will covenant the financial documentation:

- To comply with all the relevant host country social and environmental laws, regulations and permits in all material respects;
- To comply with Action Plan (where applicable) during construction and operation of the project in all material aspects;
- To provide periodic reports in a format agreed with EPFIs (frequency to be agreed, but not less than annually) that documents compliance against APs, as well as against local laws and permits; and
- To decommission the facilities in accordance with an agreed decommissioning plan.

Principle 9: Independent Monitoring and Reporting

To ensure ongoing monitoring and reporting over the life of the project, the EPFIs will, for all A Category projects and where appropriate Category B, require appointment of an independent environmental and/or social expert, or require that the borrower retain

qualified and experienced external experts to verify its monitoring information, to be shared with the EPFIs.

Principle 10: Reporting and Transparency

Each EPFI is committed to issuing periodic public reports about project implementation processes and experience with due regard for appropriate project confidentiality.

2.9 International and National Environment Standards/ Guidelines

Bangladesh and World Bank environmental standards and guidelines relevant to the construction and operation of the JEZ cover the following issues[1]:

- Atmospheric emissions and ambient air quality;
- Water Quality;
- Liquid effluent discharges to the marine environment;
- Noise emissions and ambient noise levels.

2.9.1 Ambient Air Quality Standards

As per IFC EHS Guidelines, "the ambient air quality standards are ambient air quality levels established and published through national legislative and regulatory processes and ambient quality guidelines refer to ambient quality levels primarily developed through clinical, toxicological, and epidemiological evidence (such as those published by the World Health Organization)". The current Air Quality Guidelines are:

Table 2.7: Ambient air quality guidelines

Parameter	Averaging Period	Guideline value in µg/m^3
Sulphur Dioxide (SO_2)	24-hour	125 (Interim target-1)
		50 (Interim target-2)
		20 (guideline)
	10 minutes	500 (guideline)
Nitrogen dioxide (NO_2)	1-year	40 (guideline)
	1-hour	200 (guideline)
Particulate Matter PM_{10}	1-year	70 (Interim target-1)
		50 (Interim target-2)
		30 (Interim target-3)
		20 (guideline)
	24-hour	150 (Interim target-1)
		100 (Interim target-2)

[1] *When host country regulations differ from the levels and measures presented in the EHS Guidelines, project is expected to achieve whichever is more stringent.*

Parameter	Averaging Period	Guideline value in µg/m^3
		75 (Interim target-3)
		50 (guideline)
Particulate Matter $PM_{2.5}$	1-year	35 (Interim target-1)
		25 (Interim target-2)
		15 (Interim target-3)
		10 (guideline)
	24-hour	75 (Interim target-1)
		50 (Interim target-2)
		37.5 (Interim target-3)
		25 (guideline)
Ozone	8-hour daily maximum	160 (Interim target-1)
		100 (guideline)

** Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines*

As per the provisions of Rules 12 and 13 of the ECR 1997, the MoEF is responsible for laying down environmental quality standards (pertaining to air, water, sound, odour and other components) and standards for discharge and emission of waste. Ambient air quality standards have been stipulated in Schedule 2 (Standards for Air) of the Rules. However, these standards were revised by MoEF in 2005. The revised standards have been illustrated in the Table below.

Table 2.8: Air quality standards of Bangladesh

Pollutant	Averaging Time	Concentration
Carbon Monoxide (CO)(mg/m^3)	8 hours	10 (9 ppm)
	1 hour	40 (35 ppm)
Lead (Pb)(µg/m^3)	Annual	0.5
Oxides of Nitrogen(NO_x)(µg/m^3)	Annual	100 (0.053 ppm)
Sulphur dioxide (SO_2)(µg/m^3)	Annual	80 (0.03 ppm)
	24 hours	365 (0.14 ppm)
Suspended Particulate Matter (SPM)(µg/m^3)	8 hours	200
Coarse Particulates(PM_{10})(µg/m^3)	Annual	50
	24 hours	150
Fine Particulates($PM_{2.5}$)(µg/m^3)	Annual	15
	24 hours	65

Pollutant	Averaging Time	Concentration
Ozone (O_3)(µg/m^3)	8 hours	157 (0.08 ppm)
	1 hour	235 (0.12 ppm)

2.9.2 Water Quality Standards

As per Schedule 12 of the ECR 1997, designated best use classification has been prescribed for inland surface water as given in the Table below.

Table 2.9: Standards for inland surface water

	Best Practice based classification	Parameter			
		pH	BOD (mg/l)	DO (mg/l)	Total Coliform (number/100 ml)
a.	Source of drinking water for supply only after disinfecting	6.5-8.5	2 or less	6 or above	50 or less
b.	Water usable for recreational activity	6.5-8.5	3 or less	5 or more	200 or less
c.	Source of drinking water for supply after conventional treatment	6.5-8.5	6 of less	6 or more	5000 or less
d.	Water usable by fisheries	6.5-8.5	6 of less	5 or more	---
e.	Water usable by various process and cooling industries	6.5-8.5	10 or less	5 or more	5000 or less
f.	Water usable for irrigation	6.5-8.5	10 or less	5 or more	1000 or less

Notes:

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

The standards for drinking water have been presented in the Table below as per Schedule 12 of ECR-1997.

Table 2.10: Standards for drinking water

SN	Parameters	DoE Standards (Drinking Water Standards)
1.	Aluminium (in mg/l)	0.2
2.	Ammonia (in mg/l)	0.5 mg/l
3.	Arsenic (in mg/l)	0.05 mg/l
4.	Balium (in mg/l)	0.01 mg/l
5.	Benzene (in mg/l)	0.01 mg/l

SN	Parameters	DoE Standards (Drinking Water Standards)
6.	BOD (in mg/l)	0.2 mg/l
7.	Boron (in mg/l)	0.2 mg/l
8.	Cadmium (in mg/l)	0.005 mg/l
9.	Calcium (in mg/l)	75 mg/l
10.	Chlorides (in mg/l)	150-600 mg/l
11.	Chlorinated alkanes Carbon tetrachloride(in mg/l) dichloroethylene(in mg/l) 1.2 dichloroethylene(in mg/l) Tetrachloroethylene(in mg/l) Trichloroethylene(in mg/l)	 0.01 mg/l 0.001 mg/l 0.03 mg/l 0.03 mg/l 0.09 mg/l
12.	Chlorinated phenols pentachlorophenol (in mg/l) trichlorophenol (in mg/l)	 0.03 mg/l 0.03 mg/l
13.	Chlorine (residual) (in mg/l)	0.2 mg/l
14.	Chloroform	0.09 mg/l
15.	Chlorophyll (in mg/l)	--
16.	Chromium (in mg/l)	0.05 mg/l
17.	COD (in mg/l)	4 mg/l
18.	Color	15 Hazen
19.	Copper (in mg/l)	1 mg/l
20.	Cyanide	0.1 mg/l
21.	Detergents	0.2 mg/l
22.	DO	6 mg/l
23.	Faecal Coliform (in n/100 ml)	0
24.	Fluorides (in mg/l)	1.0 mg/l
25.	Iron (in mg/l)	0.3-1.0 mg/l
26.	Kjeldhl Nitrogen (total)	1 mg/l
27.	Lead (in mg/l)	0.05 mg/l
28.	Magnesium (in mg/l)	30-35 mg/l
29.	Manganese (in mg/l)	0.1 mg/l
30.	Mercury (in mg/l)	0.001 mg/l
31.	Nickel	0.1 mg/l
32.	Nitrate (in mg/l)	10 mg/l

SN	Parameters	DoE Standards (Drinking Water Standards)
33.	Nitrite	<1 mg/l
34.	Odor	Odorless
35.	Oil and Grease (in mg/l)	0.01 mg/l
36.	pH	6.5 – 8.5
37.	Phenolic Compounds	0.002 mg/l
38.	Phosphate (in mg/l)	6 mg/l
39.	Potassium	12 mg/l
40.	Radioactive materials (gross alpha activity)	0.01 Bq/l
41.	Radioactive materials (gross beta activity)	0.1 Bq/l
42.	Selenium	0.01 mg/l
43.	Silver	0.02 mg/l
44.	Sodium	200 mg/l
45.	Sulfide	400 mg/l
46.	Sulphate (in mg/l)	400 mg/l
47.	Suspended particulate matters	10 mg/l
48.	TDS (in mg/l)	1000 mg/l
49.	Temperature (in ° C)	20-30° C
50.	Tin	2 mg/l
51.	Total Coliform (in n/100 ml)	0
52.	Total Hardness (in mg/l)	200-500 mg/l
53.	TSS (in mg/l)	10 mg/l
54.	Turbidity (in NTU)	10
55.	Zinc (in mg/l)	5 mg/l

2.9.3 Liquid Effluent Discharges

As per Schedule 10 of ECR 1997, standards for waste from industrial units or project waste have been described. The same has been detailed in the Table below:

Table 2.11: Standards for liquid effluent discharge

	Parameter	Unit	Places for determination of standards		
			Inland Surface Water	Public Sewerage System connected to treatment at second stage	Irrigated Land
1.	Ammonical Nitrogen(as elementary N)	mg/l	50	75	75
2.	Ammonia (as free ammonia)	mg/l	5	5	15
3.	Arsenic (As)	mg/l	0.2	0.05	0.2
4.	BOD 5 at 20°C	mg/l	50	250	100
5.	Boron	mg/l	2	2	2
6.	Cadmium (as Cd)	mg/l	0.5	0.05	0.05
7.	Chloride	mg/l	600	600	600
8.	Chromium (as total Cr)	mg/l	0.5	1.0	1.0
9.	COD	mg/l	200	400	400
10.	Chromium (as hexavalent Cr)	mg/l	0.1	1.0	1.0
11.	Copper (as Cu)	mg/l	0.5	3.0	3.0
12.	Dissolved Oxygen(DO)	mg/l	4.5-8	4.5-8	4.5
13.	Electro-conductivity(EC)	Micro mho/ cm	1200	1200	1200
14.	Total Dissolved Solids	mg/l	2100	2100	2100
15.	Fluoride (as F)	mg/l	2	15	10
16.	Sulfide (as S)	mg/l	1	2	2
17.	Iron (as Fe)	mg/l	2	2	2
18.	Total Kjeldahl Nitrogen (as N)	mg/l	100	100	100
19.	Lead (as Pb)	mg/l	0.1	1.0	0.1
20.	Manganese (as Mn)	mg/l	5	5	5
21.	Mercury (as Hg)	mg/l	0.01	0.01	0.01
22.	Nickel (as Ni)	mg/l	1.0	2.0	1.0
23.	Nitrate (As elementary N)	mg/l	10	Not yet Fixed	10
24.	Oil and Grease	mg/l	10	20	10
25.	Phenolic Compounds(as C_6H_5OH)	mg/l	1.0	5	1.0

	Parameter	Unit	Places for determination of standards		
			Inland Surface Water	Public Sewerage System connected to treatment at second stage	Irrigated Land
26.	Dissolved Phosphorus (as P)	mg/l	8	8	15
27.	Radioactive substance	To be specified by Bangladesh Atomic Energy Commission			
28.	pH	-	6-9	6-9	6-9
29.	Selenium (as Se)	mg/l	0.05	0.05	0.05
30.	Zinc (as Zn)	mg/l	5	10	10
31.	Total Dissolved Solids	mg/l	2100	2100	2100
32.	Temperature	° C	40	40	40-Summer
			45	45	45-Winter
33.	Suspended Solids (SS)	mg/l	150	500	200
34.	Cyanide (as Cn)	mg/l	0.1	2.0	0.2

Notes:

(1) These standards shall be applicable to all industries or projects other than those specified under the heading "Standards for sector-wise industrial effluent or emission."
(2) Compliance with these standards shall be ensured from the moment an industrial unit starts trial production, and in other cases, from the moment a project starts operation.
(3) These standards shall be inviolable even in case of any sample collected instantly at any point of time. These standards may be enforced in a more stringent manner if considered necessary in view of the environmental conditions of a particular situation.
(4) Inland Surface Water means drains/ponds/tanks/water bodies/ditches, canals, rivers, springs and estuaries.
(5) Public sewerage system means treatment facilities of the first and second stage and also the combined and complete treatment facilities.
(6) Irrigable land means such land area which is sufficiently irrigated by waste water taking into consideration the quantity and quality of such water for cultivation of selected crops on that land.
(7) Inland Surface Water Standards shall apply to any discharge to a public sewerage system or to land if the discharge does not meet the requirements of the definitions in notes 5 and 6 above.

As per the IFC EHS guidelines, the treated sanitary sewage discharge is required to meet the following guideline values.

Table 2.12: Treated sewage discharge guideline values of IFC

	Parameters	Guideline Value
1.	pH	6 – 9
2.	BOD	30mg/l
3.	COD	125mg/l
4.	Total Nitrogen	125mg/l
5.	Oil and Grease	10 mg/l

	Parameters	Guideline Value
6.	Total Suspended Solids	50 mg/l
7.	Total coliform bacteria	400 MPN/100 ml

IFC Wastewater and Water Quality Monitoring Programme

A wastewater and water quality monitoring program with adequate resources and management oversight should be developed. The following elements to be considered while setting up the programme:

- *Parameters*: The parameters selected for monitoring should be indicative of the pollutants of concern from the process and should include parameters that are regulated under compliance requirements.
- *Monitoring type and frequency*: Wastewater monitoring should take into consideration the discharge characteristics from the process over time. Effluents from highly variable processes may need to be sampled more frequently or through composite methods. Grab samples or, if automated equipment permits, composite samples may offer more insight on average concentrations of pollutants over a 24-hour period.
- *Monitoring locations*: Effluent sampling stations may be located at the final discharge, as well as at strategic upstream points prior to merging of different discharges.
- *Data Quality*: Sampling should be conducted by or under the supervision of trained individuals. Analysis should be conducted by entities permitted or certified for this purpose. QA/QC documentation should be included in monitoring reports.

2.9.4 Ambient Noise Standards

As per IFC EHS Guidelines, noise impacts should not exceed the levels presented in the Table below or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

Table 2.13: Noise level guidelines as per IFC

Receptor	One Hour L_{eq}(dBA)	
	Daytime 07:00 - 22:00	Night time 22:00 - 07:00
Residential; institutional; educational	55	45
Industrial; commercial	70	70

The MoEF under the provisions of ECR, 1997 is responsible for laying down ambient noise standards. Noise Pollution (Control) Rules, 2006 were laid down by the Ministry through a Gazette notification dated September 7, 2006. Ambient noise standards established as per the provisions Rule 5(2) of the aforementioned Rules have been furnished in the Table below:

Table 2.14: Ambient noise standards as per DoE

	Type of Area	Limits in dB(A)L_{eq}	
		Day	Night
1.	Silent Zone	50	40
2.	Residential area	55	45
3.	Mixed area	60	50
4.	Commercial area	70	60
5.	Industrial area	75	70

Note:

1. dB(A) L_{eq} represents time-weighted average noise level on the Decibel-A scale
2. Day time is from 6am to 9pm, Night time is form 9pm to 6 am
3. Mixed area is mainly residential area, and also simultaneously used for commercial and industrial purposes
4. Area up to a radius of 100 m around hospitals/educational institutions/special institutions/ establishments identified/to be identified by the Government is designated as Silent Zones where use of horns of vehicles or other audio signals, and loudspeakers are prohibited.

2.9.5 Applicable International Conventions

Environmental problems which migrate beyond the jurisdiction (Trans-boundary) require power to control such issues through international co-operation by becoming a Contracting Party (CP) i.e., ratifying treaties or as Signatory by officially signing the treaties and agreeing to carry out provisions of various treaties on environment and social safeguards. Bangladesh signed and ratified various Multilateral Environmental Agreements (MEAs), International Labor Organization (ILO) Conventions, and International Maritime Conventions. The relevant international conventions have been summarized in the in the Table below.

Table 2.15: Applicable international conventions

Treaty or Convention & holding year	Brief Description
Convention on Protection of birds, Paris, 1950	Protection of birds in wild state
Convention on oil pollution damage (Brussels), 1969	Civil liability on oil pollution damage from ships
Ramsar Convention, 1971	Protection of wetlands
World Cultural and Natural Heritage (Paris), 1972	Protection of major cultural and natural monuments
CITES Convention (Washington), 1973	Ban and restrictions on international trade in endangered species of wild fauna and flora
Bonn Convention, 1979	Convention of migratory species of wild animal
Prevention and Control of Occupational Hazards (Geneva) 1974	Protect workers against occupational exposure to carcinogenic substances and agents
Occupational hazards due to air pollution, noise	Protect workers against occupational

Treaty or Convention & holding year	Brief Description
and vibration (Geneva) 1977	hazards in the working environment
Occupational safety and health in working environment (Geneva) 1981	Prevent accidents and injury to health by minimizing hazards in the working environment
Occupational Health Services (Geneva) 1985	To promote a safe and healthy working environment
Vienna convention, 1985	Protection of ozone layer
Civil liability on transport of dangerous goods (Geneva), 1989	Safe methods for transport of dangerous goods by road, railway and inland vessels
Convention on oil pollution (London), 1990	Legal framework and preparedness for control of oil pollution
London Protocol, 1990	Control of global emissions that deplete ozone layer
UN Framework convention on climate change (Rio de Janeiro), 1992	Regulation of greenhouse gases emissions
Convention on Biological Diversity (Rio de Janeiro), 1992	Conservation of bio-diversity, sustainable use of its components and access to genetic resources
International Convention on Climate Changes (Kyoto Protocol), 1997	International treaty on climate change and emission of greenhouse gases
Protocol on biological safety (Cartagena protocol), 2000	Biological safety in transport and use of bio-products

3 Project Description

3.1 Introduction

The proposed project involves development of EZ and associated on-site and off-site facilities for the upcoming JEZ. At present on-site facilities will be constructed for the project site. EZ will be developed at later stage by the developer. The on-site development will include the following:

- Site preparation & development
- Administration Building
- Boundary wall

The total area of the upcoming JEZ is about 443 acres. As per EZ Act, 2010, EZ can have following components:

- Processing Area
- Domestic Processing Area (DPA)
- Utilities
- Non-Processing Area

Post-secondary data analysis and stakeholder consultation following industries come out to be potential industries for the Jamalpur Economic Zone.

Table 3.1: Proposed industrial sectors in Jamalpur Economic Zone

Type of Industries	Examples
Agro based industries	Jute, maize, spices, fruit and pulp, mustard oil , rice
SMEs in Jamalpur district	Soft drinks, handicrafts, fertilizers, ceramics, garments
Medical accessories & equipment sector and pharmaceutical sector	Medical equiepments, medical accessories, pharmaceutical
Cattle based industries	Leather, milk, meet
Logistics	Cold storage, warehouses, packaging

3.2 Project Objective

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

BEZA is the only responsible agency for establishment of EZs in all the potential areas of Bangladesh including the backward and undeveloped regions. The potentiality for development of EZs areas identification 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. 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 physical, economic, and social development of JEZ are based upon the following planning and development objectives.

- To provide adequate light, air and open space for all investors;
- To ensure safety from fire, flood, panic, and other natural and man-made disasters;
- Preservation, conservation and development of areas of natural scenery and landscape;
- To ensure that development within EZ does not conflict with any development regulation;
- To encourage energy efficient site designs;
- Maintenance of highest standards of environmental planning;
- Protection of natural resources and environmental assets through land use and development regulations.

To achieve these objectives, a series of key guiding principles have been adopted for JEZ.

3.3 Project Options

The initiative of the GoB for establishing economic zones in all potential areas including backward and underdeveloped regions, and the development, operation, management and control has been taken with a view to encourage rapid economic development through increase and diversification of industry, employment, production and export. These areas has been identified considering factors such as land use, land ownership, accessibility and connectivity, linkage to economically important towns/cities, infrastructure availability and engineering, environmental and social feasibility of the site. Drawing from numerous successful examples from around the world as well as Bangladesh's own positive experience with the EPZ model, GoB has launch an effort to develop a new EZ paradigm for Bangladesh based on good economic and social practices in their operation and commercial principles in their development and management. In doing so, the GoB is seeking to leverage its own resources through public-private partnership regarding the financing, developing, management and supervision of EZs.

The proposed Project site (443 acres) identified for the upcoming JEZ is a continuous section of land. This is private land and flat land without habitations. The proposed land site does not lie within any City Corporation and Cantonment Board Area as per requirement of sub-section 3 of section 5 of Economic Zone Act, 2010.

A site suitability analysis was carried out for the development of EZ for assessing environment and social feasibility of the proposed project. As per the analysis, both limitations and benefits are associated with the land for developing EZ at the

proposed site location. However, identified weakness and threats can be overcome by adopting alternative technologies and preventive measures.

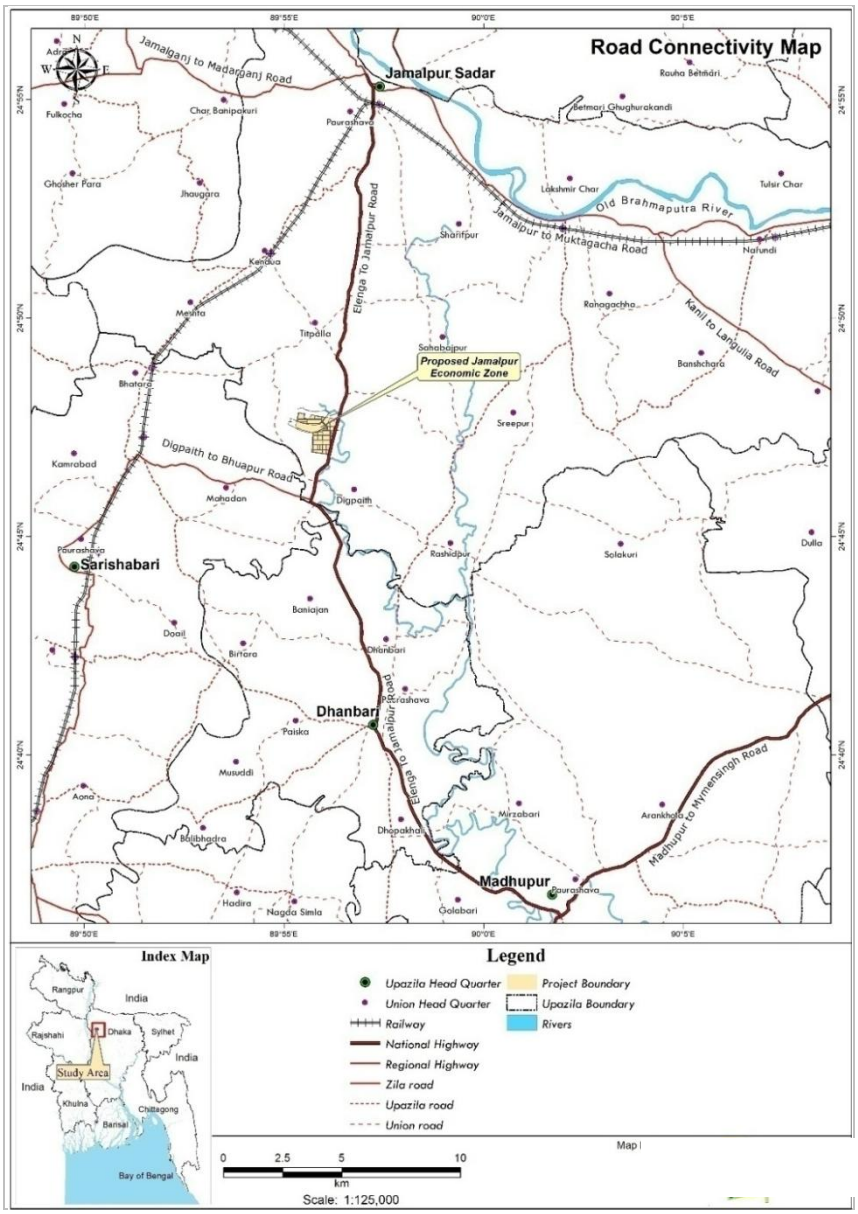
Identified strength and weakness of the site as carried out by BEZA, EZ proponent and Consultants are given in the table below.

Table 3.2: Strength and weakness of site

Parameters	Strength	Weakness
Location, Contiguity & surroundings	– Land area measuring 443 acres is available and sufficient for development of EZ. – Does not lies within any City Corporation, DAP, and Cantonment Board Area as per requirement of sub-section 3 of section 5 of Economic Zone Act, 2010. – Site is well connected by Joydevpur-Tangail-Jamalpur Highway. – Availability of power, gas, IT supports, and fresh water in the area. – Site is not surrounded by large habitations. – Education, medical and transport facilities are available.	– Requirement of construction of dikes/boundary wall to protect EZ site for security purpose.
Accessibility	– Joydevpur-Tangail-Jamalpur Highway is adjacent to the project location – Shahjalal International Airport is at distance of 178 km – Bausi Bazar Railway Station is at distance of 11 km and Jamalpur SadarRailway Station is at distance of 15 km	– Distance from Chittagong port is436km. – No access of waterway
Proximity to urban hubs & industrial areas	– Administrative offices of Jamalpur Sadar is at distance of app. 17 km – No major industrial area exists close to EZ site thus insignificant competition is expected.	– Insufficient Cargo handling facilities by water transport. – Air shipment of Cargo facilities is virtually absent.
Available Infrastructure Facility	– Abuts highway thus ease of goods transportation through road. – Digpait market is 6 km, Bausi Bazar is 11km and Dhanbari Bazar is 15 km from the project area. – Availability of gas supply through pipelines of Titas Gas field. – Setting up of all infrastructure	– No fire service and police station within 3 km of the Project site

Parameters	Strength	Weakness
	facilities will induce setting up of new townships and other developments.	
Availability of Raw Material	– Raw materials will be imported. – Large nos. of unskilled and semi-skilled industrial labor available.	– Shortage of skilled labor. – Lack of available raw materials locally.
Eco-sensitivity and threat to bio-diversity	– No significant flora and fauna within development area. – No eco-sensitivity associated with the site.	– Industries, if discharge waste/effluent, it may disturbs the aquatic ecosystem of that water body of Bamui Beel and Bangshi River.
Quality of life & Employment generation	– Creation of direct and indirect jobs for skilled, semi-skilled and un-skilled labor. – Enhanced infrastructure facilities. – Developments in nearby area after development of EZ.	– Unavailability of adequate skilled labor. – Adequate environment management plan is to be prepared to prevent damage of environment and the health of the residents in nearby area due to discharge of effluents/gases from EZ site

Figure 3.1: Road connectivity map



3.4 Interventions under Selected Options and Project Activities

Site is adjacent to Joydevpur-Tangail-Jamalpur at Jamalpur Sadar Upazila and selected for the development of economic zone. JEZ will develop the on-site facilities for the EZ site so as to provide ready to develop land and attract developers for development of EZ. EZ will be developed by developer in later stages. Off-site facilities will be developed by different government agencies. On-site facilities to be carried out by JEZ at site are listed below-

- Site preparation & development
- Administration Building
- Boundary Wall

Existing Infrastructure in and around the Project Site

JEZ is proposed to be located in six villages named- Raghunathpur Dighuli, Haridrahata, Gandail, Joanerpara, Sonita and Sultan Nagar of Jamalpur Sadar Upazila under Jamalpur District. Project site is flat land and 7-12 ft lower than the adjacent Joydevpur-Tangail-Jamalpur Highway. Details of immediate surroundings of EZ site is given in following table and figure.

At present there are mainly agricultural lands. Total site area is approx. 443 acres (approx. 9.6 acre to be acquired and approx. 100 of waterbody). The site is found as undeveloped land for industrial development and agricultural land. Land filling is required for zone development. Map showing EZ sites and existing facilities in nearby are is given in figure below-

Table 3.3: Existing features surrounding the project site

Side	Boundary Points	Coordinate	Object	Distance
North	Corner 01 & Corner 02	La-24°47'50.40"N Lo-89°55'21.17"E& La-24°47'37.70"N Lo-89°56'20.18"E	Homestead area	Adjacent to EZ
South	Corner 04& Corner 05	La-24°46'56.70"N Lo-89°55'41.14"E& La-24°46'53.05"N Lo-89°56'7.81"E	Paddy land	Adjacent to EZ
East	Corner 02 & Corner 05	La-24°47'37.70"N Lo-89°56'20.18"E& La-24°46'53.05"N Lo-89°56'7.81"E	Homestead area and Joydevpur-Tangail-Jamalpur Highway	Adjacent to EZ
West	Corner 01, Corner 03& Corner 04	La-24°47'50.40"N Lo-89°55'21.17"E; La-24°47'30.30"N Lo-89°55'16.56"E& La-24°46'56.70"N Lo-89°55'41.14"E	Paddy land	Adjacent to EZ

Figure 3.2: Boundary map of the project area

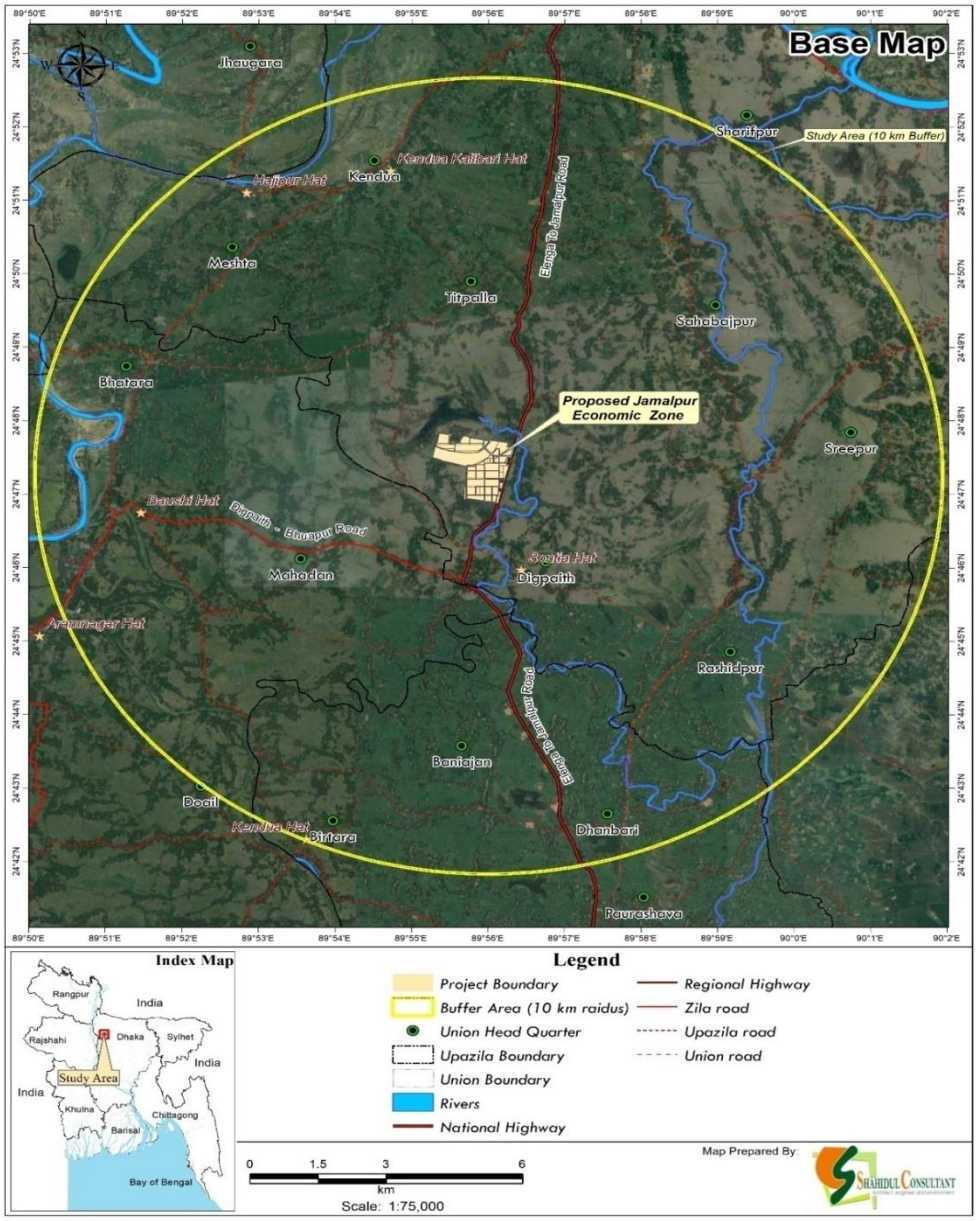
Figure 3.3: Photographs of the project site and surrounding area

Proposed EZ site

Existing road for the EZ

Surrounding area of EZ

Figure 3.4:10 km Map showing location of site and existing facilities



3.5 Project Activities

Area of the site considered for development is 443 acres. At present only on-site developments will be carried out by JEZ. Details of on-site facilities are given in table below-

Table 3.4: Details of on-site facilities

SN	Proposed Infrastructure	Details
1	Administration building	Administration building will be constructed within EZ site.
2	Site preparation and land development	Site is flat land. The site will be developed and land filling will be done by BEZA.
3	Boundary Wall	A compound wall all along the EZ boundary to a height of 12 feet above NGL is proposed to be constructed and provided with 3 feet height barbed wire fencing on top as per BEZA rule.

3.6 Project Schedule

The proposed construction time for established JEZ is 3 years. The following table presents the implementation schedule of the project infrastructure at the proposed JEZ.

Table 3.5: Proposed schedule for JEZ development

Activity	Starting Date	Ending Date
Start of Construction period	1st April. 2017	31st March, 2020
Start of Revenue from the Industrial tenants	1st April, 2020	Continue
Start of debt repayment	1st April, 2020	1st April, 2027

3.7 Resources and Utilities

Proposed project requires different utilities such as- power supply, gas supply, water distribution and storage, waste water treatment, fire station etc. Description of utilities is given below:

Water Supply

Water demand for construction and operation work will be fulfill from municipal water, ground water and beel water. Collected water will be store in tanks after treatment. The nearest location viable for tapping water from for river shall be 35 to 14 km from site. JEZ would require creating pumping stations at intervals of 8 to 10 km and providing selling tank to remove silt.

Power Supply

Jamalpur Palli Bidyut Samity shall be responsible for providing power supply in JEZ. Government will install an 11 kV substation inside the economic zone to provide

uninterrupted power supply to the industries. Power requirement during construction work is less than 1 MW, which will provide from exciting distribution network within 3 months of project start.

Further power supply requirement shall arise when operation phase starts. The authority will develop a 15 MW power supply line from Sarishabari sub-station within 6 months. Apart from this, a 6 MW power supply line within 1 year. Depending on the upgradation of the operation activities, a dedicated line of 30 MW will be constructed within 2 years connecting from the switching station in Beltia.

Gas Supply

A gas station will be installed inside the economic zone. 'Titas Gas Transmission and Distribution Company' will be in charge for gas connection to the EZ. Nearest available alternatives in site vicinity are Jamalpur Sadar Gas substation and Faizal More Gas substation.

Sewage & Effluent Treatment Plant

All industries should be responsible for treatment of the sewage and effluent generated from their units so that all industries are zero discharges. Sewage should be treated in the central STP and effluent should be treated in the ETP/CETP. Treated water should be recycled and re-used within the site.

Wastewater generated from toilets is considered as sewage and wastewater generated from bath/shower, laundry, hand basin and kitchen is considered as grey water.2 numbers of sewage treatment plant with 2 MLD capacity will be install inside the zone. Sequential batch reactor (SBR) treatment system will be consider for waste water treatment.

It is presumed that each industry will treat their effluent into sewage standards prior to discharge into the sewerage network. It is proposed to collect treated effluent, sewage & sludge through a single collection network. Sewerage network will be established by the Project implementation company considering the topography of the site.

Green Belt Development

Green buffer of 10m width will be developed all around the EZ site. Multi-layered plantation will be carried out in the buffer. Peripheral green belt will be developed by the developer. In addition to this all industries will develop green belt all around their respective plots. Native plant species consuming less water and requiring less after care and monitoring should be considered. Such species include Neem, Chambol, Sirish, Palms, Mango, Mahagony etc. Green buffer should consist of minimum 3 rows of vegetation. First row of green buffer should be small shrubs and herbs, second row of tall shrubs and small/medium height trees and last row of medium to tall heighted trees. 5% area of total area will be consider as green area (park and open spaces) during planning of economic zone.

Storm Water Management System

Rain water harvesting system shall be developed at EZ site to harvest and store rain water. Rain water shall be used to fulfill the water requirement during construction and operation phase of the Project. Water body shall be maintained in its existing condition thereby maintaining the existing drainage pattern of the area.

Drainage Network and Solid Waste Management System

Drainage system is no well-developed in the project area. It is necessary to develop a planned design for drainage network to reduce water logging and discharge of treated waste water. Solid waste will be manage by individual industries and finally dumped in the selected site for solid waste management of economic zone. So, it is important to develop a solid waste management site inside the economic zone.

Road Network

Primary and secondary Roads are planned to give access to the industries within the EZ. A proper hierarchy of roads has been proposed to ensure smooth traffic inside the zone considering reduced lead time and minimize land taken by major and minor roads. The main roads will be 25 m wide.

Highest priority has been provided in suggesting paths for pedestrian. Since the employees are going to move within the zone mostly on foot, it is essential that they have safe passage. Aesthetically designed walkways are designed along with green environment on either side of the roads. Pedestrian walkways are to be provided on all categories of roads. All services for drains, sewers, water, power, energy and telecom are maintained within the road right of way.

Necessary signage, street name boards, zone guiding maps and visitors guidance map etc. are planned to be positioned at necessary locations, such as intersections and at various strategic locations in each zone. No access is planned to be allowed near the road junctions and it is recommended that ingress / egress points will be with a set back from the road junction.

3.8 Map and Survey Information

Project Location

Jamalpur EZ is proposed to be located in Jamalpur Sadar Upazila of Jamalpur District. Project location map and mouza map is shown in the following figures.

Figure 3.5: Location map of the project site

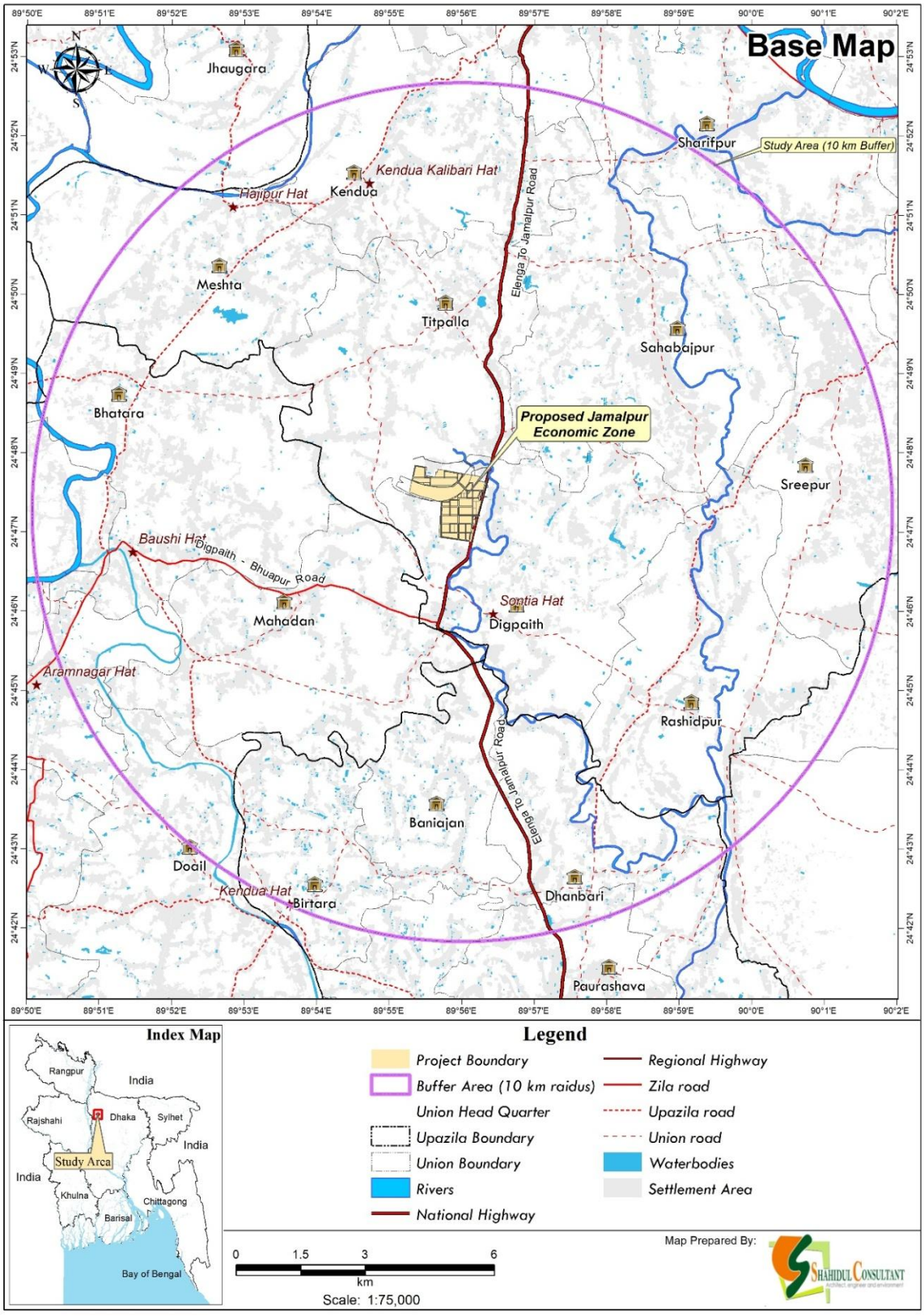
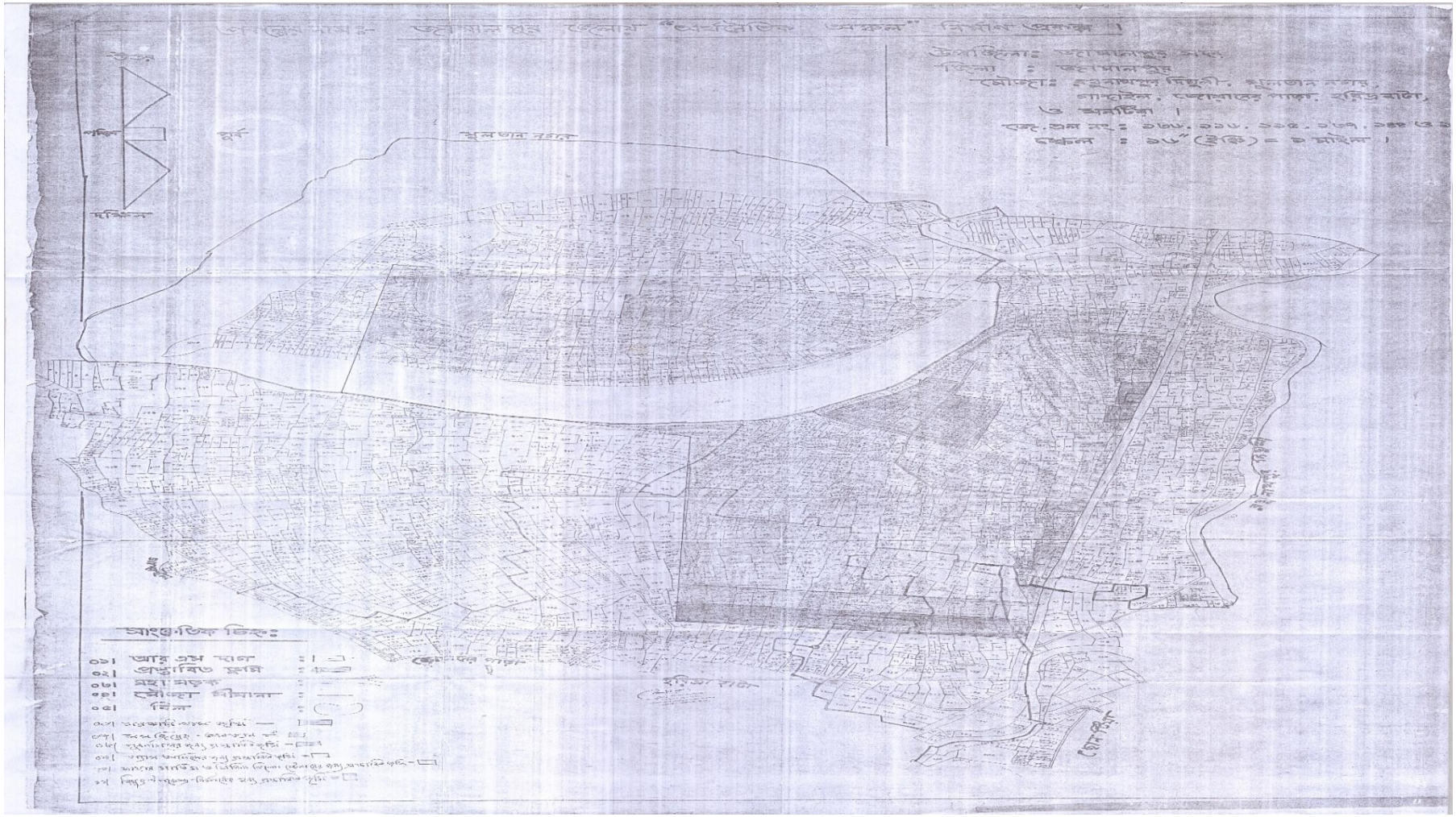


Figure 3.6: Mouza map of project area



3.9 Planning for EZ Development

Depending on the rehabilitation location of the existing village, slight variation in the master plan is anticipated during feasibility study. Based on rehabilitation location, three alternative plan was anticipated during feasibility study. Among them, master plan including rehabilitation to a plot near North-East corner of proposed project along with single owner-multiple tenants has been preferred as selected option.

Master Plan Layout map for EZ as per preliminary planning is attached in Annex-4.

Design and Master plan of the project

The overall concept focuses the vision for the development of the economic zone with the provision of world class facilities. It is important to develop the master plan to accommodate both the user industries area requirements and requirements of the various identified development components of the proposed EZ. The major features of JEZ master plan are:

- A fully fenced and secured facility with monitoring system and LED lighting.
- More than 65% area of the site is leasable.
- An EZ administration building, a customs building, a cargo/container parking area, a fire and police station and small scale convenience retail at the entrance of the site to support investors and tenants.
- Open space within the zone.
- Plot design includes flexibility, which allows a variety of building types (i.e. factories, warehouse, processing plans etc.).
- A road network with 25 meter wide main arterial for easy on and off site access and secondary roads throughout, to properly manage traffic and limit congestion. Landscaped sidewalk line the road network within the EZ.
- The site will have full range of quality utilities available to investors including consistent and stable electricity, water, drainage, wastewater and water supply treatment plants, a water retention pond and telecom. The site will also utilize an energy conservation system via a water retention pond for recycling water.
- The plan includes housing for the resettled households within the EZ.

Land Use Breakup

The suggested land distribution for JEZ in the master plan is:

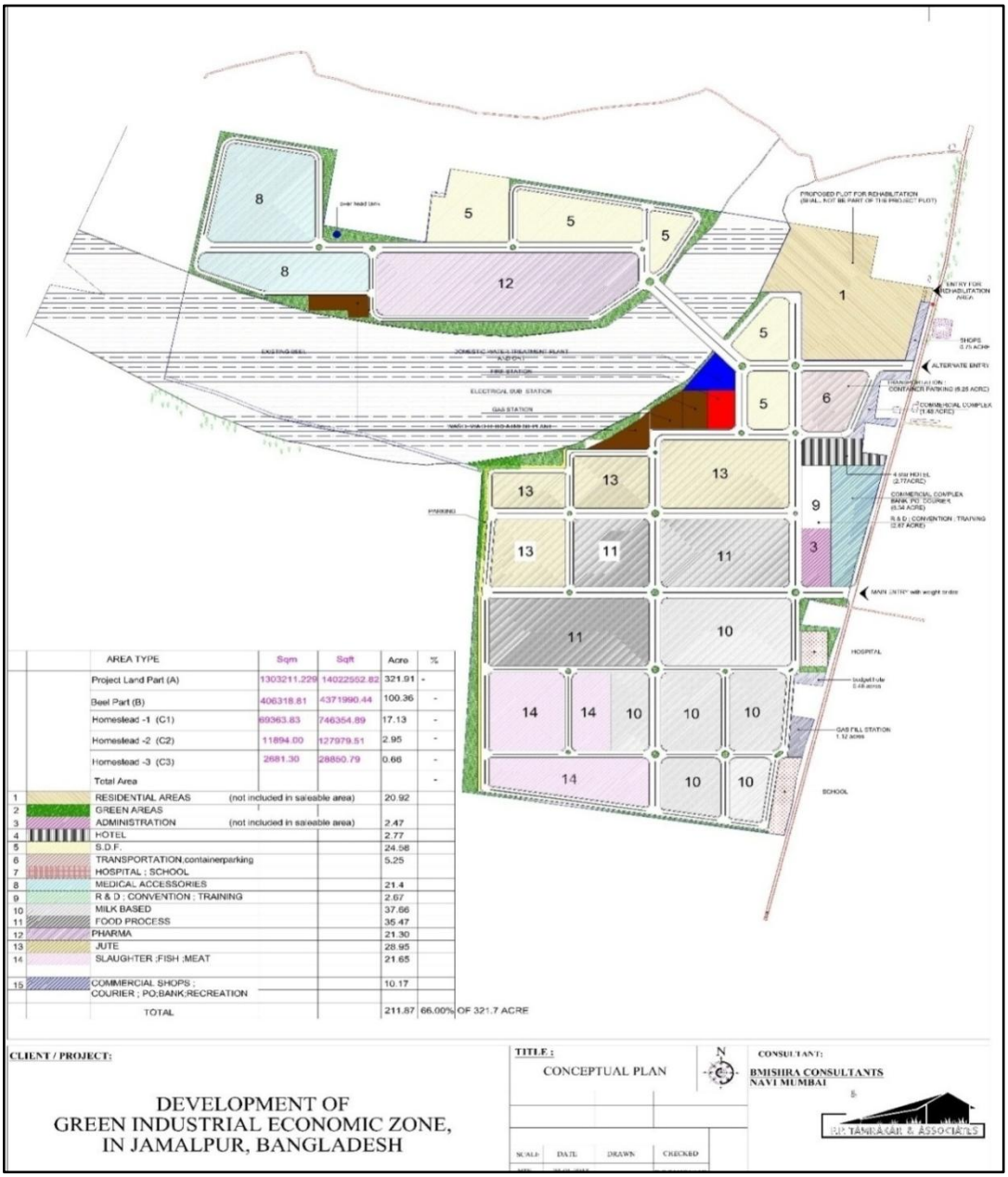
- Industrial plots: 65%
- Residential: 0%
- Parkes and open spaces: 5%
- Common infrastructure zones: 15%
- Roads and circulation: 15%
- Total site area: 100%

The industrial plots will be allotted for industries. Common infrastructures include environmental infrastructures, social infrastructures and relevant technical

infrastructures. Roads and transport area includes road, parking area, pedestrian pathway bicycle tracks etc.

Master plan of the project is given below:

Figure 3.7: Master plan and design of JEZ



3.10 Cost Estimation

The estimated project cost for the project development is BDT 209.88 core which is excluding cost of land acquisition, rehabilitation & resettlement, land filling, retaining wall with water body protection. The estimated cost for project development has been provided in the following table.

Table 3.6: Estimated cost for project without IDC

	Particulars of item	Million BT
	Responsibilities of the Private Partner	
1	Road and internal network	563.28
2	Drainage piping and waste water treatment plants	276.79
3	Domestic water piping and tanks for storage	103.19
4	Storm water drainage	71.08
5	Administrative building and associated construction work	90.00
6	Bridge	550.00
7	Green area with plantation	10.00
8	Site boundary: 2 m above the fill level	144.00
9	Fire fighting	70.00
10	Electrification - street lighting and power distribution	75.00
11	Gas distribution network	37.98
	Total direct project cost to developer in BDT million (a)	1,991.32
	Contingencies @ 5%	99.57
	Total cost including contingencies	2,090.88

Responsibilities of Contracting Authority:

- Rehabilitation (also resettlement if it is decided at a later stage)
- Land filling
- Retaining wall with water body protection
- Site boundary (only as required for land filling as retaining wall)

The Total Project Cost (TPC) that includes IDC and financial overheads. TPC and its phasing are presented below:

Table 3.7: Total Project Cost (TPC)

Capex phasing (BDT Crore	Total cost	Y-1	Y-2	Y-3
% capex phasing		25%	45%	30%
Total development cost	**210**	52.50	94.50	63.00
Escalation	**22.2**	2.6	9.7	9.99
Preliminary expenses	**3.5**	0.9	1.57	1.05
Contingencies		-	-	-
Financing fees	**3.5**	0.9	1.57	1 .05
Total project cost (excl. IDC)	**239.2**	56.86	107.32	75.02
Upfront payment	**20**	5	7.5	10
IDC	**20.56**	100	6.2	13.40
Total project cost (incl. IDC)	**279.98**	62.84	120.99	95.94

4 Environmental and Social Baseline

The environmental and social baseline is the existing status of environment and society around the proposed project site. It has been analyzed through assessment of environmental components like air, water, land, noise, soil, etc. and environmental characteristics like physical, biological and socio-economic status of the study area, within the 10 km radial zone of the project site. Physical environment includes topography, land, soil, meteorology, air, water, noise, etc. and the biological environment includes flora and fauna. Socio-economic environment of the study area includes demography, ethnicity, religion, education and employment opportunity, occupation, income, poverty, social relations, etc. Baseline environmental conditions are based on the data collected from various related agencies and the secondary documents from published sources and websites. The baseline provides the basis for assessment of impact (potential changes in the baseline conditions) due to the development of proposed Jamalpur Economic Zone. Mainly, the project area falls under Jamalpur Sadar Upazila of Jamalpur District.

The Table given below and the following figures illustrate the proposed project location and summary of various environmental settings considering 10 km radius zone, respectively.

Table 4.1: Existing environmental settings of the study area

Particulars	Details
Location	Jamalpur Sadar Upazila of Jamalpur District.
Total Area	443 acres.
Site Elevation	Around 17 m from MSL
Land Type	Medium land
Major Soil Type	Dark Grey Floodplain soil
Major crops	Paddy, vegetables.
Major Physiographic Units	Old Brahmaputra Flood Plain
Flooding	Tidal flood prone area.
Seismicity	Falls in the earthquake Zone-III
Nearest Airport	Proposed EZ is located at a distance of 178 km (approx.) from Shahjalal International Airport.
Nearest Railway Station	Bausi Bazar Railway Station is at distance of 11 km and Jamalpur Sadar Railway Station is at distance of 15 km
Nearest Port	Proposed EZ is located at a distance of approx. 436km from Chattogram port.
Climatic conditions	The annual average temperature of this district varies from maximum 33.3°C to minimum 12°C.Annual average rainfall is 2174 mm.

Particulars	Details
Ecologically Critical Area	No ecologically critical areas were found within 10 km radius of the project.
Environment and Social Hotspots	Beels, homestead, vegetation, agricultural land, school, mosqueetc.
Existing structure within the project area	106 household, 1 retail kiosk (temporary structure), 2 mosque and one club (temporary structure)
Major Settlement	Residential area.
Forests / National Parks	None within 10 km radius of the project.
Archaeological Site	None within 10 km radius of the project.
Major Waterbody	Bamui Beel, Bangshi River, ponds.

Source: Google Earth, BBS District Statistics of Jamalpur Sadar, 2011 & Site Visits

Figure 4.1: Location map of the project site

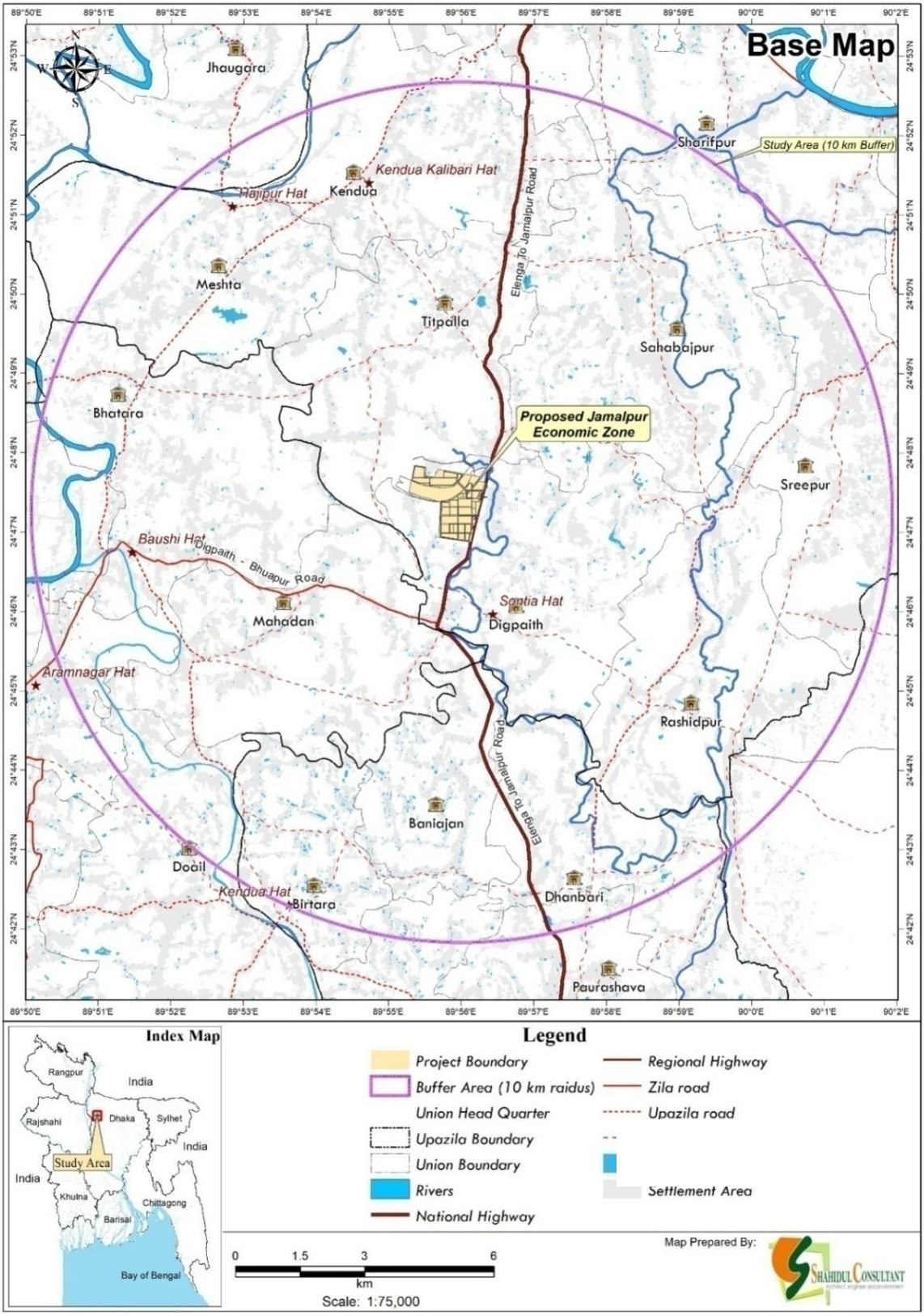
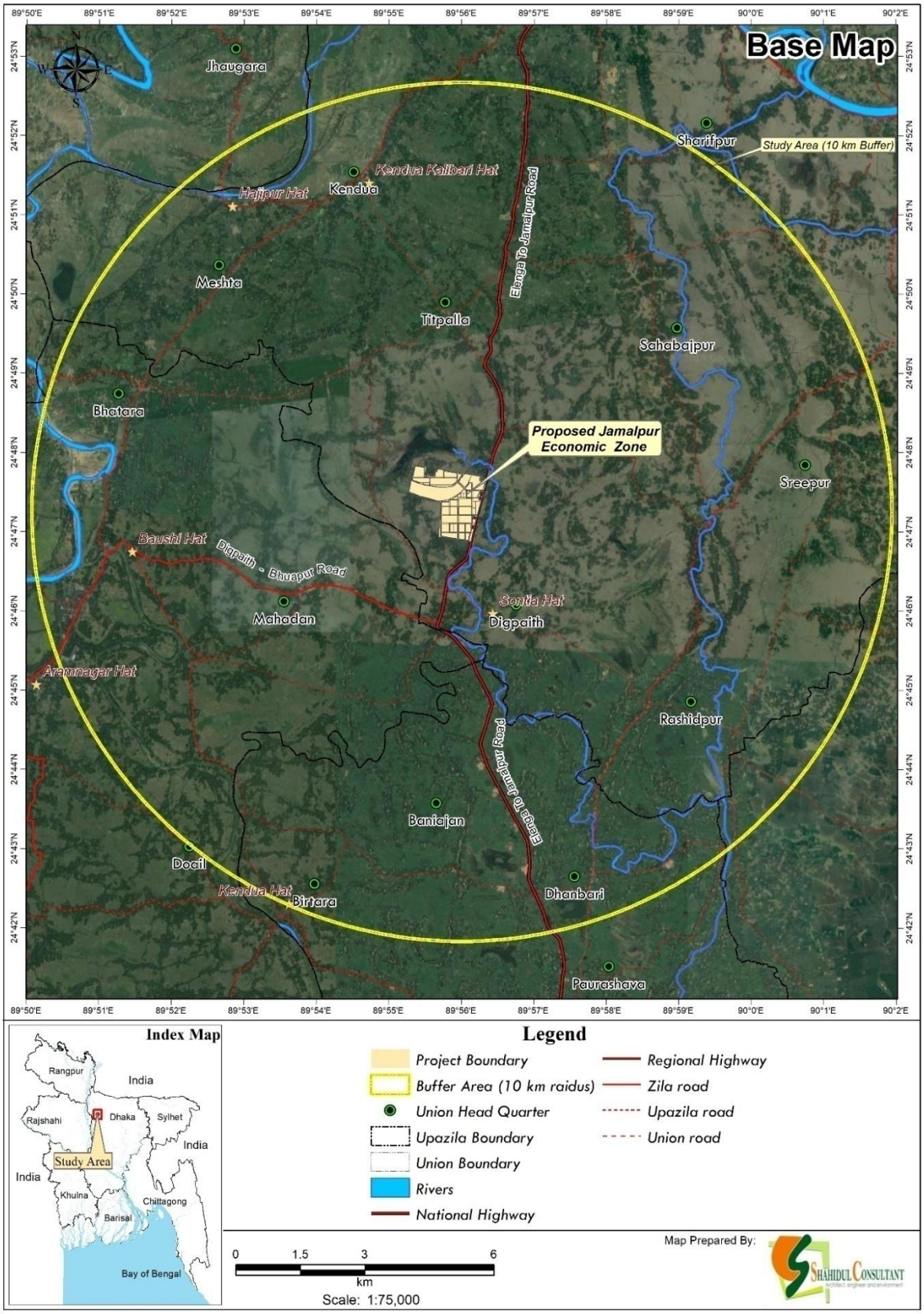


Figure 4.2: Objects within 10 km radius of the project site

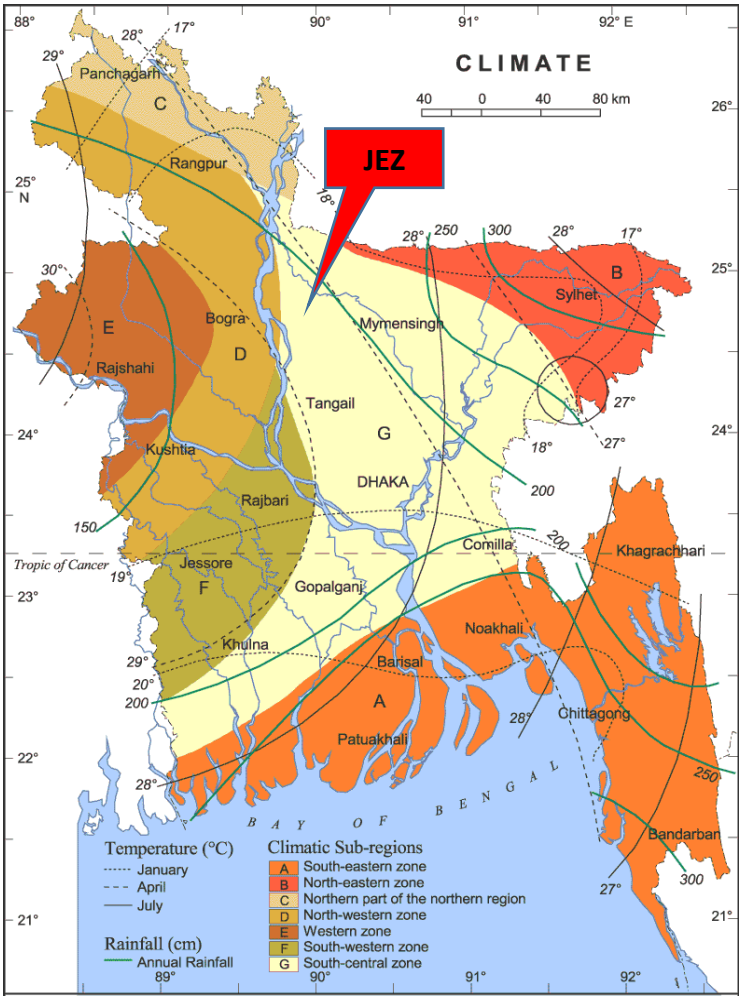


4.1 Meteorology

Bangladesh is located in the tropical monsoon region and its climate is characterized by high temperature, heavy rainfall, often excessive humidity and fairly marked seasonal variations. From the climatic point of view, three distinct seasons can be recognized in Bangladesh- the cool dry season from November to February, the pre-monsoon hot season from March to May and the rainy monsoon season which lasts from June to September. January is the coolest month with temperature averaging near 26^0C and April is the warmest with temperatures from 33 to 36^0C. Most places receive more than 1525 mm rainfall in a year and areas near the hills receive 5080 mm. Most rain occurs during the monsoon (June-September) and little in winter (November-February). Moderate rains are also reported in months of March, April and October.

The climatic sub-regions of Bangladesh are presented in the following Figure and as per that, the Jamalpur Sadar Upazila falls in climatic sub-region namely South-Central Zone. The nearest meteorological station of Bangladesh Meteorological Department (BMD) is at Mymensingh and Tangail. The climatic conditions as recorded at Mymensingh and Tangail are therefore considered applicable for the proposed JEZ. To assess the climatic conditions of the area, climatology data has been collected from BMD.

Figure 4.3: Climatic sub-regions of Bangladesh indicating JEZ



Source: www.thebangladesh.net

4.2 Temperature

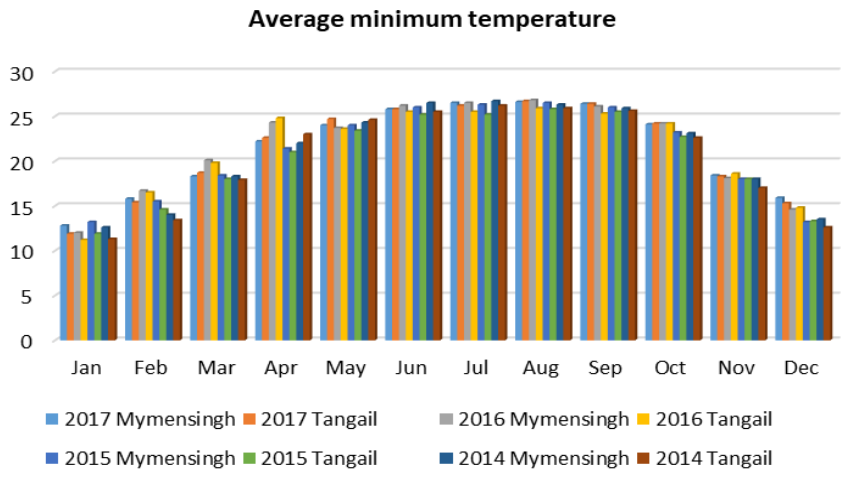
The period from February to April is marked by continuous increase in the temperatures. April is the hottest month of the year. The annual average temperature varies from maximum to 36.5°C and minimum 10.0°C, respectively. With the onset of monsoon by mid-May, the temperatures descend slightly. January is the coolest month of the year. The monthly variation of normal maximum and minimum temperatures of the project area from two stations has been given in the Table and figure given below.

Table 4.2: Average minimum and maximum temperature of two stations for last five years

Year	Stations	Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average minimum temperature													
2018	Mymensingh	11.7	16.6	20.2	21.5	23.2	25.8	26.7	26.9	26.0	22.7	-	-
	Tangail	**10.0**	15.5	30.1	21.8	23.3	25.9	26.5	26.9	26.0	22.8	-	-
2017	Mymensingh	12.8	15.8	18.3	22.2	24.0	25.8	26.5	26.6	26.4	24.1	18.4	15.9
	Tangail	11.9	15.4	18.7	22.6	24.7	25.8	26.2	26.7	26.4	24.2	18.3	15.3
2016	Mymensingh	12.0	16.7	20.1	24.3	23.7	26.2	26.5	26.8	26.1	24.2	18.1	14.6
	Tangail	11.2	16.5	19.8	24.8	23.6	25.5	25.5	25.9	25.3	24.2	18.6	14.8
2015	Mymensingh	13.2	15.5	18.4	21.4	24.0	26.0	26.3	26.5	26.0	23.2	18.0	13.2
	Tangail	11.9	14.6	18.0	21.0	23.4	25.2	25.2	25.8	25.5	22.7	18.0	13.3
2014	Mymensingh	12.6	14.0	18.3	22.0	24.3	26.5	26.7	26.3	25.9	23.1	18.0	13.5
	Tangail	11.3	13.4	17.9	23.0	24.6	25.5	26.2	25.9	25.6	22.6	17.0	12.6
Average maximum temperature													
2018	Mymensingh	22.7	27.2	31.2	30.4	30.3	33.6	31.8	32.7	32.7	30.9	-	-
	Tangail	23.2	28.6	32.8	32.0	31.6	34.2	32.6	33.4	33.6	31.5	-	-
2017	Mymensingh	19.4	22.1	23.2	26.3	28.4	28.9	29.1	29.4	29.4	27.8	24.1	21.4
	Tangail	18.9	22.3	24.5	27.8	29.6	29.6	29.4	30.0	30.1	28.4	24.2	20.9
2016	Mymensingh	23.7	27.8	31.0	32.4	32.0	32.7	31.7	33.2	32.0	32.4	29.5	27.5
	Tangail	24.4	29.2	32.8	35.4	33.8	33.8	32.5	33.6	33.2	33.2	30.0	27.3
2015	Mymensingh	24.2	26.8	30.5	30.5	32.1	31.5	31.9	31.7	32.4	32.4	29.9	25.3
	Tangail	24.2	27.9	31.8	32.5	34.0	32.8	32.4	32.6	33.4	32.8	30.4	25.3
2014	Mymensingh	24.2	25.6	30.5	33.5	33.1	32.3	32.4	31.7	31.9	31.7	29.8	24.6
	Tangail	23.4	26.2	32.1	**36.5**	35.3	33.3	32.9	32.6	33.1	32.2	30.1	24.1

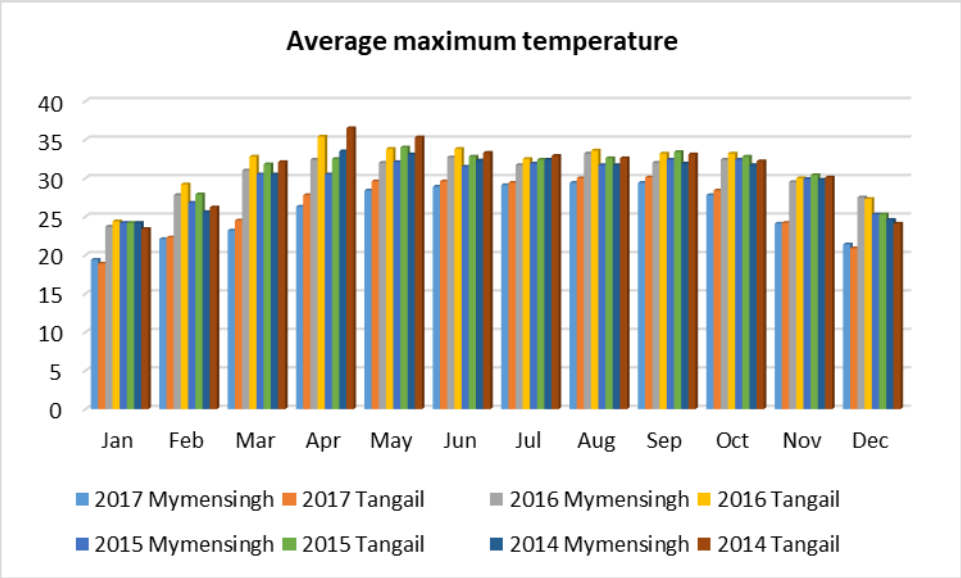
Source: BBS Yearbook of Agricultural Statistics, 2017 and Statistical Bulletin (February, 2018- October, 2018)

Figure 4.4: Average minimum temperature for two stations



Source: BBS Yearbook of Agricultural Statistics, 2017 and Statistical Bulletin (February, 2018- October, 2018)

Figure 4.5: Average maximum temperature for two stations



Source: BBS Yearbook of Agricultural Statistics, 2017 and Statistical Bulletin (February, 2018- October, 2018)

4.2.1 Humidity

Due to heavy rainfall and proximity to Bay of Bengal, the humidity levels in Bangladesh remains high. Annual average relative humidity in the project area is around 77-81%. Humidity fluctuations are stable every year in both areas in view of seasonal humidity change. The difference in the average humidity between respective months is rather small. The monthly variation of humidity patterns from Mymensingh and Tangail station has been given in Table below.

Table 4.3: Monthly variation of relative humidity of two stations for last five years

Year	Month / Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
2018	Mymensingh	86	86	75	78	81	81	82	8	82	83	-	-	-
	Tangail	84	84	66	72	77	77	81	80	79	78	-	-	-
2017	Mymensingh	76	73	78	81	80	84	86	86	87	85	81	84	81
	Tangail	77	70	72	76	77	83	86	84	84	83	79	83	79
2016	Mymensingh	84	79	75	81	80	83	86	80	87	83	81	80	81
	Tangail	79	74	69	75	75	79	85	81	84	81	77	82	78
2015	Mymensingh	82	78	74	80	80	85	84	87	85	82	81	81	81
	Tangail	81	75	66	76	76	82	83	85	80	80	77	80	78
2014	Mymensingh	82	76	72	73	79	84	84	87	86	83	81	86	81
	Tangail	83	75	65	63	74	82	84	84	82	79	78	85	77

Source: BBS Yearbook of Agricultural Statistics, 2017 and Statistical Bulletin (February, 2018- October, 2018)

4.2.2 Rainfall

About 80% of the precipitation occurs during five monsoon months (May to September). Minimum precipitations are recorded during the month of November to

February whereas average showering does occur in March, April and October. The monthly total rainfall variation and annual rainfall variation in different years has been given in Table **4.4**&Table **4.5**.

Table 4.4: Monthly total rainfall in Mymensingh and Tangail station

Year	Stations	Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2018	Mymensingh	0	10	36	230	624	361	332	172	202	77	-	-
	Tangail	0	40	42	248	303	196	299	258	144	122	-	-
2017	Mymensingh	0	0	164	319	316	530	368	436	309	341	25	34
	Tangail	0	1	61	256	242	227	503	469	290	376	17	46
2016	Mymensingh	19	8	47	111	326	391	518	106	409	32	1	0
	Tangail	8	15	26	45	182	126	359	101	141	124	4	0
2015	Mymensingh	15	19	1	203	212	502	329	413	308	78	4	0
	Tangail	0	8	14	253	158	498	408	318	185	26	0	3
2014	Mymensingh	-	42	24	78	160	342	303	559	410	16	-	-
	Tangail	-	24	24	47	127	585	239	234	320	41	-	-

Source: BBS Yearbook of Agricultural Statistics, 2017 and Statistical Bulletin (February, 2018- October, 2018)

Table 4.5: Annual rainfall for Mymensingh and Tangail station (2008-2017)

Year / Stations	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Mymensingh	2239	1662	2095	2147	1479	1739	1934	2084	1968	2842
Tangail	1856	1391	1750	1839	1469	1182	1641	1871	1131	2488

Source: BBS Yearbook of Agricultural Statistics, 2017

4.2.3 Evaporation

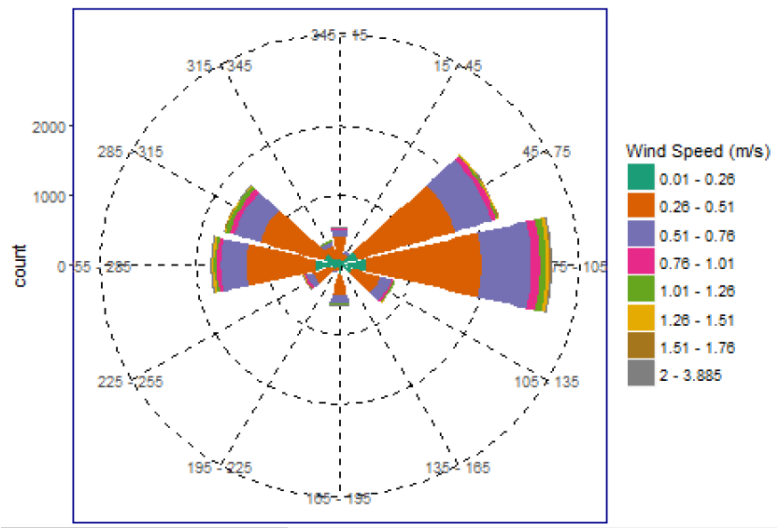
It is identified that in Bangladesh higher rate of evaporation occurs from the month of March to May and in April it is maximum. Minimum evaporation rate occurs in the month of December and January. Though temperature is not maximum in pre-monsoon but evaporation rate is high in this season because of less humidity and high radiation rate. In monsoon radiation rate is higher than dry period and humidity and temperature is maximum which makes the evaporation rate higher than dry period. Radiation is more influential over evaporation rate than humidity. On an average the total amount of yearly evaporation is 1317 mm in Bangladesh.[1] Proposes project is nearest to Dhaka.In Bangladesh, rainfall and trans-boundary river flows are the main sources of surface water. According to Banglapedia, Bangladesh has an average annual surface flow of approximately 1,073 million acre feet (MAF), of which about 870 MAF (93%) is received from India as inflow, and the remaining 203 MAF (7%) as rainfall. This magnitude of water is sufficient to cover the whole of Bangladesh to a depth of 9.14m. Approximately132 MAF (65% of rainfall and 12% of total) is lost in evaporation (114.30 cm) and the remainder, approximately 5million cubic feet (MCF) flows out to the Bay of Bengal that includes sediment load of 1.5-2.4 MCF.[2]

[1] file:///C:/Users/PC/Downloads/Full%20Thesis.pdf
[2] https://www.pgcb.org.bd/PGCB/upload/Notice/91.pdf

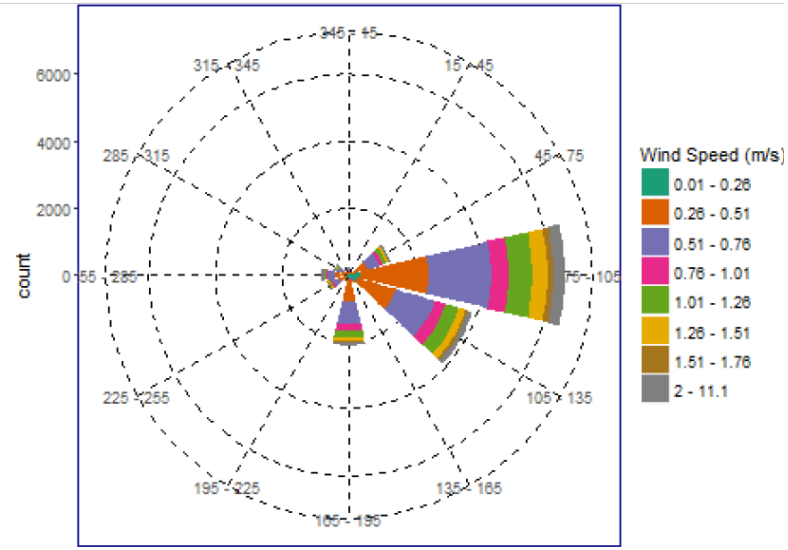
4.2.4 Wind Speed and Direction

Wind speed estimation is important for pollution dispersion. The direction of wind varies with seasonal changes. Therefore, a whole year has been divided into four seasons and each season is represented with one month for producing the wind rose diagrams (Figure given below). Wind speed data and direction have been collected for Mymenshing and Tangail station at a height of 10 m from the ground level.

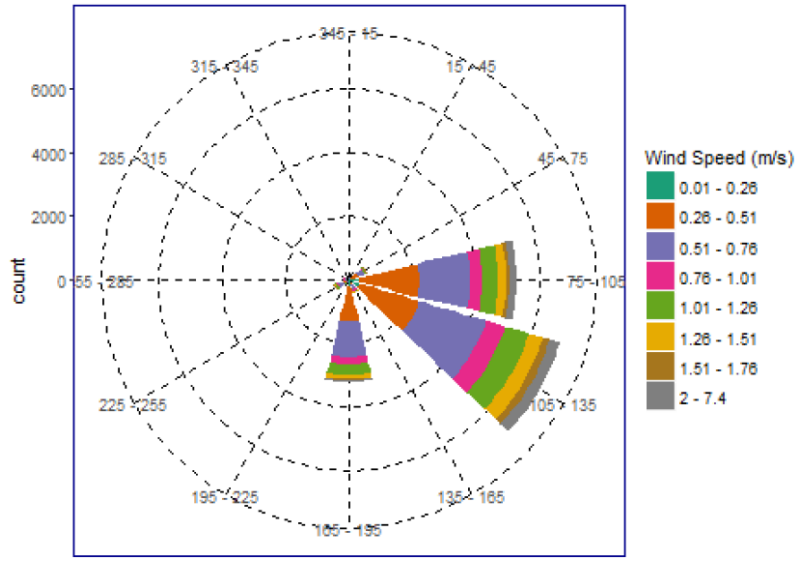
Figure 4.6 : Wind rose for selected stations

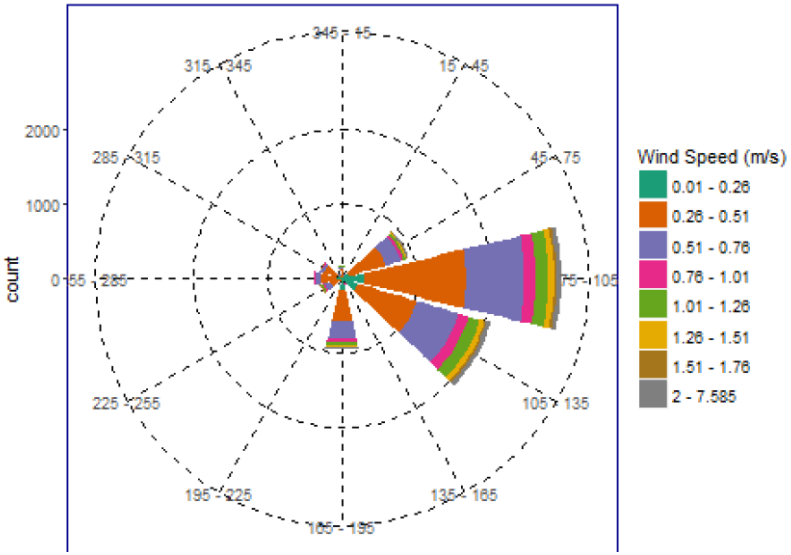


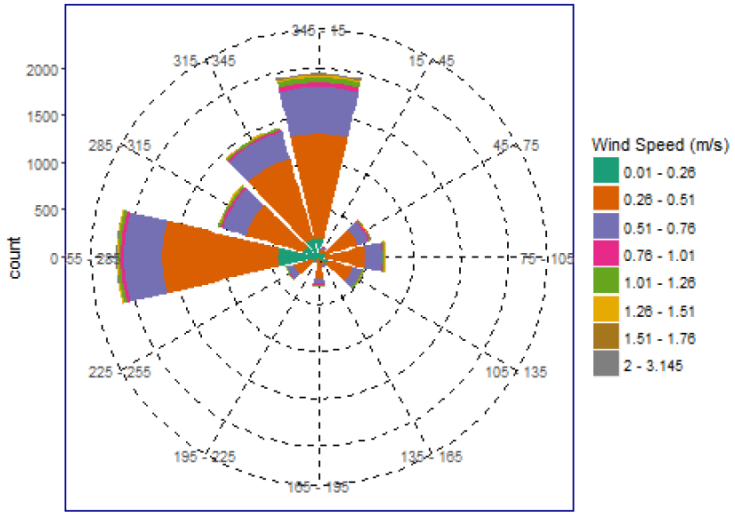
a: Wind rose diagram duringWinter at Mymensingh station



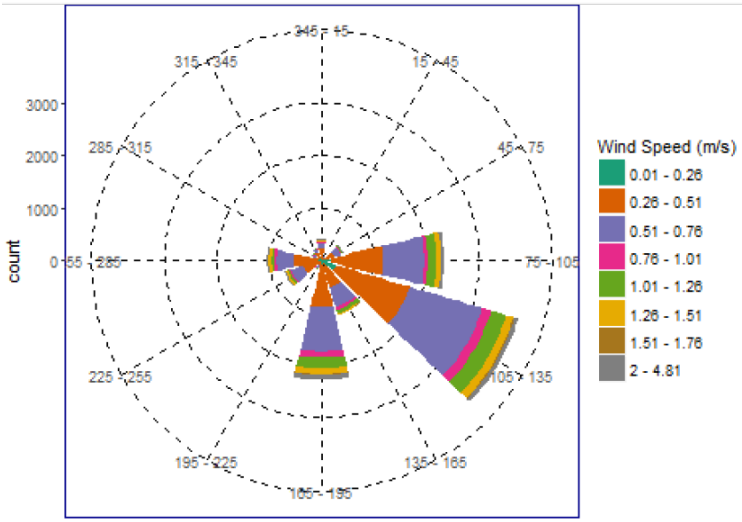
b: Wind rose diagram duringpre-monsoon at Mymensingh station



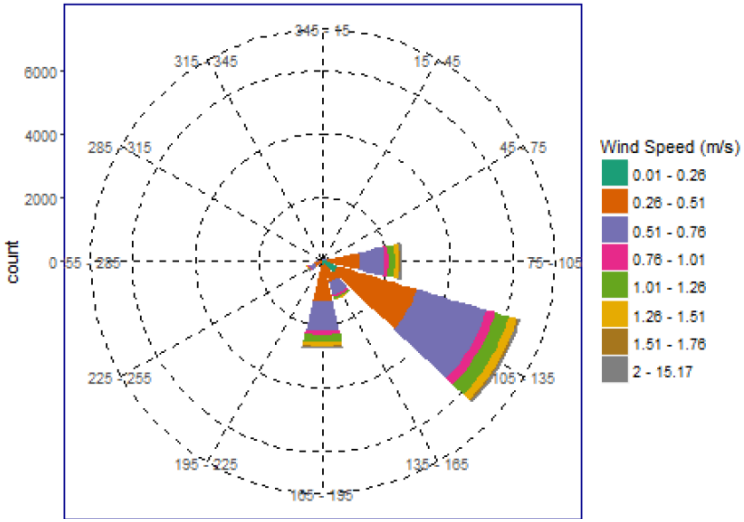




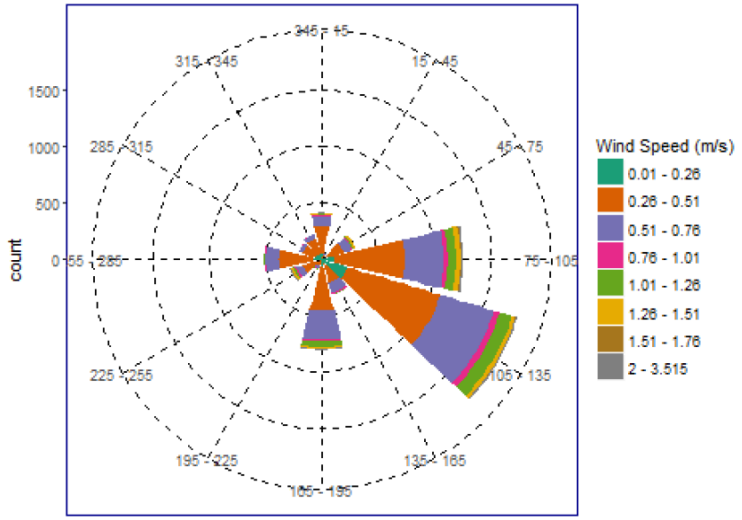
a: Wind rose diagram duringWinter at Tangail station



b: Wind rose diagram duringpre-monsoon at Tangail station



c: Wind rose diagram duringmonsoon at Tangail station



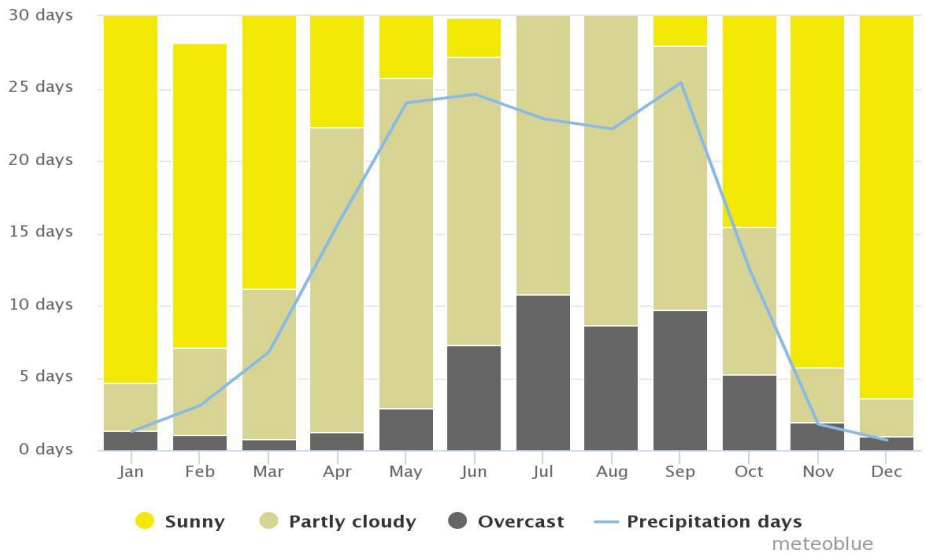
d: Wind rose diagram duringpost-monsoon at Tangail station

Source: BMD

4.2.5 Sunshine Hours

Sunshine duration or sunshine hours is a climatological indicator, measuring duration of sunshine in a given period (usually, a day or a year) for a given location on Earth; typically expressed as an averaged value over several years. It is a general indicator of cloudiness of a location, and thus differs from insolation, which measures the total energy delivered by sunlight over a given period. Sunshine duration is usually expressed in hours per year, or in (average) hours per day. In the project area, December is the sunniest, followed by January and November. July and August has the lowest amount of sunshine. The average monthly sunshine hours at the project has been given in the following figure.

Figure 4.7: Average monthly sunshine hours in the project area



Source: Meteoblue

4.3 Air Quality and Noise

4.3.1 Ambient Air Quality of the Project Site with Respect to Standards of ECR, 1997

To assess the present air quality of the area, one Ambient Air Quality Monitoring (AAQM) Stations were setup. The locations of the monitoring stations for air quality study were selected on the basis of meteorological data, topography, sensitive locations etc. Predominant wind direction during the season is from south and south east. Monitoring was conducted in respect of the following parameters:

- Total Suspended Particulate Matter (SPM)
- Sulphur Dioxide (SO_2)
- Nitrogen Oxides (NOx)
- Carbon monoxide

All the above-mentioned pollutants were monitored at the station. The equipment was placed at a height of 3 to 7 meters above ground level at the monitoring stations, thus

neglecting the effects of windblown ground dust and free from vertical obstructions within a cone of 120° from the actual position of the sampler, to avoid any impedance to the pollutants. The equipment was always placed at open space free from trees and vegetation which otherwise act as a sink of pollutants resulting in lower levels in monitoring results. The results were compared with respect to Standard of ECR, 1997 for industrial and mixed area. Summary of the monitored results are given below in the following Table.

Table 4.6: Air quality data measured at the project site.

Sample locations	Ambient air pollutants concentration µg/m^3			
	SPM	NO_x	SO_2	CO
South-West Corner	110	55	56	Nil
North-West Corner	105	58	61	Nil
South-East Corner	120	68	55	Nil
North-East Corner	127	71	60	Nil
Standard permissible limit (ECR, 1997)	200	80	80	2000
Methods of Analysis	Respirable Dust Sampler Envirotech. APM 460NL	Gaseous Sampling Attachment Envirotech. APM 411TE	Gaseous Sampling Attachment Envirotech. APM 411TE	Digital Instrument AE 14343 Taiwan

Source: Bangladesh Environ-Engineers and Lab Services Ltd.

4.3.2 Ambient Noise Level of the Project Site with Respect to Noise Pollution (Control) Rules, 2006

Sound is usually measured in decibels (dB). A decibel is a relative measure that is accompanied by a reference scale. Technically, sound pressure is 20 times the logarithm (base 10) of the ratio of the pressure level of any sound to the reference sound pressure in decibels. Sound (noise) levels can be measured and quantified in several ways. All of them use the logarithmic decibel (dB) scale. The dB scale is logarithmic to accommodate the wide range of sound intensities found in the environment. The ambient noise level of the project site has been described in the following Table.

Table 4.7: Noise Level in the Project Area

Location	Noise level dB(A)	BD Standard dB(A) (Noise Pollution (Control) Rules, 2006)
	Day	Day
South-West Corner	55	75
North-West Corner	65	

Location	Noise level dB(A)	BD Standard dB(A) (Noise Pollution (Control) Rules, 2006)
	Day	Day
South-East Corner	60	
North-East Corner	70	

Source: Bangladesh Environ-Engineers and Lab Services Ltd.

The nearby locations of the project site is used as agricultural land and residential area. Major sources of noise generations are wind and vehicular movement.

4.3.3 Air Pollutants and Noise Sources from Existing and Known Sources

Noise attenuation is typically described as a set reduction in decibel level per doubling of distance from the source. Depending on the nature of the noise source, sound propagates at different rates. Measures of sound level from a source should specify the distance from the source. The standard reference distance for sound levels at the source is 50 feet. Natural factors such as topography, vegetation, and temperature can further reduce noise over distance. The two most common types of noise are point source and line source. Point source noise is associated with noise that remains in one place for extended periods of time, such as with construction activities. Line source noise is generated by moving objects along a linear corridor. Highway traffic is the best example of line source noise. The standard reduction for point source noise is 6 dB per doubling of distance from the source while for a line source it is 3 dB per doubling of distance from the source.

Construction Noise: One of the easiest things to identify and one of the hardest things to quantify is noise associated with the actual construction of the project. How much noise construction activities will generate, how often will it occur, and how long will it last are all questions that should be answered in the assessment. Construction is usually performed in a series of steps or phases, and noise associated with different phases can vary greatly. However, similarities in noise sources allow typical construction equipment to be placed into one of three categories: heavy equipment, stationary equipment, or impact equipment.

Heavy equipment: Heavy equipment can be defined as earth-moving equipment, such as excavating machinery like excavators, backhoes, and front loaders, as well as handling equipment like graders, pavers, rollers, and dump trucks. Noise levels at 50 feet from heavy equipment range from about 72 to 97 dB. During the phase of construction using heavy equipment, noise is generated more or less at a constant level. Therefore, noise levels can be equated to an average hourly level.

Stationary Equipment: Stationary equipment such as pumps, power generators, and air compressors, Effluent treatment plant (ETP) etc., generally run continuously at relatively constant power and speed. Noise levels at 50 feet from stationary equipment can range from 68 to 88 dB, with pumps typically in the quieter range. An averaged noise level may be assumed for stationary equipment because of its fixed location and constant noise pattern.

There are several sources of air pollutants like stake emissions, emissions from different processing units, emissions from vehicles, emissions from landfill discharge, emissions from natural gas use, emissions from electricity consumption etc.

4.4 Water Resources

Water is an indispensable natural resource for sustenance of human life and other biota of a region. This vital natural resource occurs both on the earth surface and under the ground. The study area comprises rivers, beels, ponds, as the source of surface water. Besides, ground water is also available in the study area. The details of the surface water and ground water are provided in the subsequent sections.

4.4.1 Surface Water System

The proposed project site is located near the Bamui beel. Low lying water bodies and ponds are available near the project sites. A river called Bangshi River situated near the project site.This river originates from the course of old Brahamputra. Otherwise, there are no major rivers/canals in the project influential area. Water sampling and analysis was undertaken to understand the overall baseline water quality characteristics of the surface water in the study area.

4.4.2 Surface Water Quality

The surface water samples were collected from ponds. In the project area surface water used for domestic work and agricultural activity. The surface water quality was compared with the Bangladesh ECR, 1997 standard for water usable for irrigation purpose. The surface water quality data of the project area has been given in the Table below:

Table 4.8:Surface water quality

Water quality parameters	Unit	Concentration	Bangladeshi Standard (ECR, 1997)	Methods of Analysis
P^H	-	7.3	6.5-8.5	pH meter
DO	mg/L	5.9	5 or more	DO Meter
BOD_5	mg/L	5.78	10 or less	DO Meter
Total coliform (TC)	CFU/100ml	> 200	1000 or less	Membrane Filter method

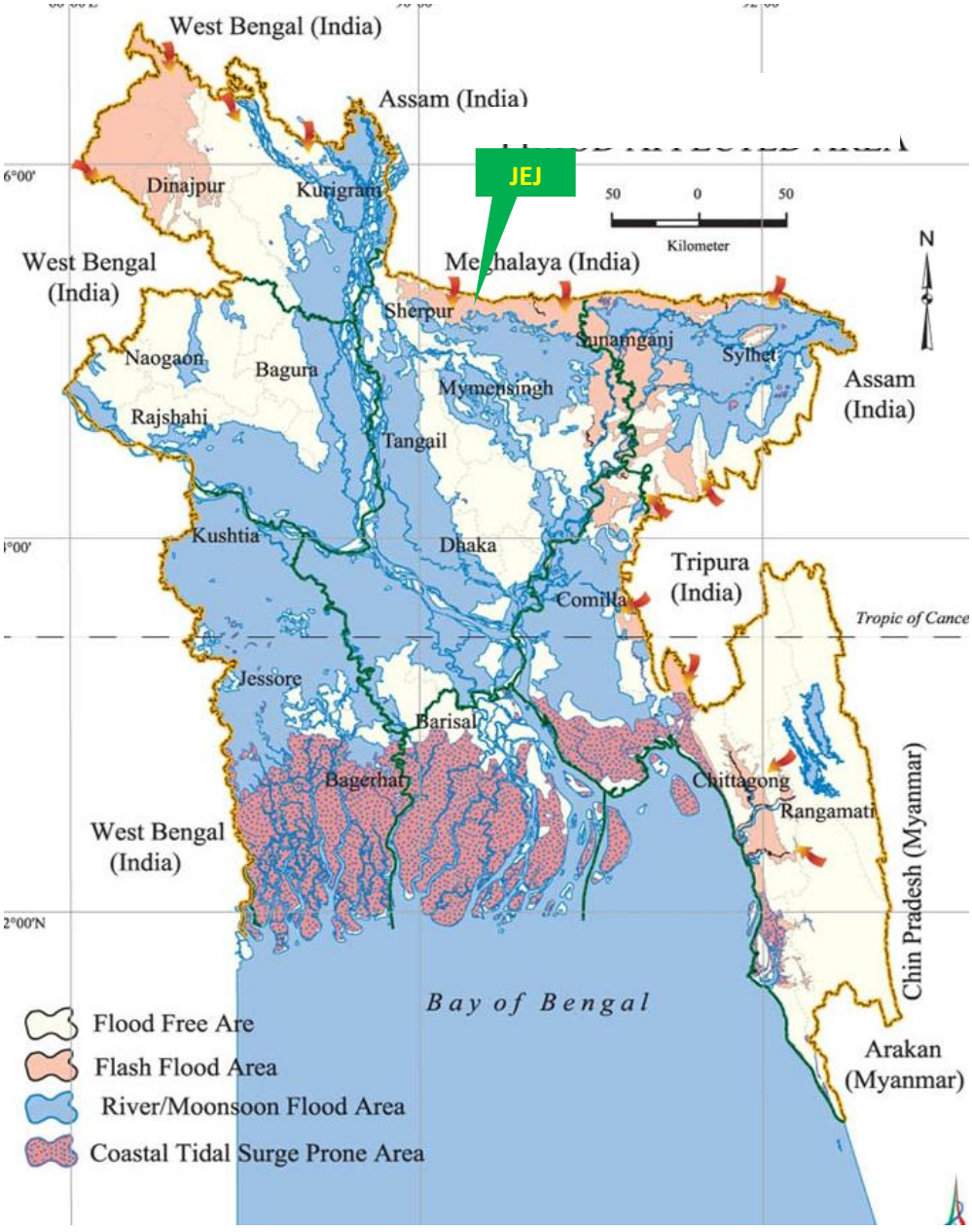
CFU = Colony Forming Unit* **Source:** Bangladesh Environ-Engineers and Lab Services Ltd.

Bangladesh is prone to seasonal flooding due to being situated on the Ganges Delta and the many distributaries flowing into the Bay of Bengal. Flooding normally occurs during the monsoon season from June to September. The convectional rainfall of the monsoon is added to relief rainfall caused by the Himalayas. Melted water from the Himalayas is also a significant reason.

Generally the onrush water from the hill across the border and collapsion of the flood control dam deteriorated the flood situation of some upazilla of Jamalpur district. River flooding is a common phenomenon in the study area and like other areas of

Bangladesh, this area also experiences flooding in every year. The major reason of flooding in the project area is lower land level, the flood water enter and inundate easily. Local people opined that there has no record of devastating and remarkable flood after 1998.

Figure 4.8: Location of project area at the flood prone areas of Bangladesh



4.4.3 Salinity

A salinity issue in Bangladesh is mainly associated with coastal regions. The Figure given below shows the saline zones of Bangladesh which clearly indicates that the proposed JEZ site is in salinity free zone. The surface water of rivers and beel are non-saline.

Figure 4.9: Salinity zones of Bangladesh

Source:Banglapedia, 2019

4.4.4 Drainage Congestion and Water Logging

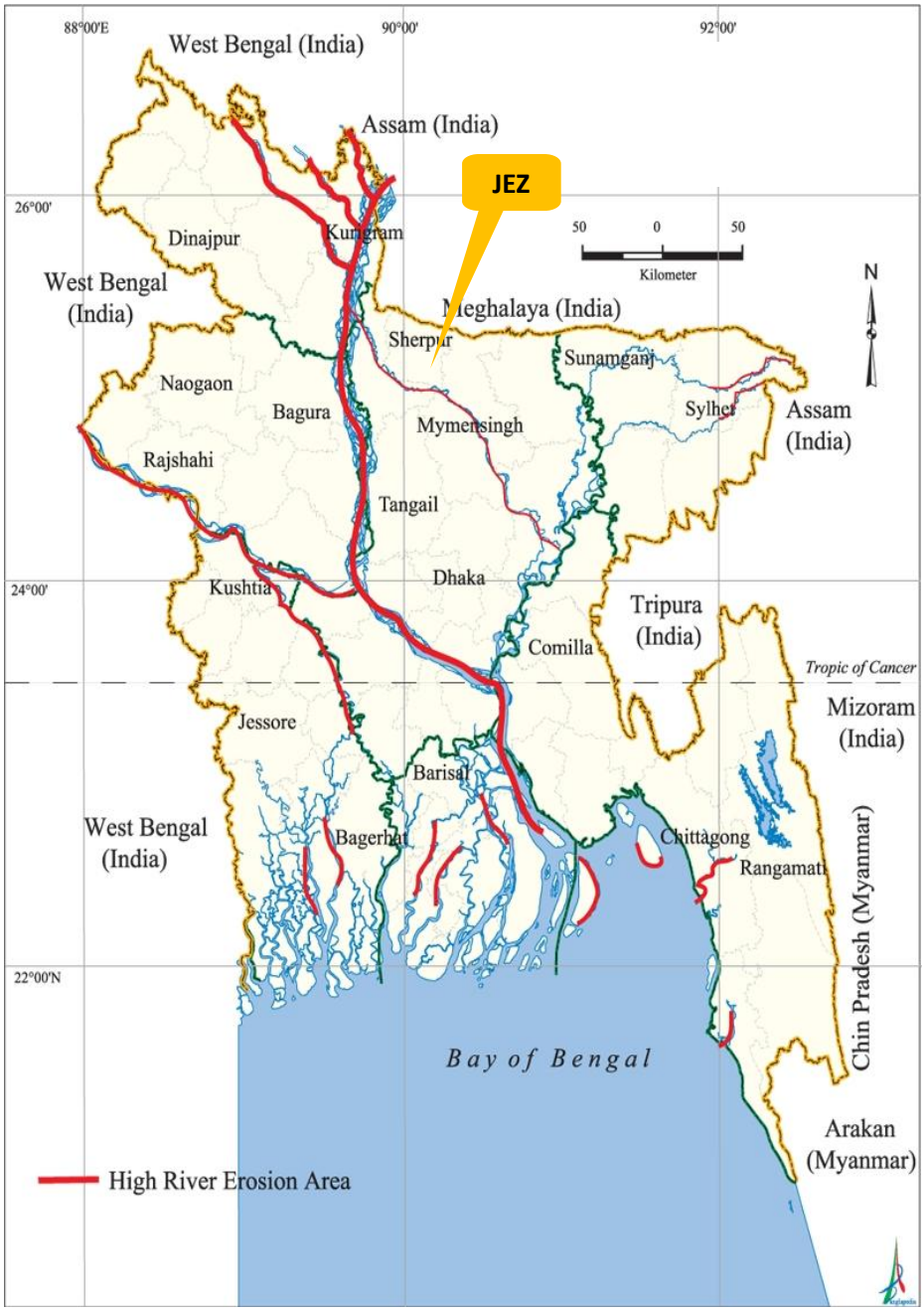
Water logging and drainage congestion has seen in the study area. Elevation of project area is higher than the surrounding area. Development activity will create a blockage on runoff of rain water into the Bamui beel this caused water logging and drainage congestion during rainy season in project area and surrounding. Clean drainage system along with the water passing path can reduce this water logging problem. Moreover, if needed the JEZ authority will develop sophisticated drainage channel across the EZ site.

4.4.5 Riverbank Erosion

Millions of people of the country are affected by Riverbank erosion every year that damages standing crops, farmland and homestead land. However, the River erosion

map of Bangladesh indicates that the proposed project area is free from risk of River erosion which is given in following Figure.

Figure 4.10: Erosion prone areas of Bangladesh including the project area



Source:Banglapedia, 2019

4.4.6 Morphology of River and Beel

A study has been conducted to study the changing patterns of Bangshi River and Bamui Beel using GIS. Google images showing the morphology of the river different years is given in the following figure.This study shows that, there are no major changes observed for last 10 years.

Figure 4.11: Google map showing Bamui Beel and Bangshi River course, 2011

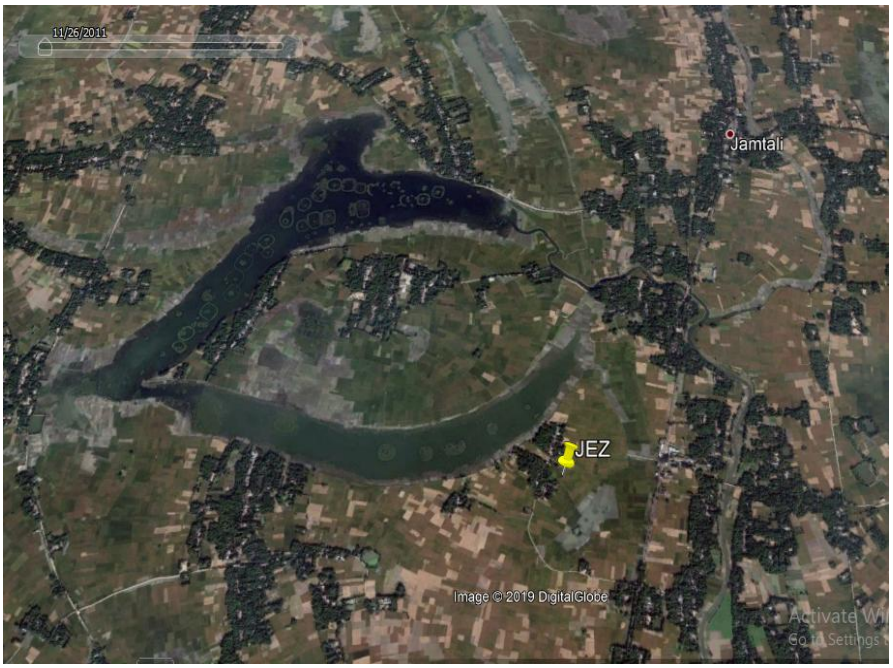


Figure 4.12: Google map showing Bamui Beel and Bangshi River course, 2016

Figure 4.13: Google map showing Bamui Beel and Bangshi River, 2019

4.4.7 Navigation System

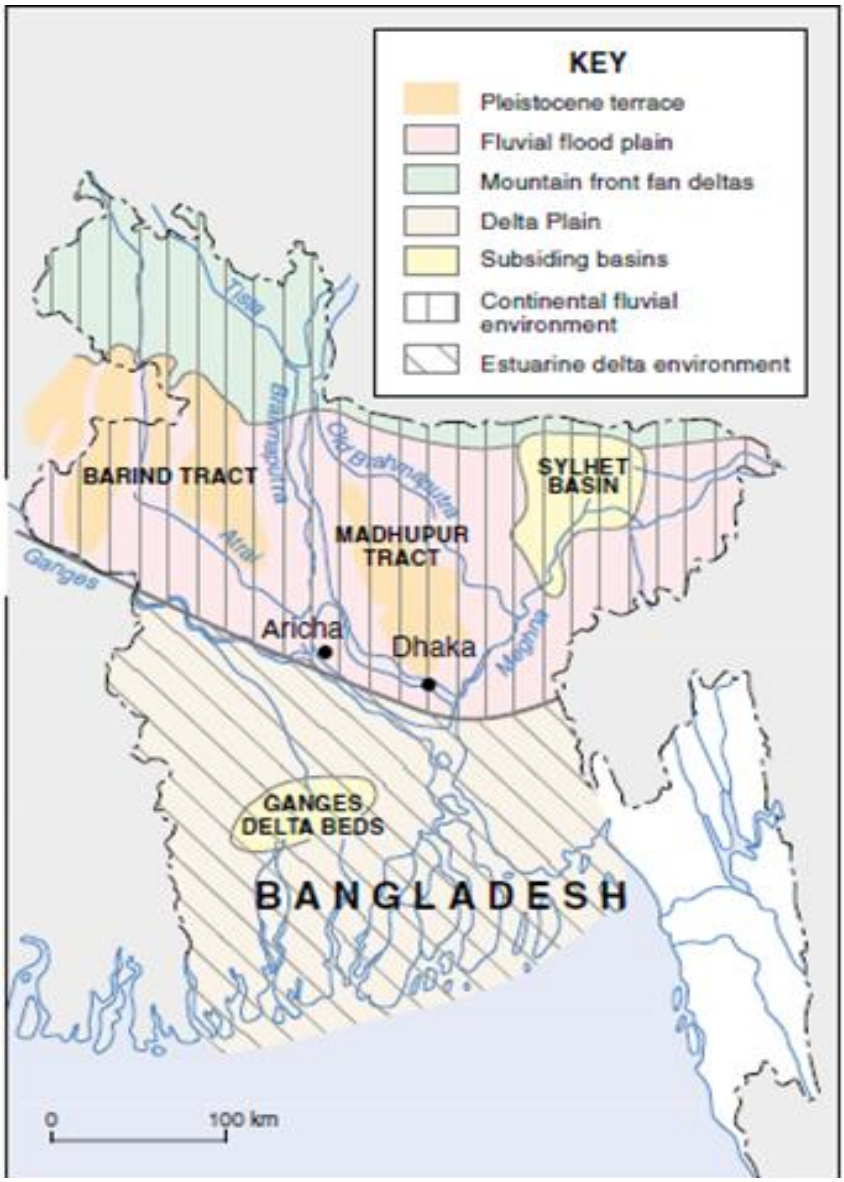
The project site lacks significant River transportation system for navigation throughout the country. Major communication facilities in the project area are roads and railways.

4.4.8 Ground Water System

Bangladesh is located over a subsiding basin of tectonic origin with a great thickness of sedimentary strata. This is an unconsolidated alluvial deposit of recent to sub-recent age overlying marine sediments. The recent delta and alluvial plains of the Ganges, Brahmaputra and the Meghna Rivers constitute the upper formation. The near surface quaternary alluvium contains good aquifer characteristics (transmission and storage coefficients). The groundwater storage reservoir has three divisions; upper clay and silt layer, a middle composite aquifer (fine to very fine sand) and a main aquifer consisting of medium to coarse sand.

Groundwater table fluctuations indicate the recharge and discharge to the groundwater reservoir. The highest groundwater table occurs in the study area during the month of August-September when the aquifer recharges fully and the lowest is during February-March due to natural discharge and groundwater use for domestic and irrigation purposes.

Figure 4.14: Simplified geology and geomorphology of Bangladesh



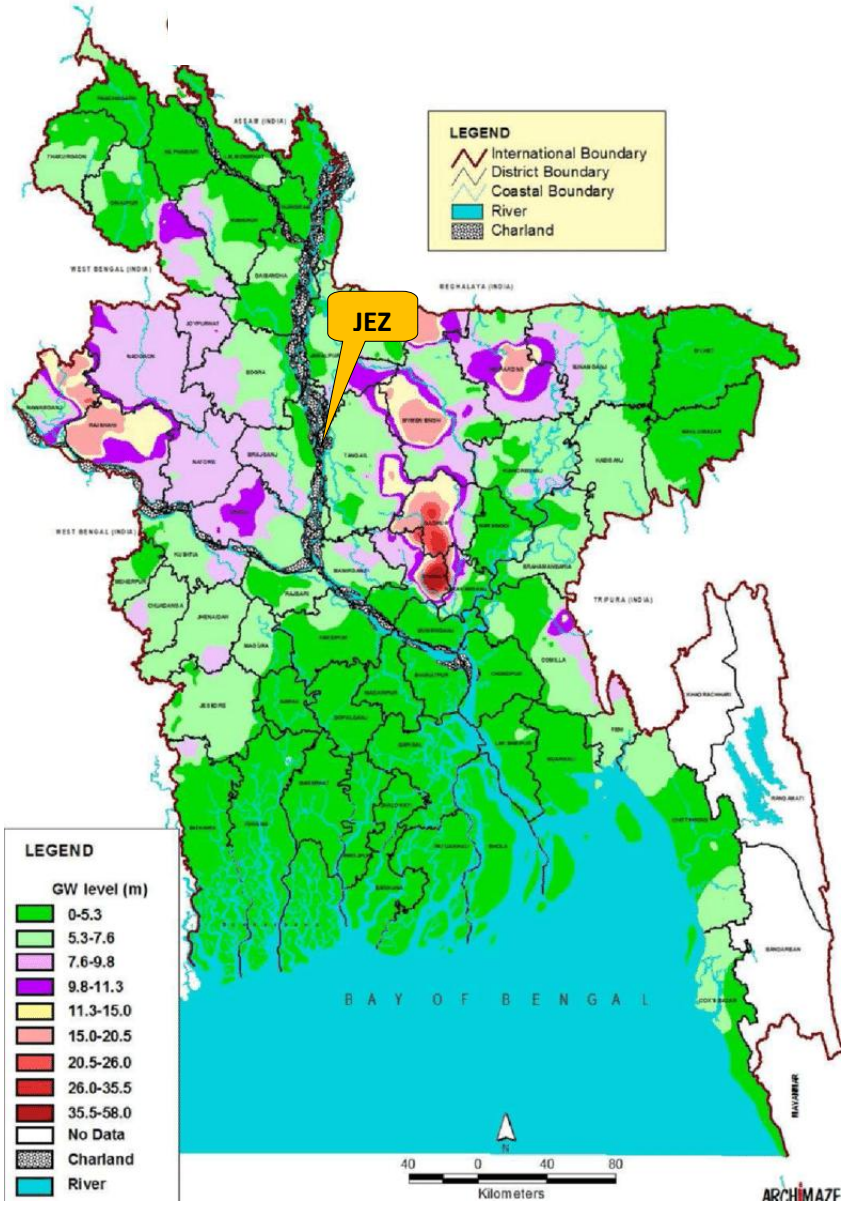
Source: British Geological Survey, NERC, 2001

Groundwater is abundant in Bangladesh and the aquifers are highly productive. The sediments are predominantly non-indurated and easy to drill by hand, at least two shallow levels. Water tables vary across the country but are typically shallow at around 1–10 m below the ground surface. These factors have made groundwater an attractive and easily accessible resource and have led to a rapid proliferation in the use of groundwater over the last few decades. Today, 97% of the population relies on groundwater for potable supplies and groundwater is also an important source for irrigation and industry. Groundwater levels across Bangladesh become depressed during the dry season, but the aquifers replenish fully during the monsoon. Exceptions occur beneath the major cities, especially Dhaka, where large-scale abstraction has led to long-term drawdown of the water table.

The number of tube wells in Bangladesh is not known but estimates put the number at around 6–11 million. The vast majority of these are private tube wells, which penetrate

the shallow alluvial aquifers to depths typically of 10–60 m. Irrigation boreholes typically tap deeper aquifers in the region of 70–100 m depth. In some areas, notably the south and the Sylhet Basin of north-east Bangladesh, deep tube wells abstract groundwater from depths of 150 m or more. In the south, the deep tube wells have been installed to avoid high salinity at shallower levels (BGS and DPHE, 2001).

Figure 4.15: Groundwater zones of Bangladesh



In the study area maximum people use ground water as a source of drinking water. Both shallow and deep tube well (more than 150-200 ft depth) found in the study area. Iron concentration is higher in shallow tube well than deep tube well. So, water from deep tube well is used for dinking purpose. Beside this, water from shallow tube well is used for other domestic work.

Water sampling and analysis were undertaken to understand the overall baseline water quality characteristics of groundwater in the project area. The water quality was

compared with the Bangladesh standard for best practice classification criteria and has been given in the following Table.

Figure 4.16: Ground water quality

	Parameter	Unit	Concentration present	Bangladesh Standard for Drinking water (ECR, 1997)	Analysis Method
1.	Temperature	^{0}C	27	20-30	Digital thermometer
2.	P^H		7.51	6.5-8.5	P^H meter
3.	TDS	mg/L	825	1000	Conductivity meter
4.	Turbidity	mg/L	2.9	10	Turbidity meter
5.	Chloride	mg/L	20	150-600	APHA, 1998
6.	DO	mg/L	2.20	6	DO meter
7.	Total coliform (TC)	CFU/100ml	0	0	Membrane Filter method
8.	Fecal Coliform	CFU/100ml	Nil	0	Membrane Filter method
9.	Arsenic	mg/L	0.01	0.05	AAS
10.	Iron	mg/L	3.42	0.3-1.0	AAS

**CFU= Colony Forming Unit; *BDL= Below Detection Limit*

Source: Bangladesh environmental engineering training & lab services ltd.

It is observed from the ground water analysis that Iron content in the ground water of the project area exceeded the Bangladesh Standard. Maximum people use ground water as drinking water in the project area. Ground water from more than 200 ft has less iron concentration or free from iron. Iron is highly corrosive. Industrial machineries will be damage if iron concentrated water used in industries

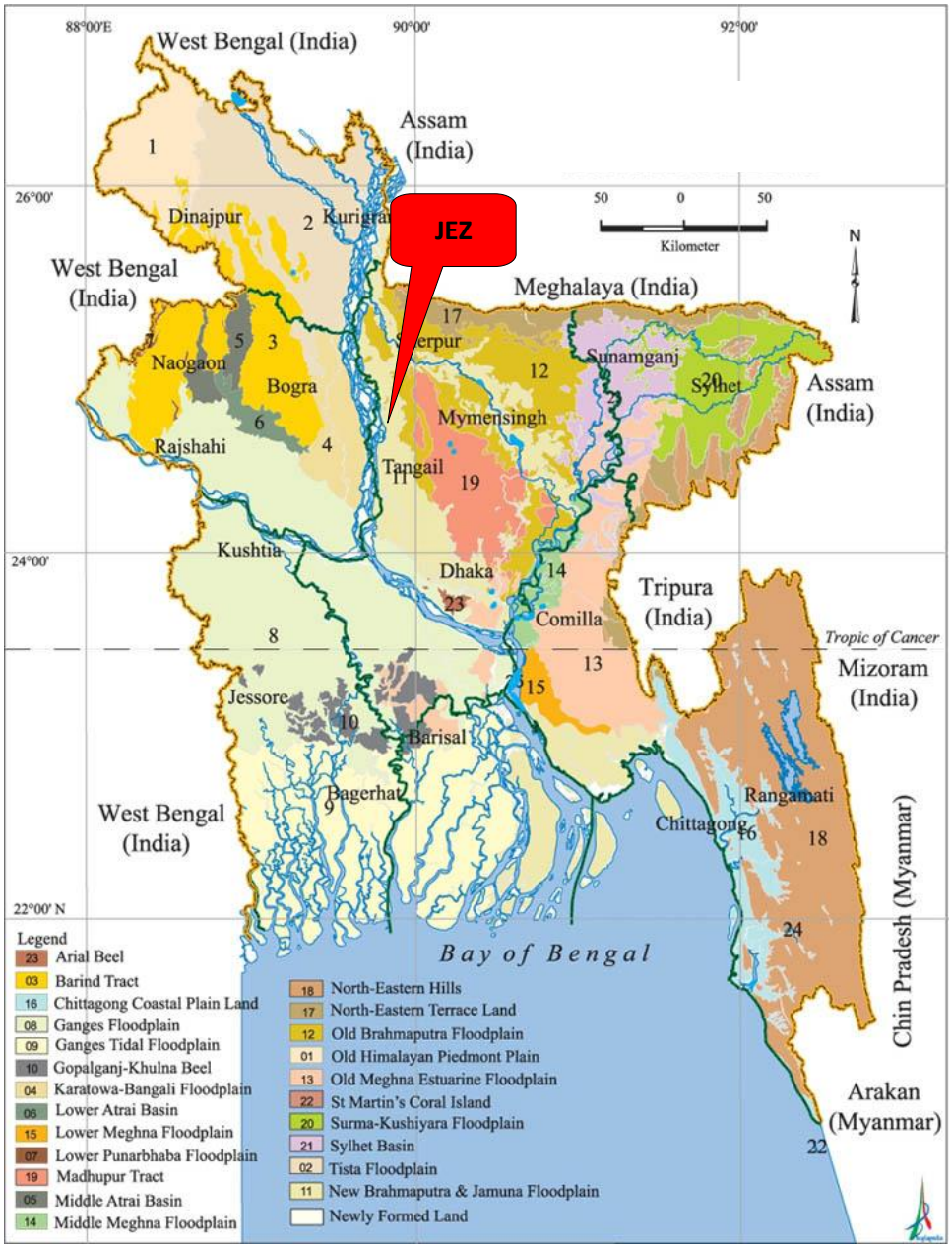
4.5 Geology

4.5.1 Physiography

Physiography is the terrain condition of a particular tract of land and reveals the surface condition of the land. Physiographic region refers to a region in which all land tracts are similar in terms of physical characteristics, with a uniform geomorphic history, and whose pattern of topographical features or landforms differs significantly from that of adjacent regions.

In the context of physiography, Bangladesh may be classified into three distinct regions-floodplains, terraces and hills, further divided into twenty physiographic units. The study area of the proposed project forms a part of the Old Brahmaputra Flood Plain. This region occupies a large area of Brahmaputra sediments before the river shifted to its present Jamuna channel about 200 years ago. The region has broad ridges and basins. Relief is irregular, especially near the old and present river channel.

Figure 4.17: Physiographic regions of Bangladesh

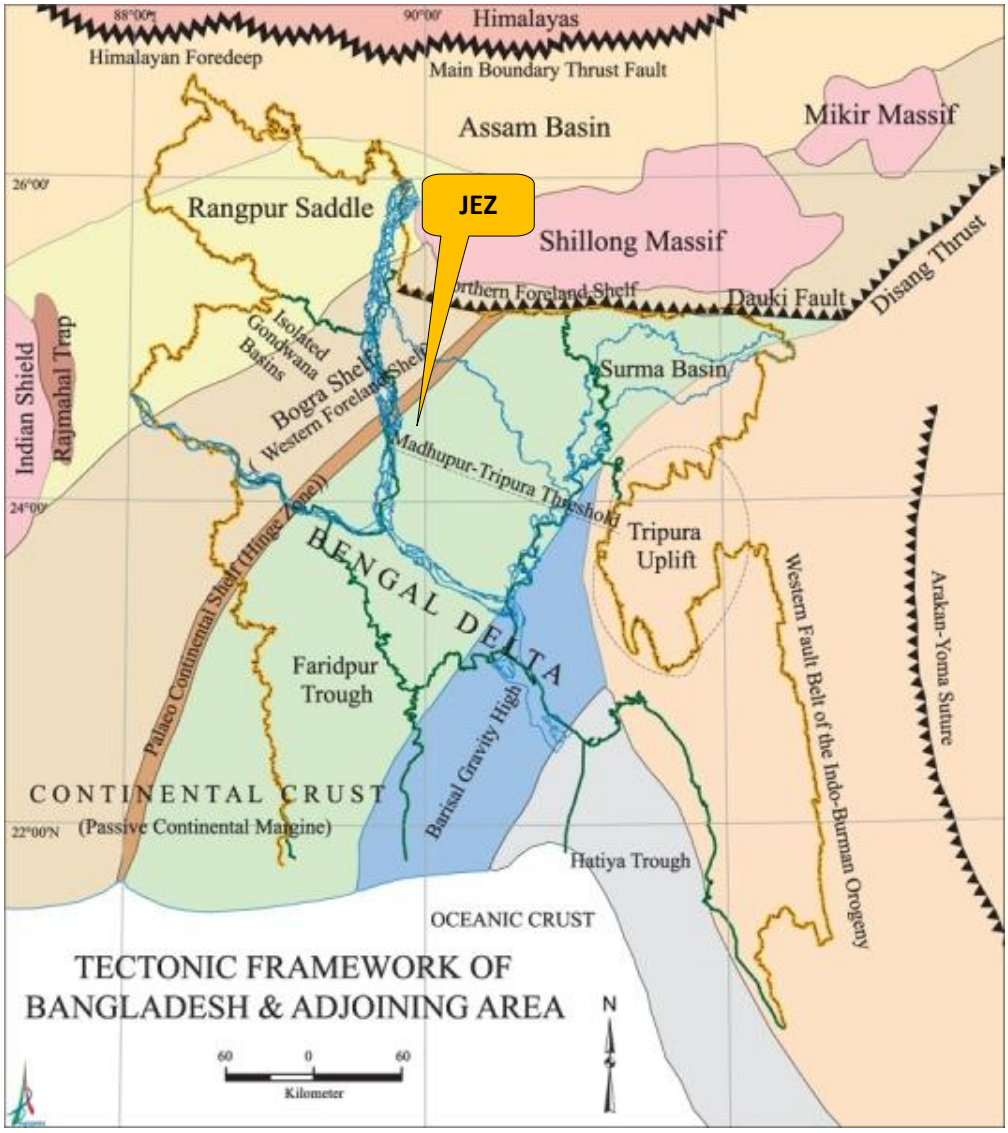


4.5.2 Tectonic Setting

Tectonic Framework refers to the basic structural frame on which Bangladesh stands. It is essential to have a clear conception about the tectonic framework of Bangladesh in order to evaluate the prospect of mineral resources including oil and natural gas. Bangladesh is divided into two major tectonic units: i) Stable Pre-Cambrian Platform in the northwest, and ii) Geosynclinal basin in the southeast. A third unit, a narrow northeast-southwest trending zone called the hinge zone separates the above two units almost through the middle of the country. This hinge zone is currently known as palaeo continental slope.

The Proposed project area falls near Hing Zone. The junction of Bogra Shelf and Madhupur-Tripura Threshold shows in the following Figure. As the project area falls close to two tectonic elements, a detail study to be conducted before taking up construction design.

Figure 4.18: Tectonic framework of Bangladesh

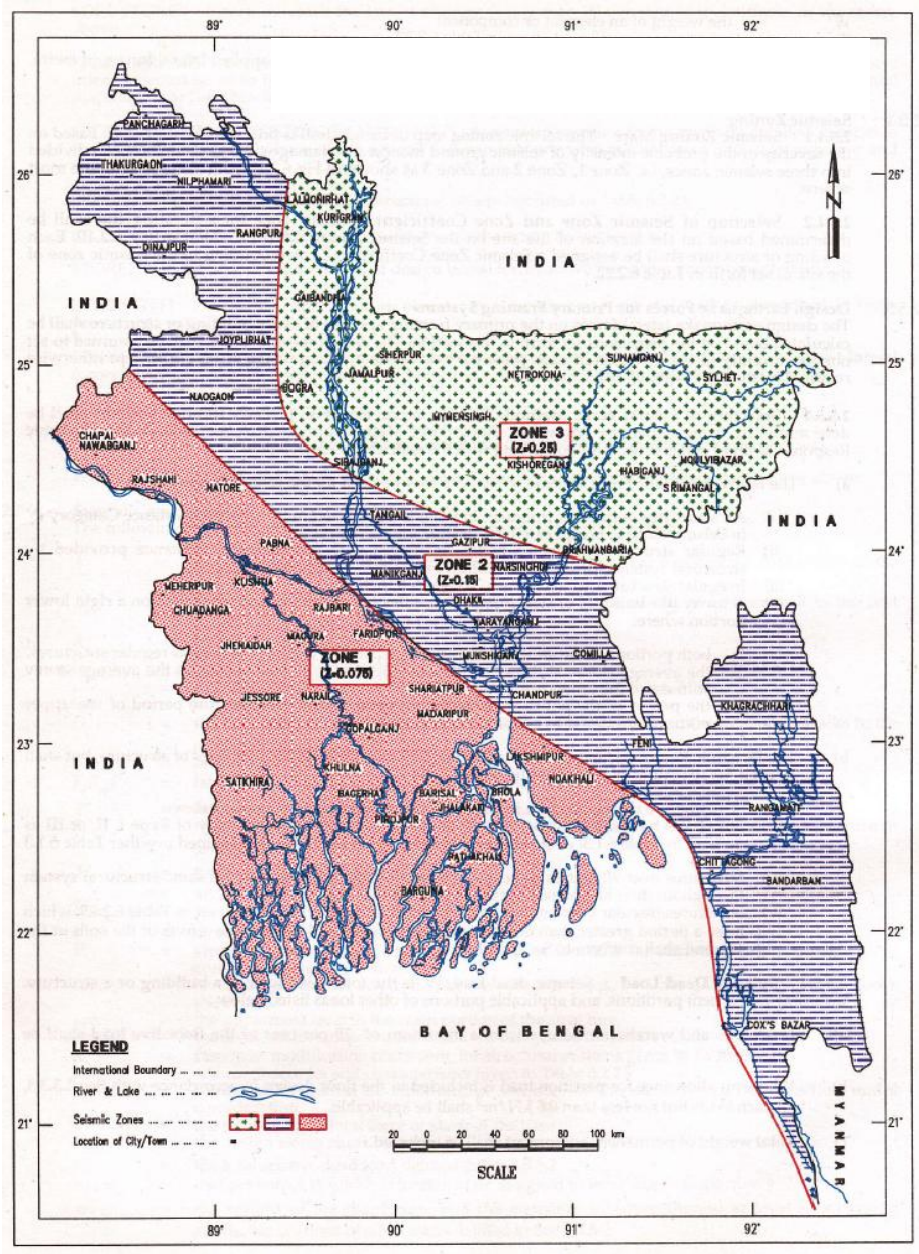


Source: http://en.banglapedia.org/index.php?title=Tectonic_Framework

4.5.3 Seismicity

The proposed Jamalpur Economic Zone area is located within Zone III of the earthquake zoning map of Bangladesh, where the seismic intensity of this Zone is sever i.e. 0.25 g. The seismic coefficient represents the proposed project site is highly vulnerable in terms of earthquake. During designing of the structure for the proposed economic zone, Bangladesh building code should be followed.

Figure 4.19: Seismic zone of Bangladesh



Source:BNBC.2006

4.6 Land Resources

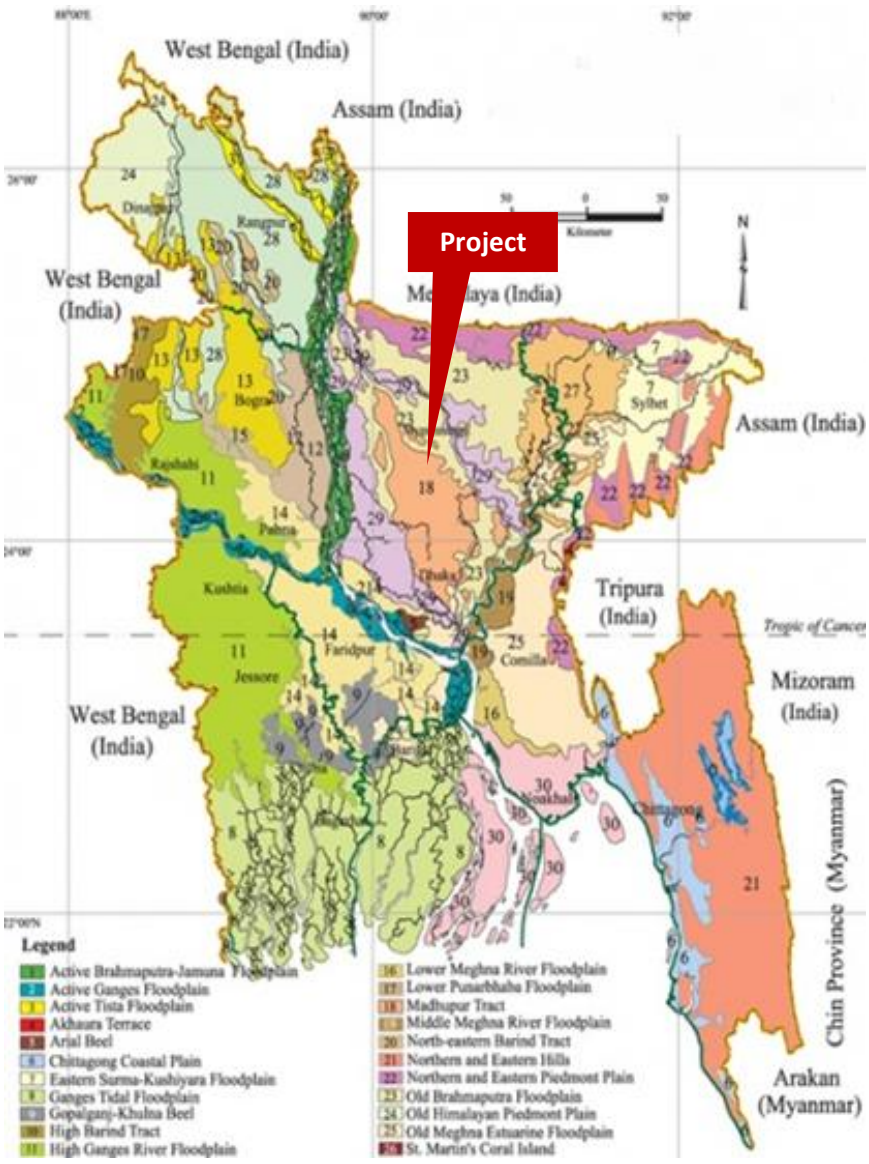
4.6.1 Agro-Ecological Zones (AEZs)

Agro-ecological Zones are land areas categorized on the basis of four elements such as physiography, soils, land levels in relation to flooding and agro-climatology. Physiography forms the primary element in defining and delineating the agro ecological regions in Bangladesh. Soils form the second element in defining and differentiating agro ecological zones as soil conditions determine important properties for plant growth, moisture supply, root aeration and nutrient supply. The third factor is land level in relation to flooding. The last one is related to different agricultural products for different climatic conditions of the regions (Banglapedia, 2019). It is considered in

identifying agro ecological zones in Bangladesh comprises the four climatic zones of the country. Agro-ecological zone indicates an area characterized by homogeneous agricultural and ecological characteristics. This homogeneity is more prominent in the sub-region and unit levels.

The agro-ecological zones of Bangladesh have been divided in 30 regions. The proposed project falls under the Old Brahmaputra Floodplain. This region occupies a large area of Brahmaputra sediments before the river shifted to its present Jamuna channel about 200 years ago. The region has broad ridges and basins. Soils of the area are predominantly silt loams to silty clay loams on the ridges and clay in the basins. General soil types predominantly include Dark Grey Floodplain soil. Organic matter content is low on the ridges and moderate in the basins; topsoils are moderately acidic but subsoils neutral in reaction. General fertility level is low.

Figure 4.20: Agro-ecological regions of Bangladesh

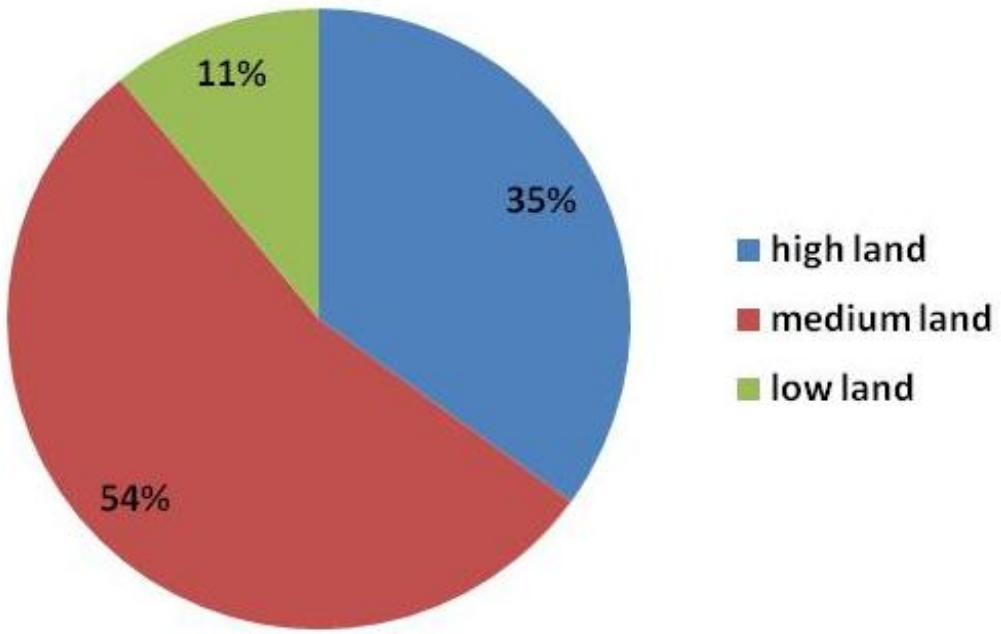


Source: www.thebangladesh.net

4.6.2 Land Type

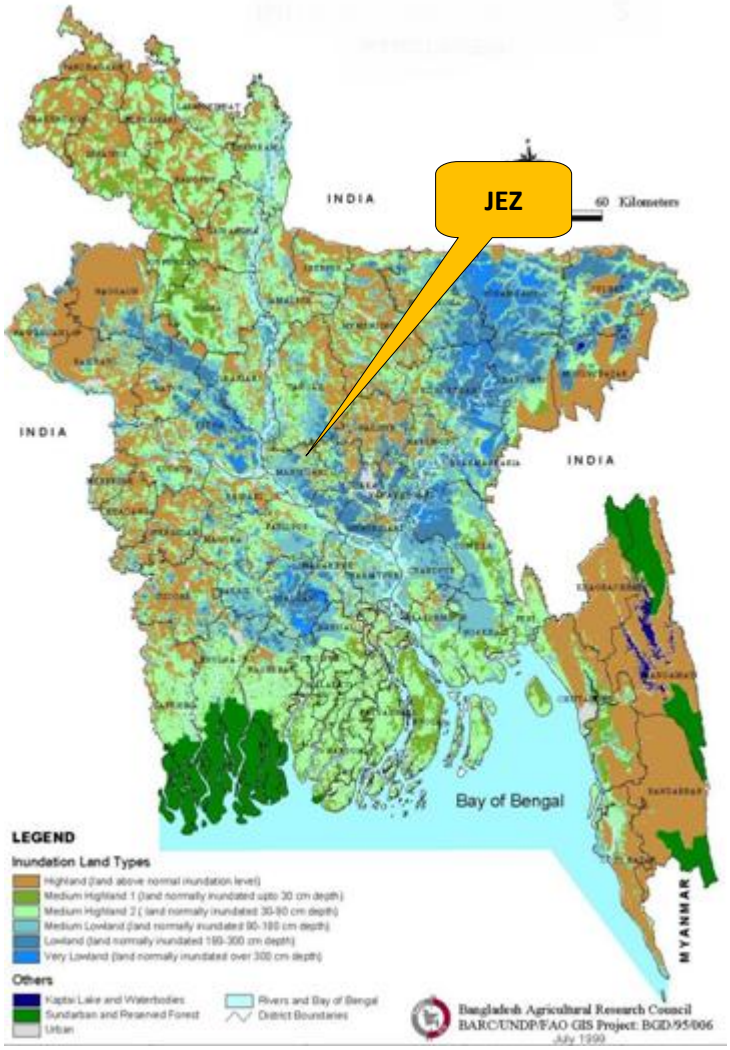
Based on depth of inundation during monsoon season, land type of Bangladesh has been classified. In terms of depth of flooding, five classes of land type are recognized. These are high land (land above normal inundation), medium highland 1 (land normally inundated upto 30 cm depth),medium highland 2 (land normally inundated upto 30-90 cm depth), medium lowland (land normally inundated upto 90-180 cm depth), low land (land normally inundated upto 180-300 cm depth) andvery lowland (land normally inundated over 300 cm depth). Project area is mainly medium low land and flat terrain. The land type Jamalpur Sadar Upazila is medium land. Out of total 120975 acres of land, 11% (13964 acres) low land, 54% (64980 acres) medium land and 35% (42031 acres) are high land in Jamalpur Sadar Upazila. Figure below show the land types of proposed project.

Figure 4.21: Land type in Jamalpur Sadar



Source: Jamalpur District Statistics, 2011

Figure 4.22: Inundation land types map of Bangladesh indicating the project site

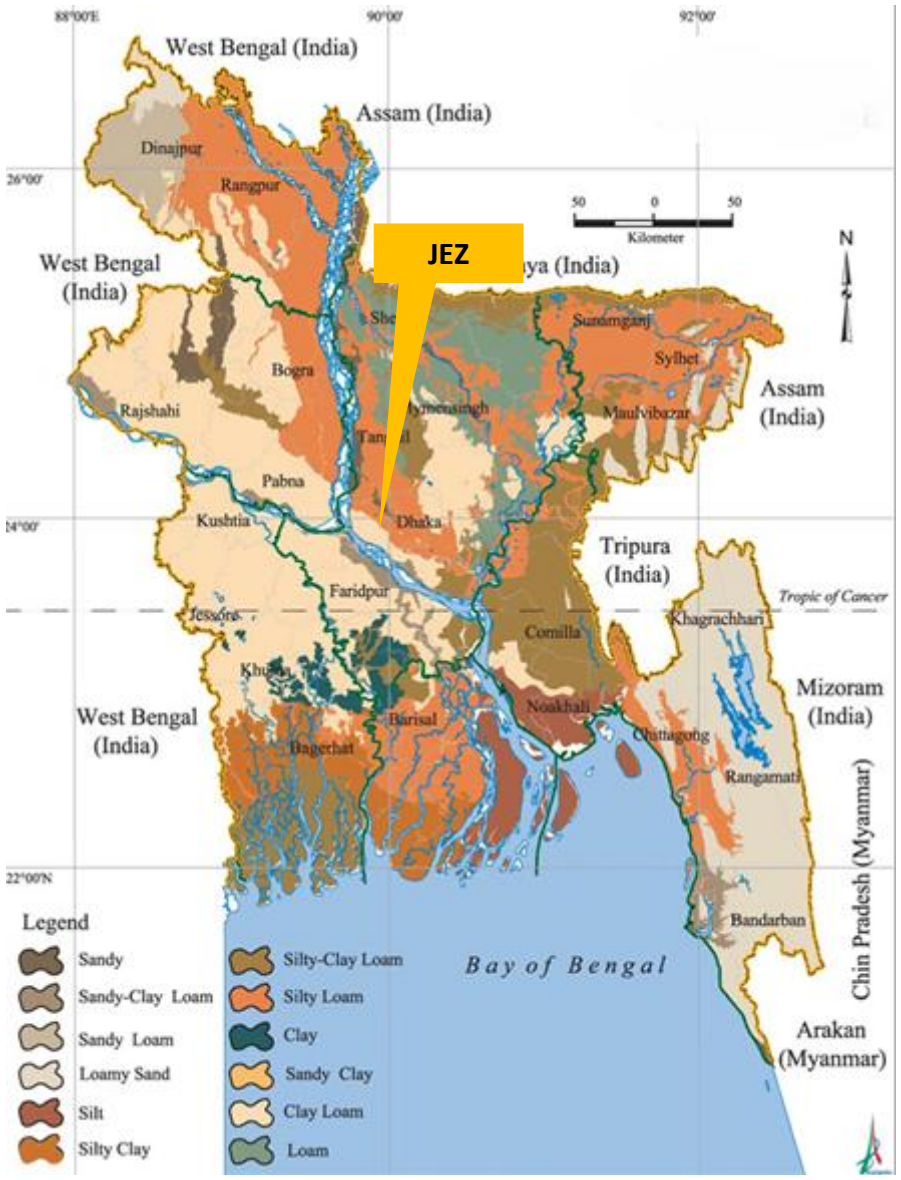


4.6.3 Soil Texture

Soil texture is known as a qualitative classification instrument used both in the field and laboratory for agricultural soils to determine classes based on their physical texture. While classes are distinguished in the field and the class is then used to determine crop suitability and to approximate the soils responses to environmental and management conditions such as drought or calcium (lime) requirements. As a qualitative rather than a quantitative tool it is a fast, simple and effective means to assess a soil's physical characteristics.

The proposed JEZ is located Old Brahmaputra Floodplain. Soils of the area are predominantly silt loams to silty clay loams on the ridges and clay in the basins. General soil types predominantly include Dark Grey Floodplain soil. Organic matter content is low on the ridges and moderate in the basins; topsoils are moderately acidic but subsoils neutral in reaction. General fertility level is low.

Figure 4.23: Soil texture map of Bangladesh



Source: Banglapedia,2019

4.7 Agricultural Resources

4.7.1 Farming Practice

Total area of Jamalpur Sadar Upazilla is 353.31sq km (Jamalpur District Statastics, 2011). There is no reserve forest within the project area. The Bangladesh Bureau of Statistics, provided the land area based on utilization of Jamalpur Sadar Upazilla. Farmers cultivate their crops using their perception and indigenous knowledge about the environment, especially the duration and magnitude of flood. Paddy, jute, sugarcane, mustard seed, peanut, wheat, sweet potato, tobacco, betel leaf, chilly, pulse, vegetables, etc. are main fruits of Jamalpur district. Major farming practice in the project area is paddy and vegetables. No industry or other major economic enterprises were set up in the project area.

Table 4.9: Land area based on utilization (area in acres and production in metric ton)

Name of the Crops	2010-2011		2009-2010	
	Areas	Production	Areas	Production
Wheat	2585	2200	2485	2105
Jute	5735	23378	1955	8481
Sugarcane	273	5196	395	7590
Lentil (Masur)	52	8	79	13
Mug	5	15	7	19
Maize	15	41	17	47
Gram	4	1	-	-
Motor	5	2	-	-
Kheshari	23	6	-	-
Mash-Kalai	43	14	-	-
Potato	2573	16814	2523	16461
Sweet potato	250	1325	375	2154
Rape and mustard	195	599	201	629
Ground nut	47	53	55	62
Til	28	7	35	10
Pepper	856	296	878	305
Onion	246	401	258	420
Garlic	100	147	111	167
Turmeric	490	682	332	463
Ginger	250	984	248	971
Tomato	160	510	178	568
Radish	286	1093	331	1487
Bean	87	151	96	167
Pumpkin	76	292	81	297
Parble (Potol)	72	149	82	166
Cabbage	111	430	128	499
Brinjal	246	487	253	494
Lady's finger	62	121	63	130
Arum	196	1668	223	1743
Cauliflower	196	744	225	852
Cucumber	145	551	153	561
Papaya	11	916	10	899
Guava	68	449	63	427
Lime and Lemon	2	10	3	11
Jackfruit	482	6263	407	6097

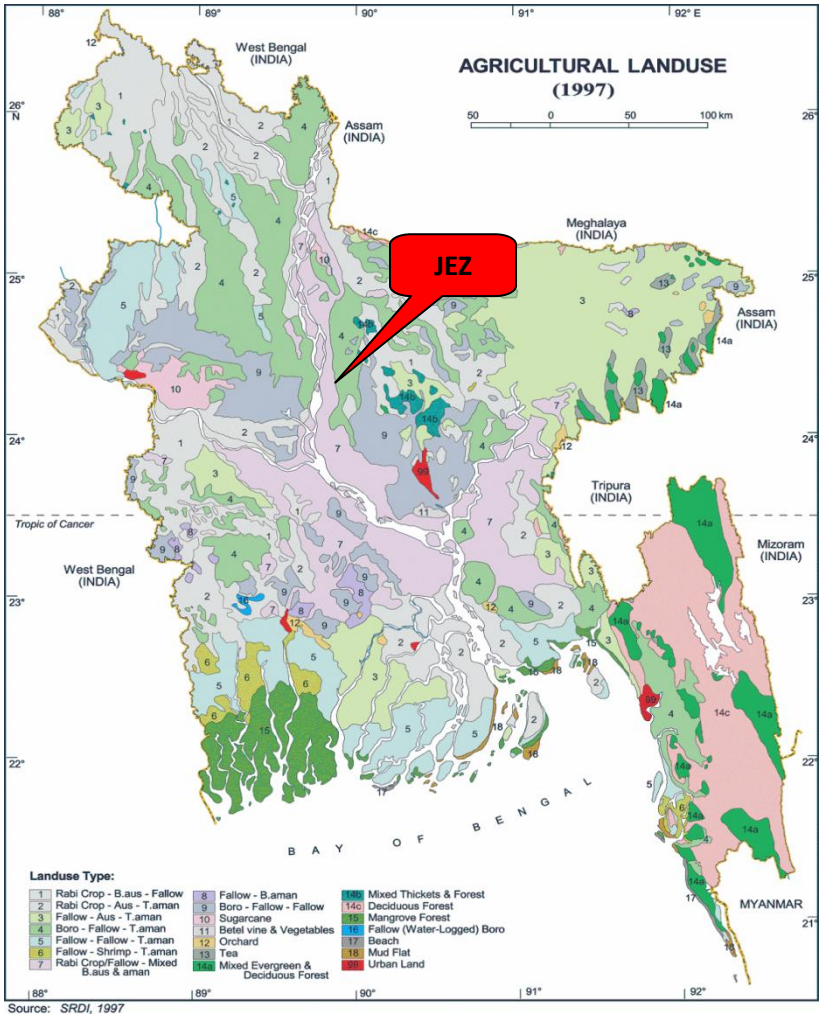
Name of the Crops	2010-2011		2009-2010	
	Areas	Production	Areas	Production
Banana	364	2476	381	2494
Pineapple	134	384	136	390
Mango	148	3897	272	450
Litchi	30	384	13	16
Blackberry	20	255	51	13
Water melon	18	47	16	42

Source: Jamalpur District Statastics, 2011

4.7.2 Land Use and Cropping Pattern

Existing main cropping pattern of the project area is boro-fallow-transplant aman. The cropping intensity of Jamalpur district is 190 % while the national cropping intensity is about 173 % (Yearbook of Agricultural Statistics, 2017). Out of 90230 acre of temporary cropped area, 526 acre, 15120 acre, 49890 acre, and 25220 acre are current fallow, single, double and triple cropped area, respectively (Jamalpur District Statistics, 2011).The following figure shows the agricultural land use map of Bangladesh.

Figure 4.24: Agricultural land use Map of Bangladesh

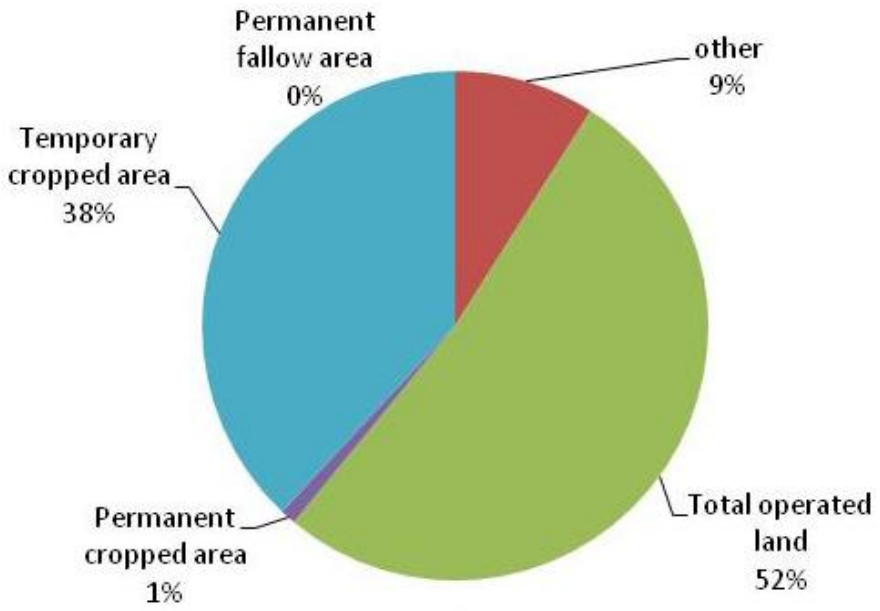


Source: https://www.thebangladesh.net/agricultural-landuse-of-bangladesh.html

4.7.3 Cropped Area

The total operated land area is 121009 acres, permanent cropped is 2120 acres, temporary cropped area is 90230 acres, permanent fallow area is 704 acres and other is 21348 acres in Jamalpur Sadar Upazila. Figure below shows the cropped area of the project site.

Figure 4.25: Cropped area for Jamalpur Sadar



Source: Jamalpur District Statastics, 2011

The project will not hamper the agricultural practices and development; rather the farmers could be benefited indirectly by promotion of economic growth of the area by the project.

4.7.4 Crop Production

The main crop of the project is shrimp and salt. Most of the people are earning money by cultivation and working of salt and shrimp field. Other crops are Paddy, potato, mustard, pepper, maize, sugarcane, wheat, groundnut, betel, tobacco, watermelon, vegetables in the study area. Crop production especially for Paddy, wheat and potato in the study area is not a full satisfactory trend. Table 49 shows the rice production in the project area.

Table 4.10: Production of Rice in the Project Area (Area in acre and production in metric ton)

Year	Types of rice					
	Aus		Aman		Boro	
	Area	Production	Area	Production	Area	Production
2009-2010	83	40	67700	52326	73474	118373
2010-2011	345	125	73568	61264	74997	120889

Source: Jamalpur District Statastics, 2011

4.7.5 Crop Damage

Crop production is damaged by different climatic threats like food, drought, heavy rainfall, untimely rainfall, tornado, cyclone, river bank erosion etc. Within the threats, flood is main object that can damage the crops seriously. Every year, almost one-third of Bangladesh is flooded. However, because of topographical characteristics, the regions of the country experience the degree of flooding; some parts may be under deep flood water, others unaffected. Flooding is beneficial only within certain limits of timing, duration and magnitude. In the project area, mostly flood is main responsible to damage the crops. So, the project should have scope to do required management in the project area.

4.7.6 Main Constraints of Crop Damage

Economic, environmental and other factors can constrain crop production in different ways. Economic demotivation and financial problem can cause initial pessimism in production decision. Environmental hostile factors like disasters and unwanted conditions can cause harms in latter stage of production. Main constraints of crop production in the project area are-

- Irregular irrigation facilities during winter season
- Flood water submerged the land during rainy season
- Lack of training for suitable cultivation and overcoming the loss of crop to the farmers
- Non-introducing the new high yielding varieties and new technologies;
- Low fertility of land
- Lack of open market sell of seeds and fertilizer, quality seed and other inputs as demanded by farmers
- Unavailability of credits
- Lack of agricultural loans of flood-affected farmers

4.8 Livestock and Poultry

4.8.1 Status of livestock and poultry

Livestock and poultry has been playing significant role in the economy of the study area, as in the agricultural share of economy of Bangladesh. Along with agriculture, it is an essential part of integrated farming system. Livestock provides supports for cultivation like threshing and crushing of oil seeds; cow dung as a source of manure and fuel; a ready source of funds; and meat, milk and eggs for household consumption. Agricultural by-products can be used as fodder and feed of Livestock and poultry.

Table 4.11: Status of livestock and poultry at the project area

Particulars	Number
Cow & buffalo	121589
Goat	67310
Sheep	2138
Hen and Cock	461302

Particulars	Number
Duck	168728

Source: Jamalpur District Statistics, 2011

Most of the households in the project area have poultry and livestock, a practice that helps to reduces poverty through generating alternative income and employment. The common livestock and Poultry found in the Project area are Cow/bullock, Buffalo, Goat, Sheep, Duck, Chicken etc.

4.8.2 Feed and Fodder

Fodders and feed is the most important input of livestock rearing. Crop residues and naturally grown grasses alongside roads, river bank, char lands, etc. are the main feed for the cattle in Bangladesh. Shortage of fodder and high price of feed ingredients are affecting the small holders significantly. Dairy units are running off due to shortage of fodder or grazing land/ high price of feed ingredients. The pasture land has reduced significantly all over the country due to cultivation of High Yielding Varieties (HYV) of rice to meet the demand of growing population. Climate change is causing unusual behavior in temperature, rainfall, flooding pattern etc., and affecting either in natural growth or damaging the pasture grasses. Besides, adulteration of commercial feed by the miller; Inadequate or no quality control system of commercial feed is traceable.

A potential threat to natural growth of grasses in the char lands for grazing of animals. Fodder cultivation is not generally practiced by the smallholders, because of land constraints belonging to them. However, Private dairy farmers grow the fodder for their cows either in their own land or leased out lands from others. Most of the poor families do not have their adequate land to grow fodders. They are to depend on naturally grown grasses in alongside roads, embankments and polders, and also on aquatic plants. The smallholders suffer from shortage of fodder during cropping seasons. Seasonal variation is experienced by the farmers in availability of forages. Crop residues and a very little amount of green forages are given to their animals throughout the year. The dairy farmers cultivate maize as fodders and fodders of exotic and high yielding varieties for their animals. Some of these are perennial type, such as: Napier, Para, German, Sudan grass, Jumbo, etc. However, fodder cultivation in cultivable land depends on opportunity costs with other crop (Bangladesh Delta Plan, 2010). Constraints of feeds and fodder availability in the project site for cattle can be summarized as follows:

1. Scarcity of grazing land;
2. Scarcity of land for fodder cultivation.
3. Low quality and adulterated feed in the market
4. Use of crop residues as household cooking fuel and other purposes.
5. Change in cropping pattern
6. Lack of standards and quality control system
7. Lack of knowledge of feeding system
8. Lack of coordinated effort.

4.8.3 Livestock and Poultry Diseases

Parasites and diseases cause serious losses 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. Mainly, 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. Newcastle disease, fowl pox, fowl cholera and duck plague are common among poultry.

The most crucial period is between July and October (rainy season) for outbreak of livestock and poultry diseases. The duck plague generally occurs in summer. However, some diseases prevail throughout the year. During monsoon season, the wet condition of the animal shelter promotes various kinds of diseases to the bullocks and cows. The unhygienic condition of the courtyards during this season may also spread the diseases to the poultry birds.

4.9 Fisheries Resources

4.9.1 Introduction

The study area possesses diversified freshwater fish habitats, which include river, beel, floodplain, fish pond, etc. Fish production of the area mostly comes from capture fisheries whereas the culture fisheries have also countable contribution.

4.9.2 Problems and Issues

Fish biodiversity of the project area is shrinking due to morphological changes of River, disruption of ecology, intensive agriculture, indiscriminate fishing, and loss of River-khal connectivity for filling wetlands and water regulatory structures on beel on the project area. The key fisheries problems and issues identified during baseline survey are as follows:

- Dumping of untreated toxic liquid and solid wastes in and around the project site is the main reason of fishes diminishing in the proposed project area;
- Interrupting fish migration and movement due to improper management and mal-functioning of the water regulatory structures along with encroachment and barriers;
- Siltation of internal khals, causing loss to the year round river-khal connectivity;
- Lack of quality fish seed and feed for the improved aquaculture practices;
- Insufficient loan facilities for aquaculture practices;
- Lacking of extension services and updated information;
- Prevalence of fish diseases;

- Lack of technical knowledge on pond management; and
- Insufficiently trained farmers in the project area.

4.9.3 Habitat Distribution and Characteristics

Different types of open water bodies and closed water bodies are present in the study area. The open water bodies include river, beel and closed water bodies comprise in fish pond and cage fish culture. However, fish habitats in the study area may be classified in two major groups-capture fisheries and culture fisheries.

Capture fisheries: The capture fisheries having river, canal and floodplain function as important fish habitats in the study area. Bangshi River serve as fish habitation for major carp, cat fishes, prawn and other inland fresh water fishes. Besides the rivers, the study area contains Bamui beel which function as fish migration corridor for indigenous fishes.

Culture fisheries: The culture fisheries in the study area are classified into fish pond and cage fish culture. Most of the ponds situated along with homestead land. Traditional to semi-intensive aquaculture are practices in these ponds and culture systems are depends on pond size, water availability and water quality.

4.9.4 Fish Production and Effort

The total annual fish production in Jamalpur District was 82428 Metric Ton (MT) in 2016-17. The annual fish production in River, beels, flood plain, pond and seasonal cultured water body were 1442 Metric ton, 18629 metric ton, 30241 metric ton, 25766 metric ton, and 6312 metric ton, respectively (Fisheries Statistical Yearbook, 2016-17). However, the production is declining typically due to obstacles to fish migration and reduction of fish habitats. Aquaculture is expanding gradually in the area by converting the cultivated land, as well as the medium low lands of the area.

The information regarding fisheries in Jamalpur Sadar Upazila is given in the Table.

Table 4.12: Fish production in Jamalpur Sadar Upazila

Sources	2010-2011	2009-2010
Number of pond	6884	-
Number of Dighee	1	-
Number of fisherman	5980	5960
Production of fish	1326	1392

Source: Jamalpur District Statastics, 2011

4.9.5 Fish Migration

Fishes generally migrate to one habitat to another for feeding, sheltering, breeding and nursing purposes. River, internal Khal and floodplain have combined function of feeding, breeding and sheltering of fishes in the study area. Many fish species migrate horizontally and many other vertically in these water bodies as part of their life cycle.

4.9.6 Fish Species Diversity

The Project area is low in fish biodiversity though biodiversity of fishes has been declining over the years. Obstruction in fish migration routes, morphological changes of internal khals, siltation of fish habitats, squeezing of spawning and feeding grounds and further expansion of both culture fishery are some of the causes of gradual declining of fish abundance and biodiversity.

The common varieties of fish that are found in different water bodies of the district are ruhi or salmon (*Labeo rohita*), mrigel (*Cirrhinus mrigala*), kalbous (*Labeo calbasu*), katla or carp (*Catla catla*), etc. shoal fish (*Channa striatus*), scorpion-fish or singi (*Heteropneustes fossilis*) are also found in large quantity in beels and khals. Many other spieces of river and fresh water fishes are also found in the district. Of these the principal varieties are boal/sheat fish (*Wallago atttu*), dhain, chital (*Notopterus chitala*), ghona, airh (*Mystus aor*), bagair (*Bagarius yarrellii*), pangas (*Pangasius pangasius*), boal (*Wallago Attu*), rita (*Rita rita*), bain or eel (*Mastacembelus armatus*), chapila (*Gudusia chapra*), bhagna (*Labeo boga*), nandail bacha, pon, gargle (*Arius gagora*), kaulia, kapali, khorsols mehsir, golsha (*Mystus bleekeri*), tengra (*Mystus vittatus*), chanda (*Mene muculata*), tekchanda (*Gerres argyreus*), kachki (*Corica soborna*), baila (*Glossogobius giuris*), bheda (*Nandus nandus*), batashi (*Pseudoutropius atnerinoides*), kakila (*Strogylura strogylura*), phali or flat fish (*Notopterus notopterus*), tatkeni (*Crosscheilus latius*), pabda or butter fish (*Ompok pabda*), chela (*Chela cachius*), gangchela, gazar (*Channa marulius*), koy or climbing fish (*Anabas testudineus*), kholisha (*Colisa fasciatus*), puti (*Barbus puntius*), sharputi (*Puntius sarana*), taki (*Channa punctatus*), walking fish (*Ophicephalus striaxtus*), malandi, bashpata (*Danio devario*), kakra (*Scylla serrata*), meani, shrimps, and prawn are found in the district. However , some of these varieties, specially those which inhabit the marshes and tanks, are dwindling due to over catching and other reasons such as use of insecticides and pesticides for crop production, etc.

4.9.7 Fisheries Management

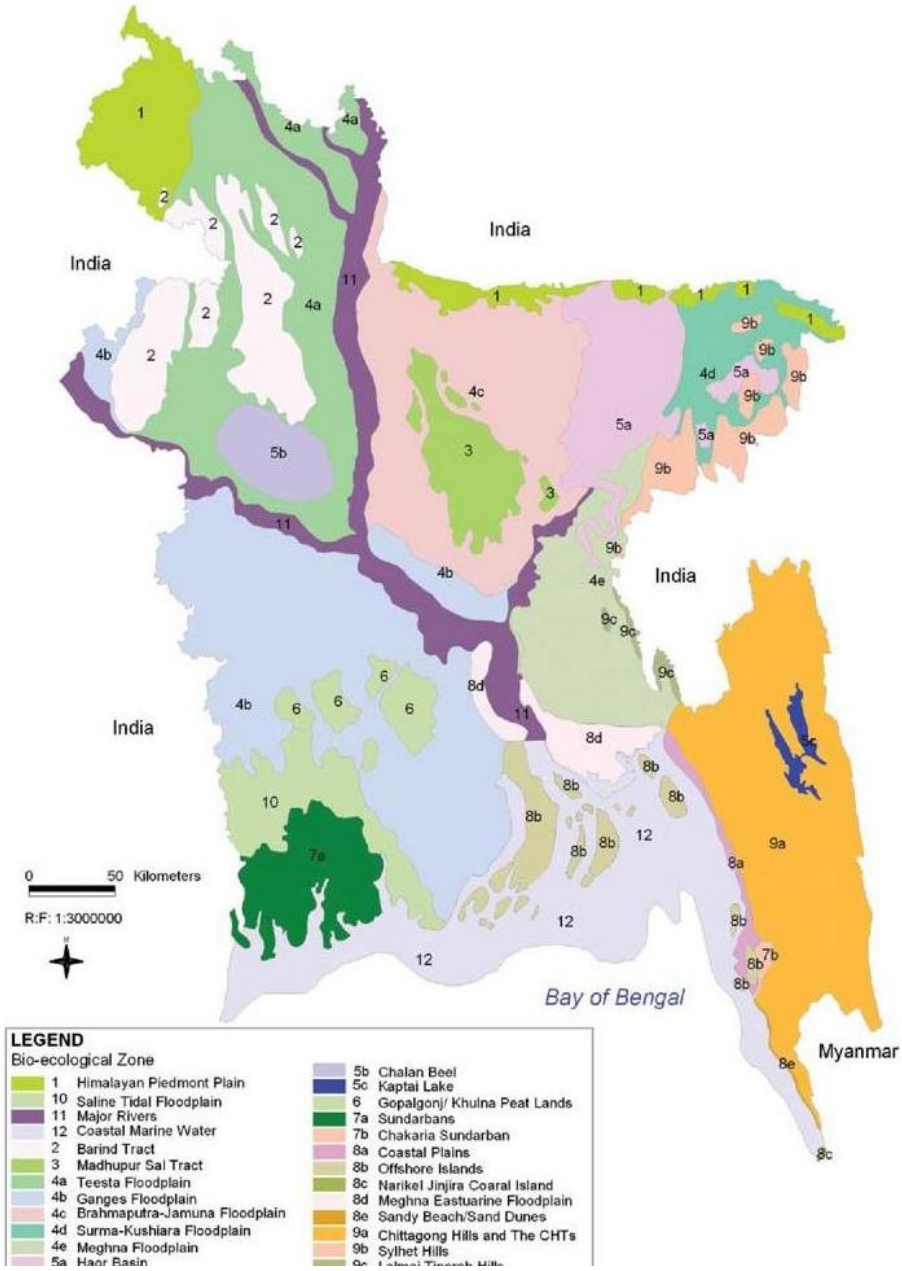
There is no fishery based community association found in the study area. Fishing right on existing fish habitats is limited. Enforcement of fisheries regulation is also weak. No fish sanctuary is found in the study area.

4.10 Ecological Resources

4.10.1 Bio-ecological Zone

IUCN, The World Conservation Union, has divided Bangladesh into 25 Bio-ecological Zones (Nishat et al, 2002) in the context of physiographic and biological diversity. The study area has fallen under bio-ecological zone of Brahmaputra-Jamuna Floodplain (4c). The area (both directly and indirectly impacted area) occupies terrestrial as well as aquatic ecosystems. Each of the bio-ecological zones represents the overall ecological situation of an area of the country. A map of the Bio-ecological zone is presented in the figure below.

Figure 4.26: Bio-ecological zone of Bangladesh



4.10.2 Common Flora and Fauna

Terrestrial Flora

A part of the Jamalpur district lies in the physiographic sub-region. Brahamaputra–Jamuna left bank active floodplain consisting of the Diaras along the left bank and the chars within the river where the soils are mainly silty alluvium with extensive areas of sand in the chars. Another part of the district lies in the sub-region, the old Brahamaputra floodplain where the soils are mainly loams on the ridges and clays in the basins.

Crops: The main agricultural crops of the district are rice, jute and sugarcane. Jute and sugarcane remain the main cash crops. Among rice crops, transplanted aman covers the largest area followed by boro and aus. Rabi season crops include potato, sweet potato, pulses, different kinds of vegetables, spices, cheena, etc. Banana is grown thickly around the homesteads, especially in the newer accretions.

Fruits: There is a wide variety of trees in the district. Most of these trees are planted at the raised platforms of homesteads. The chief fruit trees of the district are mango (*Mangifera indica*), jackfruit (*Artocarpus heterophyllus*), jambura (*Citrus decumana*), guava (*Psidium guajava*), papaya (*Carica papaya*), wood apple, or bel (*Aegle marmelos*), ata (*Anona squamosa*), boroi or kul (*Zizyphus mauritiana*), kamranga (*Averrho karambola*), black berry (*Syzygium cumini*), labu (*Citrus carantifolia*), kodbel (*Limonia acidissima*). The most characteristics feature of the landscape is the palm, the commonest species being khejur (*Phoenix sylvestris*), betel nut (*Areca catechu*), coconut (*Cocos nucifera*) and tal (*Borassus flabellifer*). On comparatively higher ground jackfruit or kanthal and lichi are the most frequent.

Trees: Along the water sources and water tanks, the mandar (*Erythrina variegata*), badi (*Lannea grandis*) and hijol (*Barringtonia acutangula*), kadam (*Anthocephalus cadamba*), neem (*Azadirachta indica*), pitraj (*Aphanamixis polystachia*), gab (*Diospyros precatorius*), jalpai (*Elaeocarpus tectoris*), jarul (*Legerastroemia speciosa*), bakul (*Mimusops elengi*), mendi (*Lawsonia inermis*), gamar (*Gmelina arborea*), mitinga bans or bamboo (*Bambusa bambos*) and bora bans (*Bambusa balcooa*). However, various exotic trees like teak, mahagoni (*Swietenia macriophylla*), sissu (*Dalbergia sissoo*), etc. have been introduced as wayside trees as well as farm forestry. Mandar, a thorny tree mostly used as fuel and fencing, is seen in almost every household forest. Shimul (*Bombax ceiba*), palosh (*Butea monosperna*) katbadam (*Terminalia catappa*) and kadam trees are very common and are preferred for manufacturing match stick. The fruit or shimul or karpus is used for stuffing mattresses and pillows and has a silky appearance. Newly introduced trees include Eucalyptus and Pine. Mango wood is not good as a timber, but owing to its being in abundance, it is much used. The wood of tamarind and kul is hard grained and of good quality. The amaltas is used for house and rough furniture. Jarul is used for boat building and pillars of house. The luxuriant growth of palms is the most characteristic feature of the vegetation. Toddy palms or tal (*Borassus flabellifer*) and date palms (Khejur) are also very common. Date palm is valuable tree. The juice is extracted and made into gur, the leaves are used for making large fans. Shady trees include banyan or bat (*Ficus benghalensis*), aswatha (*Ficus religlosa*), pipal (*Ficus religiosa*) and neem (*Azadirachta indica*). There are several varieties of cane, a good deal of bamboo of different varieties and thatching grass (chhan) although their plantations are gradually decreasing steadily. Use of bamboo is widespread such as post and fencing of houses, making of baskets and trays of various kinds. Besides, roadside trees are represented by sonalu (*Cassia fistula*), debdaru (*Polyalathia longifolia*), krishnachura (*Delonix regia*), tetul (*Tamarindus indica*), etc. These trees are commonly seen everywhere.

Lichen/Ferns: The swamps, ditches and many of the village ponds contain a rich variety of species. The kachuri pana (*Telanthera philoxeroides*), topa pana (*Pistia stratiotes*), khudi pana (*Lemna paucicostata*), pani phal (*Trapa bispinosa*), the cucurious floating ferns, *azolla pinnata* and *salvinia natans* etc. are seen in these water bodies. In older and shallower ponds are found species of padma (*Nelumbo nucifera*), shapla (*Nymphaea nouchali*), nil padma (*Nymphaea stellata*), the common aquatic leafy greens, kalmi (*Polygonum*), helencha (*Tilanthera philoxcroides*), etc.

Figure 4.27: Different flora in the study area

Terrestrial Fauna

Mammals: Among the mammalian fauna the smaller species are usually seen in the countryside of Jamalpur district. They include chika (*Suncus murinus*), rat (*Bandicota bengalensis*), ground rat (*Mus booduga*), mouse (*Mus musculus*), sajaru (*Atherurus macrourus*), squirrel (*Petaurista magnificus*). Katbiral (*Collosciurus pygerythrus*), rabbit (*Caprologus hispidus*), benji (*Herpestes edwardis*), jackal (*Canis aureus*), fox (*Vulpes bengalensis*), bat (*Rousettus leschenaulti*), indian pipistrelle (*Pipistrellus coromandra*), bengal mongoose or benji (*Herpestes auropunctatus*), etc.

Birds: The resident birds that are ubiquitous in the countryside and urban areas are bulbuli (*Picnonotus cafer*), sparrow (*Passer domesticus*), crow (*Corvus splendens*), vat

shalik (*Acridotheres tristis*), kali pencha (*Glaucidium radiatum*), bhuban chil (*Milvus migrans*). Other common resident birds comprise punkaor (*Phalacrococan niger*), korchey bok (*Ardeola grajii*), dove or tila ghugu (*Streptopelia chinenisis*), horial (*Treron phoenicoptera*), tia (*Psillacula krameri*), pigeon (*Columba sp.p.*), cuckoo (*Cuculus microplerus*), nimpokh (*Otus bakkamaena*), laxmi pencha (*Tyto alba*), ababil (*Hirundo rustica*), kingfisher (*Alcedo atthis*), little kingfisher (*Alcedo atthis*), banashpati (*Merops orinetalis*), kaththokra (*Picus myrmecophoneus*), bharat pakhi (*Mirafra assamica*), jhuti shalik (*Acredotheres fuscus*), tuntuni (*Orthotomus sutorius*), magpie robin (*Copsychus saularis*), titpokh (*Parus major*), madhuchuski (*Nectariniaasiatica*), mautushi (*Nectarinia zeylonica*), babui (*Ploceus philippinus*), tila munia (*Lonchura punctulata*), etc. Besides, various species of migratory birds are seen in different open water bodies of the district. These are khonjan (*Motacilla cinerea*), Indian tree pipit (*Anthus hodgsoni*), booted warbler (*Hippolais caligata*), lalbok chotok (*Muscicapa parva*), badami koshai pakhi (*Lanius cristatus*), little stint (*Calidris minuta*), kadakhucha (*Gallinago gallinago*), chaga (*Gallingo stenura*), kalo hans (*Aythya ferina*), bhuti hans (*Aythya nyroca*), giria hans (*Anas querquedula*), lenja hans (*Anas acuta*), chokachoki (*Tadorna ferrugeniea*), shachka (*Tadorna tadorna*), raj hans (*Anser indicus*), greenleg goose (*Anser anser*), gadwall (*Anas strepera*), plover (*charadrius alenasdrinus*), herring gull (*Larus argentatus*), common swallow (*Hirundo rustica*), etc. Raptorial birds include king vulture or shakun (*gyps bengalensis*), lanner falcon or baj (*Falco biarmicous*), marsh harrier or gochila (*Circus aeruginosus*), pariah kite or cheel (*Milvus migrans*), several species of stork like pond heron or kani boga (*Ardeola grayii*), cattle egret or o baga (*Babulcus ibis*) and black bittern or kala boga (*Dupeter plovicollis*), and some other domestic species. Water birds include the little cormorant or pankawri (*Phalacrococan niger*), waterhen or dauk (*Amaurornis phoenicurus*), watercock or kora (*Gallicrex cinarea*), etc.

Reptiles and Amphibians: The reptiles include different species of snakes are dhora shap (*Xenocirophis piscator*), meteshap (*Micropisthodon plumbicolor*), and painashap (*Enhydris enhydris*). The most poisonous snakes are variety of cobras. They are shankhini shap (*Bungarus cacruleus*) and jatshap (*Naja kaouthia*). Reptiles also include gui shap (*Varanus salvator*), hungui shap (*Varanus flaviscens*), kori kaitla (*Kachuga tecta*), dhum kasim (*Trionyx hurum*), tiktiki (*Hemidactylus brooki*), shanda (*Gekko gecko*), etc. (Jamalpur District Statistics, 20111 & field visit).

Figure 4.28: Different fauna in the study area

4.10.3Ecosystem Services and Function

The Millennium Ecosystem Assessment (MA) defined ecosystem services are "the benefits people obtain from ecosystems." The MA also delineated the four categories of ecosystem services—supporting, provisioning, regulating and cultural. The national economy and the people of Bangladesh are inseparably linked to the productivity and sustainability of Bangladesh's ecosystem, including vast and differentiated terrestrial ecosystem that are seasonally variable in their characteristics as well. The population of the project area usually gets all types of ecosystem services as discussed below.

Supporting services

Ecosystem services "those are necessary for the production of all other ecosystem services". These include services such as nutrient recycling, primary production and soil formation. These services make it possible for the ecosystems to provide services such as food supply, flood regulation, and water purification.

Products obtained from ecosystems

- Food, crops and spices
- Raw materials (including lumber, skins, fuel wood, organic matter, fodder, and fertilizer)
- Genetic resources (including crop improvement genes, and health care)
- Water

- Biogenic minerals
- Medicinal resources (including pharmaceuticals, chemical models, and test and assay organisms)
- Energy (hydropower, biomass fuels)
- Ornamental resources (including fashion, handicraft, jewelry, pets, worship, decoration and souvenirs like furs, feathers, ivory, orchids, butterflies, aquarium fish, shells, etc.)

Regulating services

"Benefits obtained from the regulation of ecosystem processes."

- Carbon sequestration and climate regulation
- Waste decomposition and detoxification
- Purification of water and air
- Pest and disease control

Cultural services

"Nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences"

- Cultural (including use of nature as motif in books, film, painting, folklore, national symbols, architect, advertising, etc.)
- Spiritual and historical (including use of nature for religious or heritage value or natural)
- Recreational experiences (including ecotourism, outdoor sports, and recreation)
- Science and education (including use of natural systems for school excursions, and scientific discovery)
- Therapeutic (including Ecotherapy, social forestry and animal assisted therapy)

4.10.4Status of Protected Area/Threatened Species in the Project Site

There is no protected or ecologically critical area or habitat for threatened species in the proposed project site. In addition, no species were found during field visit which fall under IUCN red category.

4.11 Socio-economic Condition

4.11.1Demographic Information

Jamalpur Sadar, the largest upazila of Jamalpur District in respect of both area and population, came into existence in 1853 as a thana and was upgraded to upazila on 1 December, 1983. Nothing is definitely known about the origin of the upazila name. There is a hearsay that, during the time of Emperor Akbar, Hazrat Shah Jamal (R.A) along with two hundred followers came from Yemen and camped at Singhajanee mauza on the south bank of the Brahmaputra River. In course of time settlements grew up around the place which became known as Jamalpur after the name of Hazrat Shah Jamal.

Table 4.13: Demographic scenario of the study area

Key Indicators	District		Upazila	
	2011	2001	2011	2001
Population (Enumerated)				
Both Sex	22,92,674	21,07,209	6,15,072	5,68,726
Male	11,28,724	10,75,694	3,01,912	2,90,159
Female	11,63,950	10,31,515	3,13,160	2,78,567
Urban	3,36,010	2,99,648	1,42,764	1,20,955
Other Urban	51,859	31,616	7,408	7,208
Rural	19,04,805	17,75,945	4,64,900	4,40,563
Annual growth rate (%)	0.83	1.18	0.77	1.26
Sex Ratio				
Total	97	104	96	104
Urban	99	105	100	105
Other Urban	97	103	97	111
Rural	97	104	95	104
Household				
Total	5,63,367	4,81,235	1,52,174	1,32,265
Urban	81,668	67,746	33,845	26,756
Other Urban	12,568	7,377	1,774	1,487
Rural	4,69,131	4,06,112	1,16,555	1,04,022
Household Size (General)				
Total	4.06	4.37	4.01	4.28
Urban	4.06	4.40	4.11	4.46
Other Urban	4.11	4.27	4.17	4.72
Rural	4.06	4.37	3.98	4.23
Area sq. km.	2115.16	2031.99	508.80	489.56
Area sq. mile	816.66	784.55	196.45	189.02
Density per sq. km.	1084	1037	1209	1162
Density per sq. mile	2807	2686	3131	3009
Urbanization (%)	16.92	15.72	24.42	22.54
Literacy (7 years and above) (%)				
Both Sex	38.4	31.8	47.0	39.7
Male	41.1	35.4	49.6	42.6
Female	35.9	28.0	44.5	36.7
School Attendance (5 to 24 years) (%)				
Both Sex	54.7	37.7	37.7	42.4
Male	58.4	40.8	62.3	45.5
Female	51.2	34.4	54.7	39.3
Population (Adjusted)				
Both Sex	23,84,810	22,06,427	6,40,539	5,96,024

Key Indicators	District		Upazila	
	2011	2001	2011	2001
Male	11,74,104	11,26,348	3,14,432	3,04,090
Female	12,10,706	10,80,079	3,26,107	2,91,934
Administrative/Geographic Unit				
Upazila	7	7	1	1
Union	68	68	15	15
Mauza	745	844	253	300
Village	1,361	1,346	365	353
Paurashava	6	6	1	1
Ward	57	57	12	12
Mahalla	225	225	76	79

Source: Community Report of Jamalpur, 2011

Area and location: The upazila occupies a total area of 508.80 Sq.km. It is located between $24^0$42 and $24^0$58' north latitudes and between $89^0$52' and $90^0$12' east longitudes. The upazila is bounded on the north by old Brahmaputra river, Sherpur Sadar Upazila and Nakla Upazila of Sherpur Zila, east by Muktagachha Upazila and Mymensingh Sadar Upazila of Mymensingh Zila, south by Madhupur Upazila and Dhanbari Upazila of Tangail Zila and Sarishabari Upazila and west by Melandaha Upazila and Madarganj Upazila.

Administrative/Geographic Unit: The upazila consists of 1 paurashava, 12 wards, 76 mahallas, 15 unions, 253 populated mauzas and 365 villages. The average size of population of each ward and mahalla are 11897 and 1878 respectively. On the other hand, the average size of population of each union, mauza and village are 31487, 1867 and 1294 respectively.

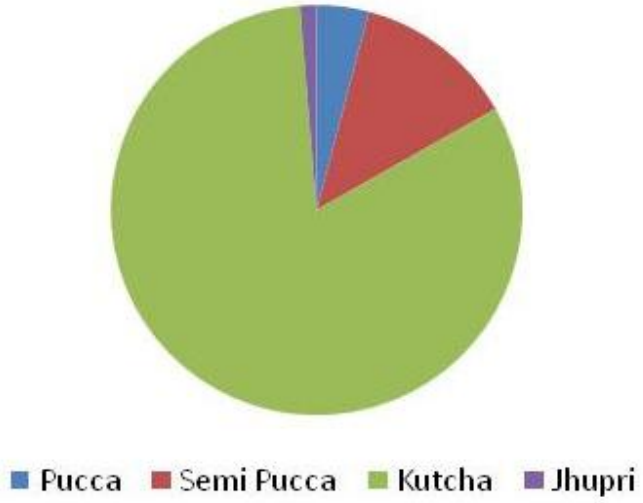
4.11.2Status of Life Indicators

Housing and Household Characteristics: In the upazila, there are 152174 households. Distribution of household by type shows that there are 99.68% general unit 0.04 institutional and 0.28% other unit.

Household Size: The average household size (General) for the upazila is 4.0 persons, for rural area the size is also 4.0 and for urban area the size is slightly higher i.e.

Type of Housing Structure: In the upazila, 4.1% general household live in pucca house, 12.7% in semi-pucca house, 82.0% in kutcha house and the remaining 1.2% live in jhupri which is shown in a pie-chart in the figure below.

Figure 4.29: Housing structure by type at Jamalpur Sadar Upazila



Source of Drinking Water: In Jamalpur Sadar Upazila, 96.1 % general household get the facility of drinking water from tube-well, 1.0% from tap and the remaining 2.9% household get water from other sources.

Sanitation: In the upazila, 53.8% general household use sanitary latrine, 38.4% non-sanitary latrine and the remaining 7.8% have no toilet facility.

Access to Electricity: All the 15 unions of the upazila have brought under the Rural Electrification Program. However, a total of 50.0% general household reported to have electricity connection in the entire upazila in 2011 as against 28.7% in 2001.

Population Characteristics: According to Population and Housing Census 2011, the total population of the upazila is 615072 of which 301912 are males and 313160 are females. The sex ratio of the upazila is 96 which have remarkably decreased in 2011 as against 104 in 2001.

Growth Rate: The decadal population growth rate for the upazila is 8.15% and annual compound growth rate is 0.77%. The decadal growth rates over the last half-century are shown in the following table.

Table 4.14: Decadal growth rate of population, 1951-2011

Decades	Growth Rate (%)
1951-1961	7.6
1961-1974	40.0
1974-1981	22.0
1981-1991	18.4
1991-2001	13.3
2001-2011	8.1

Source: Community Report of Jamalpur, 2011

Literacy and Education: Information on literacy and education is furnished below:

Literacy: In Jamalpur Sadar Upazila, it is found that 47.0 % populations aged 7 years and over are literate. Literacy rate by sex of three consecutive censuses are shown in table.

Table 4.15: Literacy rate by sex, 1991-2011

Item	1991	2001	2011
Both Sex	27.6	39.7	47.0
Male	32.8	42.6	49.6
Female	22.1	36.7	44.5

Source: Community Report of Jamalpur, 2011

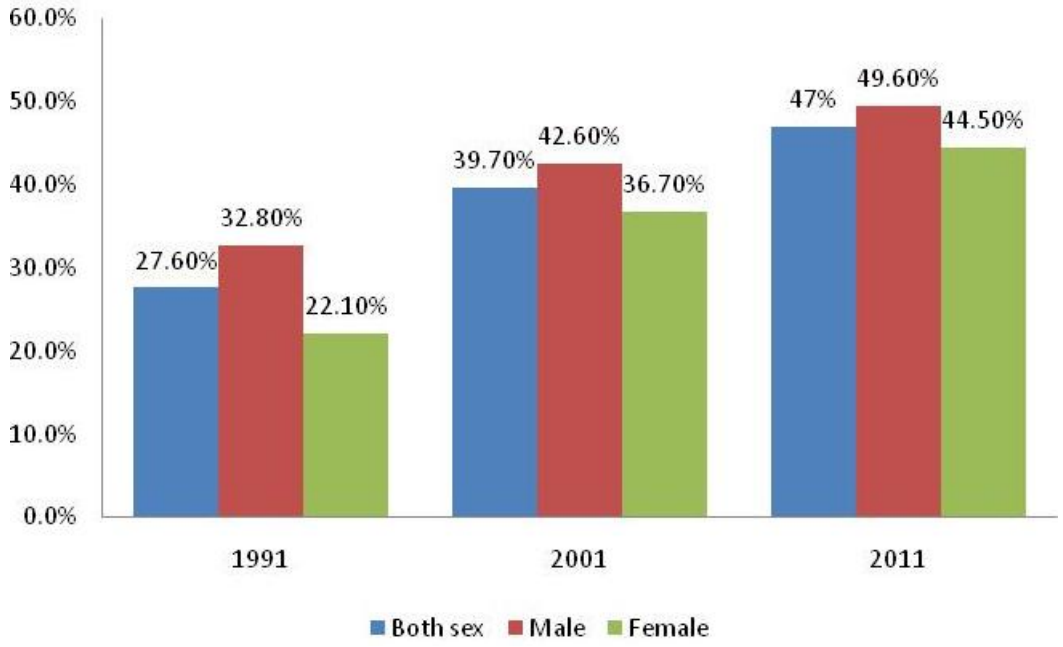


Figure 4.30: Literacy rate by sex, 1991-2011

Above data shows that the literacy rate of the upazila in 2011 is 47.0% for both sex, 49.6% for male and 44.5% for female. It shows an increase of 7.3, 7.0 and 7.8 percent point in 2011 over 2001 for both sex, male and female respectively. In the upazila, the literacy is the highest i.e. 82.2% in Ward No. 03 of Jamalpur Sadar Paurashava and the lowest i.e. 32.9% in Lakhmmir Char Union.

Education: School attendance of boys and girls between ages 3-29 years is presented in table.

Table 4.16: School attendance rate by sex, 2011

Item	3-5 Years	6-10 Years	11-14 Years	15-19 Years	20-24 Years	25-29 Years
Both Sex	9.91	79.39	84.51	54.19	13.31	2.17
Male	10.07	79.25	82.53	58.77	20.00	3.19
Female	9.74	79.54	86.65	49.47	8.97	1.39

Source: Community Report of Jamalpur, 2011

There exist differences in school attendance rates in different age groups which can be observed from the table. The female attendance rate in the age groups 6-10, and 11-14

years is higher than their male counterparts. On the other hand, male attendance rate in the age groups 3-5, 15-19, 20-24 and 25-29 year is higher than female. The highest school attendance rate is 86.65%, which is found for female in the age group 11-14 years.

Table 4.17: Number and types of different educational institutions in the project area

Name of the educational institutions	Number of educational institutions
Government primary school (class I-V)	166
Registered primary school (class I-V)	60
Private (non-registered) primary school(class I-V)	5
Kindergarten school (pre schooling)	26
NGO school	53
Government secondary school	3
Non-government secondary school	101
School & college (operating jointly)	2
Government college	2
Non-Government college	11
Madrasah	11
Kawmi madrasah	63
Ebtedayee madrasah	37
Technical and vocational institution	4
University	1

Source: Jamalpur District Statistics, 2011

Noted Educational institutions of the Jamalpur Sadar Upazila are Government Ashek Mahmud College (1946), Government Jaheda Safir Mahila College (1967), Jamalpur Zilla School (1881), Jamalpur Government Girls' High School (1882), Shinghajani Girls' High School (1901), Shinghajani Multilateral High School (1918), Kaidola Sahabajpur High School (1920), Bangladesh High School (1924), Shreerampur Multilateral High School (1927), Rashidpur NU Fazil Madrasa (1930), Nandina Maharani Hemanta Kumari Pilot High School (1935). (Banglapedia, 2019).

In HIES 2016, literacy rate stands at 65.6% at the national level where 67.8% for the male and 63.4% for the female population. In rural areas, literacy rates of population of both sexes, male and female are 63.3%, 65.5% and 61.2% respectively. In urban areas, literacy rates of population of both sexes, male and female are 71.6%, 74.0% and 69.3% respectively. In 2010, literacy rate was 57.9% at the national level for both sexes with 53.4% in rural areas and 70.4% in urban areas. Literacy rate of male was 61.1% and that of female population was 54.8%. In rural areas male literacy rate was 56.7% compared to 73.1% in urban areas. Similarly, female literacy rate was 50.2% in rural areas as compared to 67.7% in urban areas.

Health

The health profile for Jamalpur Sadar Upazilla indicates that the most prevalent diseases within the project area are tuberculosis, pneumonia and diarrhoea etc. Other seasonal diseases in the project area like cold, seasonal viral fever etc. The condition of health services related institutions of the project are given in the following Table.

Table 4.18: Health related facilities in the project area

Health related facilities	Number of health related facilities
1. Government health complex	262
2. Private hospital/clinic	20
3. Diagnostic center	51
4. Missionary hospital and charitable dispensary	0
5. Physician/Practitioner	315
6. Number of health center providing health and family planning services	15
7. Number of existing family planning personnel	1
8. Number of Community clinic	61

Source: Jamalpur District Statistics, 2011

Transportation

Road transport and railway communication are available in the project area. Joydebpur-Tangail-Jamalpur highway is in the east site the project. In Jamalpur Sadar Upazila, there are 250 km metalled road, 103 km semi metalled road, 743 km un-metalled road, 48 km waterways during monsoon season and 46 km railways (Jamalpur District Statistics, 2011). The culture of the area is manifested in various cultural forms, including music, dance and drama, art and craft, folklore and folktales, literature, philosophy and religion, festivals etc.

4.11.3 Income and Poverty

The estimate of HCR (Head Count Rates) in 2016 using the lower poverty line for Mymensingh Division is 17.6 percent and upper lower poverty line is 32.8. Enrolment from poor households for Mymensingh division is 92.1% and for non-poor households is 96.6%. Average amount received (tk) per household from Social Safety Nets Programme (SSNP) is 3240.2. Poverty rate (using upper poverty lines) of Jamalpur District is 52.5 (HIES, 2016).

4.11.4 Gender and Women

The sex ratio is in Jamalpur Sadar Upazila is96. The difference between literacy rates (7+) of women (44.5%) and men (49.6%) in Jamalpur Sadar Upazilla is not so high (BBS Jamalpur District Statistics, 2011). Women comprises almost 50% of the total population which indicates a healthy sex ratio. This indicates a lower disparity for the girl child. However, women in Jamalpur District may still be classified as vulnerable due to the fact that a large fraction of the same are not allowed to work or earn a living or pursue higher level education due to cultural and religious belief. They are mostly relegated to household chores, raising families and domestic works like raising cattle

and crop harvest. They are also occasionally attributed to social evils like child marriage, polygamy and domestic violence.

4.11.5 Common Property Resources

Throughout the world there are assets that are neither private nor state property, but common property. The term denotes a class of institutions that govern the ownership and rights-of-access to assets. Common property assets are to be distinguished from "public goods," in that, unlike the latter, use by someone of a unit of a common property asset typically reduces the amount available to others by one unit (in economic terminology, such an asset is rivalrous in use). The institution of common property creates and harbors reciprocal externalities. As some of the most interesting examples of common property assets are natural resources, this entry is restricted to them. Social Institutions, Khals, Playgrounds can be referred as common property resources. Hats, bazars and fairs are social institution or at least the mechanism of not only trade but also social interaction. The common property resources of the project are having been given in the table below.

Table 4.19: Common property resources of the project area

Common property resources	Number of common property resources
Daily bazar	25
Weekly hat	36
Public library	2
Mosque	985
Eid-Gah	144
Temple	42
Church	7
Pagoda	0
Stadium/ Playground	212
Park/ Amusement Park	2
Bridge	53
Baily bridge	1
Culvert	671

Source: Jamalpur District Statistics, 2011

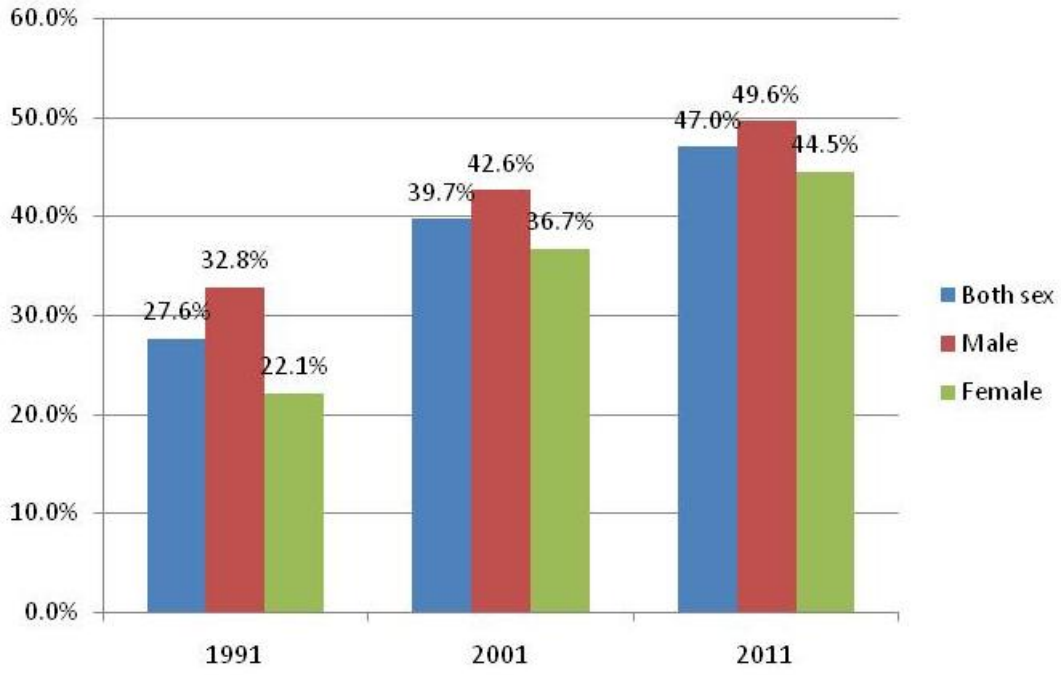
4.11.6 Literacy Rate

47.0 % populations aged 7 years and over are literate in Jamalpur Sadar Upazila. Literacy rate by sex of three consecutive censuses are shown in the table below:

Table 4.20: Literacy rate by sex, 1991-2011

Item	1991	2001	2011
Both	27.6	39.7	47.0
Male	32.8	42.6	49.6
Female	22.1	36.7	44.5

Figure 4.31: Literacy rate by sex, 1991-2011



Source: Community report of Jamalpur District, 2011

Above table shows that the literacy rate of the upazila in 2011 is 47.0% for both sex, 49.6% for male and 44.5% for female. It shows an increase of 7.3, 7.0 and 7.8 percent point in 2011 over 2001 for both sex, male and female respectively. In the upazila, the literacy is the highest i.e. 82.2% in Ward No. 03 of Jamalpur Sadar Paurashava and the lowest i.e. 32.9% in Lakhmmir Char Union (Community report of Jamalpur District, 2011).

4.11.7 Conflict of Interest and Law and Order Situation

The entire community of Jamalpur district receives law and order service from 08 police stations: Jamalpur, Melandoho, Sarishabari, Dewangonj, Islampur, Madargonj, Bakshigonj and bahadurabad, 02 outposts under 02 circles. There are one thana in Jamalpur Sadar Upazila.

Local conflicts may occur between local residents who may feel that they have received unfair compensation and other local residents or conflict with staff of the Deputy Commissioner's Office. Conflict may occur between local residents and external workers because of any changes to local customs if external workers cannot understand local customs. Regulations in Bangladesh stipulate the need to conduct public consultations in land acquiring processes.

Local people should be employed for the construction works to the maximum extent possible, and any workers from other countries should be taught to respect local customs in order to facilitate good relationships with local people. The lodgings of the project workers should be equipped with sufficient living facilities to keep workers at the project site as much as possible.

4.11.8 Historical, Cultural and Archaeological Sites

Tomb of Hazrat Shah Jamal (R), Dayamayee Mandir and Radhanath Jeur Mandir are remarkable place in Jamalpur Sadar Upazila.But,there are no historical, cultural and archaeological properties or heritage sites in or around the project site.

4.11.9 Affected People due to project

During feasibility study social assessment was carried out and it was found that 106 household will be affected due to the project directly. There are also two mosque within the project area. As per government record, impacted homestead is 9.6 acre, which is less than 3% of total project area. Beside these, also some people will affected indirectly.

As per social survey, 69% affected household are prefer to get project assisted relocation. Beside these, 78% of the respondents opted 'structure for structure loss' and rest 22% prefer 'cash for structure loss as compensation. A compensation structure is developed by government to give proper compensation to the affected people.

5 Identification and Analysis of Key Environmental Issues

5.1 Environmental Sensitivity Investigation

The proposed project area is environmentally sensitive due to the geographical location. All the environmentally sensitive issues were investigated by a selected consultants group through carry out primary and secondary data analysis. The main hindrances of the proposed project sustainability are natural calamity like flood earthquake etc. Design consultants should consider this sensitive issue in the design structure to make project environmentally sound and sustainable. The structure should be maintained adequate height to protect from flood, earthquake, landslide etc. Disaster management plan has to be developed by the project proponent to protect from natural calamities.

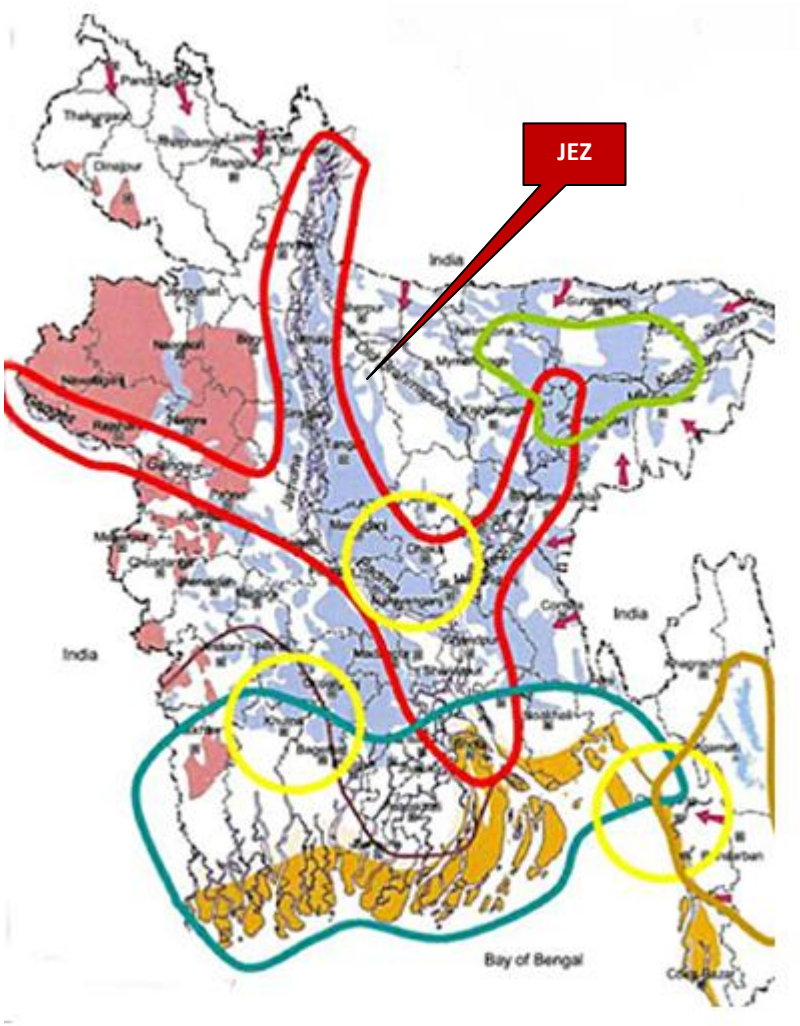
5.1.1 Natural Hazard

A vulnerability map gives the precise location of sites where people, the natural environment or property are at risk due to a potentially catastrophic event, often induced by climate change, which could result in death, injury, pollution or other destruction. Such maps are made in conjunction with information about different types of risks. It could delineate the commercial, tourist, and residential zones that would be damaged in case of natural disaster.

Vulnerability mapping can allow for improved communication about risks and what is threatened. It allows for better visual presentations and understanding of the risks and vulnerabilities so that decision-makers can see where resources are needed for protection of these areas. The vulnerability maps will allow them to decide on mitigating measures to prevent or reduce loss of life, injury and environmental consequences before a disaster occurs. Those preparing the maps can overlap flood inundation and slope stability zones with property maps in order to determine which properties and buildings are at risk. They can then notify the landowners and inform them of government subsidies or other support available for undertaking a measure that would protect their homes from potential damage by, for example, water inundation or slope failure.

The following figure shows the vulnerability map of different hazards of Bangladesh. Form the figure it is understood that the study area is fall in flood affected area. It would help the decision maker to take decisions during design period.

Figure 5.1: Inventory of different hazard areas



Source: CEGIS

Note:
Inventory of the vulnerable areas for droughts –pink; floods-light blue; surges-yellow ochre;
Hot spots related to large rivers -in red; coast-blue; urban centres-yellow; haor/wetlands-green; hill tracts/soil erosion-yellow ochre. [1]

5.1.2 Seismicity

Seismic structural strength assessment of existing buildings, strengthening of existing proposed foundation system and superstructures of critical structures, incorporation of liquefaction potential criteria in the structural design process for structures are few of the considerations to be in mind. A preventive measure can be coordinated by ensuring anti-seismic design (end bearing pile foundation including bored or driven piles and use reinforced concrete raft for shallow foundation), quality control (selection of adequate material and appropriate workmanship) under expert supervision.

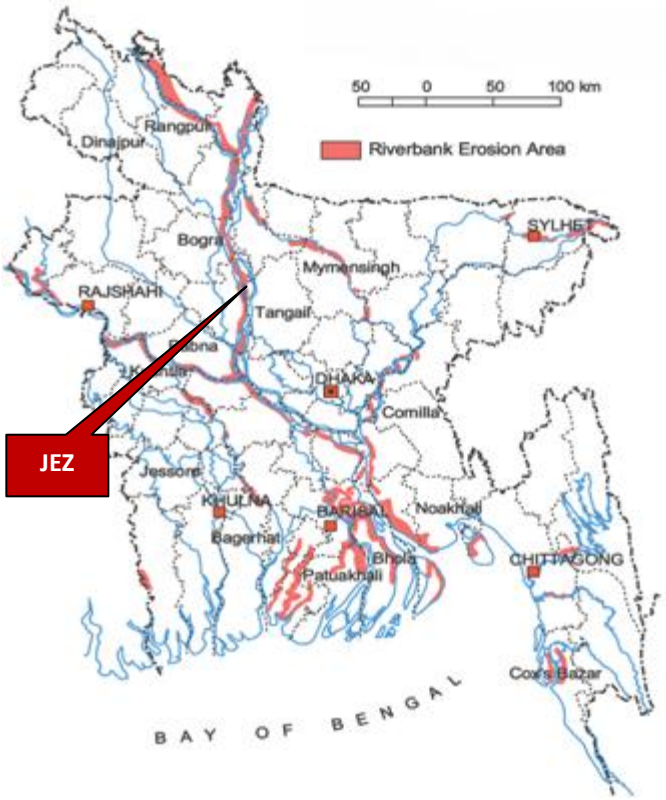
[1] https://www.dutchwatersector.com/news-events/news/11347-bangladesh-government-takes-up-100-year-delta-plan-to-reduce-climate-risks.html

JEZ site lies in the seismic zone-3 which is high intensity seismic zone with basic seismic coefficient of 0.25 g. The buildings and land based structures for this project should be designed to withstand maximum effect of earthquake.

5.1.3 Flooding and River Bank Erosion

The flood prone map of Bangladesh shows that proposed JEZ falls in monsoonal flooding area. River bank erosion is found as a problem in the project area. So, the project proponent needs to develop land by land filling and manage water logging in the project and surrounding area.

Figure 5.2: Erosion map pf Bangladesh



5.1.4 Change of Meteorology

Development work of the area will affect local climate such as temperature, rainfall, humidity, etc. Effluents need to treat properly before discharge into the environment. So, the species distribution including flora and fauna will not be disturbed in this region.

5.2 Environmental Asset

Environmental assets identified in the study area are listed below:

1. Air quality of the area
2. Water quality of the area
3. Noise level of the area
4. Transportation system of the area
5. Ecosystem of study area

Identified Environmental assets of the project are likely to be impacted due to development of the different facilities during the pre-construction, construction and operation stages of the project along with the project activities which may have an impact on the Environmental assets and the associated impacts are listed below. The detailed impact identification and mitigation measures are given at Chapter 8.

Table 5.1: Environmental assets of the project area

	Environmental Assets	Impact	RelatedProject Activity
Pre-Construction & Construction Phase			
1.	Air quality of study area	Degradation	Site clearance/preparation, construction activities, excavation, exhaust from construction vehicles/machinery.
2.	Water quality of study area	Degradation	Solid and liquid waste discharge.
3.	Noise level of study area	Increase in noise levels	Construction activities, movement of construction vehicles/machinery.
4.	Transportation system	Traffic congestion	Increased nos. of vehicles carrying construction raw material and construction debris
5.	Eco-system of project area	Impact on flora and fauna	Cutting of trees, littering activities, disposal of waste, construction activities, and fugitive emissions.
Operation Phase			
1	Air quality of study area	Degradation	Exhaust from vehicles and machinery.
2	Water quality of study area	Degradation	Solid and liquid waste discharge.
3	Noise level of study area	Increase in Noise levels	Increased traffic movement and industrial activities.
4	Transportation system	Traffic congestion	Increased nos. of vehicles due to industrial activities.
5	Eco-system of study area	Impact on flora and fauna	Disposal of untreated solid and liquid waste, impact on fisheries.

5.3 Environmental Hotspot

As observed during site visit, there are vegetation and trees at the proposed EZ location. There is no wildlife sanctuary or reserve forest within 10 km of the proposed site. Project proponent must be consider the impacts on fisheries of beel and surrounding ecosystem.

5.4 Likely Beneficial Impacts

The Project will bring in much direct and indirect positive impact on the environmental and social wellbeing of the locality. The likely benefits from the proposed development are listed as below:

5.4.1 Socio-Economic-Environmental Benefits

Currently a lot of industries are being set up in Jamalpur district. The proposed JEZ with its well connectivity, government subsidized and specially arranged benefits, compactness of facility will provide a good alternative to all the impending industrial ventures. This shift of location might improve the environment of the zone significantly with a negligible effect on the environment.

5.4.2 Infrastructural Development

The infrastructural development for the JEZ will improve the economic activity of the region greatly. New roads, electrical network, residential area, school, college, hospital and other modern faculties of life will follow the establishment of the economic zone.

5.4.3 Industrial Decentralization

Most importantly JEZ will come with the promise of employment of thousands of skilled and unskilled people of the locality. Inevitably, standard of living is projected to improve significantly. In addition to individual benefits, the proposed economic zone will significantly add to the overall economic development of the country.

5.5 Community Recommendations

During stakeholder consultations the local community informed the following. The area is already developed. However, some of the concerns raised by the stakeholders regarding development of project are listed below:

1. As positive externalities, proposed JEZ should improve and create livelihood to the local people;
2. For less disturbance to local settings, JEZ should engage qualified contractor to ensure quality of works as well as timely completion of work;
3. Local people should be employed by the contractor during construction work;
4. Adequate safety measures should be taken during construction work;
5. Concerns were also raised on possible traffic and population pressure caused by external employed personnel;
6. Water treatment system should be installed to prevent water pollution;
7. Finally, local people have appreciated the EZ Project and employment generation; and have promised that they will cooperate with the executing agency during Project implementation.

The detail of the community recommendations is provided in chapter 7.

5.6 Alternative Analysis

Project alternative is required, if the impacts of the project design are significant to the environment and social components. Different sites were analyzed on the basis of location, accessibility, potential for industrial growth, availability of raw material, infrastructural development, availability of man-power, vulnerability to natural and

manmade disasters, availability of the basic amenities and utilities for industrial development, etc.

Scope of Alternative Location

The Project is not adjacent to or in any environmentally sensitive, reserve or protected areas, and does not cause an impact on terrestrial biodiversity as well as aquatic fisheries values if appropriate mitigation measures will take. The proposed project location is adjacent to Bamui beel. The land is JEZ own purchased land. Therefore, the site will produce minimum or no socio-economic impact regarding land acquisition. These factors leave no scope for considering a more feasible site other than the current one.

Alternative Technology and Raw Materials

Most of the technologies proposed in the project are labor intensive. Minimum mechanical equipment will be used during construction work. All these works will be done by labor force with minimum mechanical equipment except in the case of piling. This action will produce minimal environmental impacts. During piling period sound pollution may occur which will adversely affect the workers and operator exposed to machine. Care should be taken and adequate protective measures should be applied for the working persons at and nearby the pilling site.

'Non-Project' Consideration

The analysis has also been done with and without project scenario. Implementation of proposed project will create lot of positive impacts on investment, employment, indirect source of income, education, and socio-economic status of community as well. Provision of good quality facilities will help to enhance the quality of life of the people. The project will help to create job opportunities to considerable number of people. The Implementation of the proposed project will produce only negligible and insignificant environmental impacts using efficient and effective technology.

On the other hand, if the project is not implemented, the people of the project area will still have to suffer from various problems they are facing today. In the absence of a good investment infrastructure the region will be deprived from the potential for increased production, generation of new economic activities and employment. The economic zone project will facilitate opportunity for investment (national as well as foreign) significantly.

It is assessed from the impact study that majority of the impacts will be caused during construction phase of the project and would be of insignificant in nature. Some Positive impacts on socio-economic status will be revealed during operation phase. All the negative impacts can be mitigated through adoption of advanced technologies, appropriate mitigation measures, and adopting sound engineering designs. Hence, considering all technical, social and environmental issues proposed site is more feasible than the other site. The proposed site shall also be more feasible in terms of economic factor.

5.7 Environmental and Social Impacts Assessment Methodologies

The assessment of effects and identification of residual impacts takes account of any incorporated mitigation measures adopted due to any potential impact of project activities and will be largely dependent on the extent and duration of change, the number of people or size of the resource affected and their sensitivity to the change. Potential impacts can be both negative and positive (beneficial), and the methodology defined below will be applied to define both beneficial and adverse potential impacts. The criteria for determining significance are generally specific for each environmental and social aspect but generally the magnitude of each potential impact is defined along with the sensitivity of the receptor. Generic criteria for defining magnitude and sensitivity used for the project are summarized below.

5.8 Magnitude

The assessment of magnitude has been undertaken in two steps. Firstly, the key issues associated with the project are categorized as beneficial or adverse. Secondly, potential impacts have been categorized as major, moderate, minor or negligible based on consideration of the parameters such as:

- Duration of the potential impact;
- Spatial extent of the potential impact;
- Reversibility;
- Likelihood; and
- Legal standards and established professional criteria.

The magnitude of potential impacts of the project has generally been identified according to the categories outlined in the Table below.

Table 5.2: Parameters for determining magnitude of impacts

Parameters	Major	Moderate	Minor	Negligible/Nil
Duration of potential impacts	Long term (more than 25 years)	Medium Term Lifespan of the project (15 to 20 years)	Less than project lifespan	Temporary with no detectable potential impact
Spatial extent of the potential impacts	Widespread far beyond project boundaries	Beyond immediate project components, site boundaries or local area	Within project boundary	Specific location within project component or site boundaries with no detectable potential impact
Reversibility of potential impacts	Potential impact is effectively permanent, requiring considerable intervention to return to baseline	Baseline requires a year or so with some interventions to return to baseline	Baseline returns naturally or with limited intervention within a few months	Baseline remains constant

Parameters	Major	Moderate	Minor	Negligible/Nil
Likelihood of potential impacts occurring	Occurs under typical operating or construction conditions (certain)	Occurs under worst case (negative impact) or best case (positive impact) operating conditions (Likely)	Occurs under abnormal, exceptional or emergency conditions (occasional)	Unlikely to occur
Legal standards and established professional criteria	Breaches national standards and or international guidelines/obligations	Complies with limits given in national standards but breaches international lender guidelines in one or more parameters	Meets minimum national standard limits or international guidelines	Not applicable

5.9 Sensitivity/Rating

The sensitivity of a receptor has been determined based on review of the population (including proximity/numbers/vulnerability) and presence of features on the site or the surrounding area. Criteria for determining receptor sensitivity of the project's potential impacts are outlined in the Table below.

Table 5.3: Criteria for determining sensitivity of receptors

Sensitivity Determination	Definition
Very High	Vulnerable receptor with little or no capacity to absorb proposed changes or minimal opportunities for mitigation.
High	Vulnerable receptor with little or no capacity to absorb proposed changes or limited opportunities for mitigation.
Medium	Vulnerable receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation.
Low / Negligible	Vulnerable receptor with good capacity to absorb proposed changes or/and good opportunities for mitigation.

5.10 Assigning Significance

Following the assessment of magnitude, the quality and sensitivity of the receiving environment or potential receptor has been determined and the significance of each

potential impact established using the potential impact significance matrix shown in Table below.

Table 5.4: Assessment of potential impact significance

Magnitude of Potential impact	Sensitivity of Receptors			
	Very High	High	Medium	Low / Negligible
Major	Critical	Major	Moderate	Negligible
Moderate	Major	Major	Moderate	Negligible
Minor	Moderate	Moderate	Minor	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

5.11 Mitigation Measures

Subsequent to the impact assessment discussed above, appropriate mitigation measures have been proposed to avoid, offset, mitigate/reduce, or compensate for the identified impacts. Generally, impacts having moderate to critical consequence require appropriate avoidance/ mitigation/compensatory measures to reduce the significance. Impacts having low to negligible significance can be left alone not needing any mitigation measures.

Generally, preference is given to the avoidance of the impact with the help of options available for nature, siting, timing, method/procedure, or scale of any project activity. If avoidance is not possible, appropriate mitigation and control measures are proposed to reduce the consequence significance of the predicted impact. Finally, if impact reduction is not possible, compensatory measures are proposed.

5.12 Assessment of Residual Impacts

The final step in the impact assessment process is determining the significance of the residual impacts, which essentially are the impacts which would be experienced even after implementing the mitigation/compensatory measures. Ideally, all of the residual impacts should be of negligible to low significance. For any residual impacts having moderate significance, monitoring mechanism is necessary to ensure that their significance does not increase. No residual impacts having major or critical significance are generally acceptable.

5.13 Impact Screening

As part of the environmental impact assessment process, a screening matrix was used tailored specifically to the proposed project, focusing the potential environmental impacts during the design, construction and operation phases. The matrix examined the interaction of project activities with various components of the environment. The impacts were broadly classified as physical, biological and social, and then each of these broad categories further divided into different aspects. The potential impacts thus predicted were characterized as follows:

- High negative (adverse) impact
- Low negative impact

- Insignificant impact
- High positive (beneficial) impact
- Low positive impact
- No impact

The potential Environmental and Social Impacts Matrix of JEZ have been given in the following Tables. The negative impacts predicted in this manner were the 'unmitigated' impacts. Appropriate mitigation measures were recommended as part of this EIA, thus reducing the occurrence possibility and severity of the potentially adverse impacts.

Table 5.5: Environmental impact identification matrix (construction phase)

Parameter	Physical Environment					Ecological Environment			Social Environment				
	Topography	Hydrology	Water Quality	Air Quality	Noise	Vegetation	Fauna	Aquatic Environment	Displacement	Employment	Service	Health	Culture
Possession of Land	P												
Site development	P			T		P				T		T	
Civil and Structural Work			T	T	T					T		T	
Mechanical and Electrical Work				T	T					T			
Water Requirement		T	T										
Transport				T	T								
Employment			T							T	T		T

Here, P= Permanent, T= Temporary

Table 5.6: Environmental impact identification matrix (operation phase)

Parameter	Physical Environment					Ecological Environment			Social Environment				
	Topography	Hydrology	Water Quality	AirQuality	Noise	Vegetation	Fauna	Aquatic Environment	Displacement	Employment	Service	Health	Culture
Water requirement		P											
Liquid effluent			T					T				T	
Gaseous effluent				T		T						T	
Solid waste												T	
Hazardous waste			T									T	
Transport				T	T								
Operational noise					P							P	
Immigration			T							P	P		P
Employment										P			

Here, P= Permanent, T= Temporary

Table 5.7: Checklist of potential environmental impacts

Project phase	Actions affecting environmental resources	SEI_s without mitigation measures				Type		Comments
		None	Minor	Medium	Major	Adverse	Beneficial	
Construction phase	Land value depreciation	×					×	Land value change: Positive impact
	Loss of and displacement from homestead land	×						Displacement of 10 household: compensation provided
	Loss of and displacement from agricultural land	×						Primary economic activity to secondary activity
	Damage to nearby operation	×						No impact anticipated as no major installation
	Disruption of drainage pattern	×				×		Take care of local drainage pattern
	Encroachment into precious ecology	×						No precious ecological issues: no impact
	Runoff Erosion		×					Take care of local drainage pattern
	Worker accident		×			×		Take care by good housekeeping
	Sanitation diseases hazard		×			×		Concentration of labourers may cause unhygienic environment
	Noise/ Vibration hazard			×		×		Pilling/equipment installation may cause noise
	Traffic congestion				×	×		Regular monitoring by designated security
	Employment				×		×	Good employment opportunity
Operation phase	Encroachment into precious ecology	×						No precious ecological issues: No impact
	Depreciation of environmental aesthetics		×					Local community prefer employment generation activities

Project phase	Actions affecting environmental resources	SEI_s without mitigation measures				Type		Comments
		None	Minor	Medium	Major	Adverse	Beneficial	
	Erosion/Silt runoff	×						Having boundary wall: no impact
	Pollution from liquid discharge		×					Preventive measure will be undertaken
	Pollution from solid wastes		×			×		No significant solid waste: No significant impact
	Air quality	×						No major impact
	Occupational health hazard			×		×		Reduce by good management practice
	Odour hazard	×						No obnoxious odor: no major impact
	Traffic congestion	×						No carrying of product
	Noise hazard		×					Moderate impact
	Employment			×			×	Good employment opportunity

6 Environmental and Social Impacts

6.1 Introduction

The study was carried out considering present environmental setting, nature and extent of the proposed activities of the zone. Potential environmental impacts associated with the proposed project activities are classified as: i) impacts during site preparation or pre-construction phase, ii) construction phase, and ii) operation or post construction phase.

Some of the important impacts associated with the proposed project will be linked with land use, land stability (soil erosion), soil contamination, water availability, surface and ground water quality, water pollution, waste and wastewater disposal, ambient air quality, ambient noise levels, vegetation, fauna (terrestrial and aquatic), drainage pattern, hydrology, climate change, socio-economic, places of social/cultural importance (religious structures, community structures), construction and raw material sourcing and storing, and OHS. Adequate mitigation measures are needed to mitigate/minimize all likely environmental impacts and those have been discussed along with the impacts.

During the field visit, consultations were also held with people in the locality including those presently living in and around the project areas, local businessmen, students, nearby residents, etc. Outcome of these consultations were used in impact assessment and devising mitigation measures.

6.2 Impact on Air Quality and Noise

6.2.1 Pre-construction Phase

Air Quality

Generation of dust is expected by land preparation, and generation of air pollutants (SO_X, NO_X etc.) is anticipated from the operation of heavy machinery and trucks, but the impact will be limited only to the development stage.

Mitigation Measures

Watering the area, especially in the dry season, and using cover sheets on trucks for the transportation of soil/sand will be undertaken to reduce dust generation. Periodic maintenance and management of all the land filling machinery and vehicles will be conducted to reduce exhaust gas discharged from the machinery and vehicles.

Noise and Vibration

The impact of noise caused by the operation of heavy land filling machinery and trucks is predicted but will be limited to the surrounding area.

Mitigation Measures

Sufficient consideration must be given to minimizing any noise impact.

6.2.2 Construction Phase

Air Quality

The proposed project involves construction activities which include- site development (filling, leveling, earth work), civil construction, construction material handling and stockpiling; and transportation of construction material, equipment and labours.Air quality will be impacted from the following sources during the construction phase:

- Fugitive dust emissions from site clearing, excavation work, cutting and leveling work at sites and access roads, stacking of soils, handling of construction material, transportation of material, emission due to movements of vehicles, plying of heavy construction machinery etc.;
- Vehicular emissions due to traffic movement on site and on the connecting roads;
- Exhaust emissions from construction machineries, other heavy equipment as bull dozers, excavators, compactors; and
- Emissions from diesel generator required for emergency power during construction period.

Gaseous emissions containing PM_{10}, $PM_{2.5}$, SPM, CO, HC, NO_X, SO_2 and lead will be released from the vehicular and construction equipment exhaust. The vehicular movement on the unpaved roads will also result in the fugitive dust emissions. The movement of trucks carrying construction material to the site will lead to fugitive and exhaust emissions which would impact the people in the project area of influence. The movement of heavy trucks also increases the potential for road accidents.

Mitigation Measures:

To mitigate the construction impacts, JEZshould have contract agreements with contractors as well as sub-contractors to implement the measures provided in EMP.

- Sprinkling of water at construction site and haul roads;
- Covering the scaffolding (in case of administration building) to reduce the dust emission inoutside environment;
- Provision of respiratory mask to workers to minimize inhalation of dust particles;
- Construction of barricades between the settlements and the site to minimize travel of fugitive emissions towards settlements;
- Minimizing stockpiling by coordinating excavations, spreading, re-grading, compaction and importation activities;
- Cease or phase-down work if excess fugitive dust is observed, investigate source and take suppression measures such as water spray;
- Adequate parking space should be provided for the construction vehicles so as to prevent idling of the vehicles and the emissions generating from them;
- Vehicles carrying construction material and debris should be covered with tarpaulin cover;

- Raw materials, excavated soil and other debris should be stored under covered sheds or cover with tarpaulin;
- Tree Plantation on the either side of the approach road to mitigate the fugitive dust emissions;
- Green buffer should be developed all along the EZ boundary;
- 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;
- Speed of vehicles on site is recommended to be 10-15 km/hr which will help in minimizing fugitive dust emissions due to vehicular movement.

Noise and Vibration

Operation of different machineries and equipment for construction activities, running of heavy load traffic for construction materials transportation, and regular traffic movement may generate noise during construction period. The heavy equipment, machineries, transportation and earthworks used for the construction activities are the major sources of noise. It is envisaged that there will be an increase in traffic and thereby in traffic noise impacts on the receptors near the approach road from the transportation of equipment, construction materials. The residents in the vicinity of the site would be impacted due to the noise emissions. The impactis expected to be temporary and localized. Noise levels will have compounding effect when multiple equipment and trucks operate at the same time.

Mitigation Measures

The following mitigation measures will be implemented to minimize potential noise impacts during the construction phase:

- Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components should be conducted;
- Machinery and construction equipment that may be in intermittent use should be shut down or throttled down during idle time;
- Acoustic enclosure will be provided for the DG set;
- Equipment known to emit noise strongly in one direction should be orientated so that the noise is directed away from nearby sensitive receptors as far as practicable;
- Honking should be avoided;
- Construction work should be carried out only during day time (from 8.00 am to 6 pm); and
- Machinery to be used should comply with the noise standards prescribed by DoE;
- At individual worker level, the construction contractor should be insisted to provide earmuffs to the workers exposed to high noise levels.

To deal with noise exposure by construction workers in construction site, pocket guide by OSHA is helpful. The following noise reduction measures are suggested in the pocket guide.

Reduce It: Reduce the noise by using the quietest equipment available. For example, choose a smaller, quieter generator.

Move It: Move the equipment farther away with the use of extension cords, additional welding leads, and air hoses. Noise levels go down as we increase our distance from a noisy object. Move the generator (example) farther away orface it in a direction that is away from where most people are working. If you are not required to be in a high noise area, move to a quieter area.

Block It: Block the noise by building temporary barriers of plywood or other on-site materials to keep the noise from reaching workers. Place a five-sided, oversized wooden box over the generator. Add fire-resistant acoustical absorbing material (foam) inside the box. If the generator sits on soil or sand, that will help absorb some of the noise.

6.2.3 Post-Construction Phase

Air Quality

Post development of the EZ & 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. It is envisaged that particulate matter, sulphur dioxide, metals, VOCs, fugitive emissions and other criteria pollutants like ozone, oxides of nitrogen and carbon monoxide will be generated during industrial operations.

Mitigation Measures

- Provision should be made for peripheral green belt all along the EZ boundary. Green belt should have minimum of three rows of local variety of tree. Tree species should be selected such that first inside row is of smaller height, middle row of tree is of medium height and last row of tree is of higher height so that green belt formed appears like a canopy;
- Development of thick green belt (10 m) and organized greens within each industrial plots;
- Power generators should be provided with stacks of adequate height (higher than nearest building) to allow enough dispersion of emission;
- Process emission if any should be controlled 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;

- The latest technology and equipments should be used for control of air pollution;
- Fully automated machines should be installed in the manufacturing processes;
- Preference of usage of clean fuel like LPG, low sulphur diesel should be explored;
- Energy conservation should be adopted by opting the alternate energy options like solar power;
- Odour should be managed at the site using odour suppressant and planting fragrance flowering trees;
- Periodic checkups should be conducted for the workers working in the industries;
- To reduce exposure levels, rotate the shifts of the workers;
- Appropriate PPEs such as half face respirator, dust mask etc. should be used for workers in working in manufacturing processes;
- Biodegradable plastics shall be promoted;
- Boiler ash should be converted and stored;
- Chemicals should be stored and transferred in close conveyors in all the industries.

Noise and Vibration

During operation phase the noise levels may rise due to vehicular movement and industrial activities. Operation of water pumps during operation phase of economic zone may also contribute to the local noise level.

The operation of industrial units can create vibration, but this will be limited to the adjoining area. In the operation of different industries, advanced technologies should be used as much as possible to ensure low vibration. Workers should use safety equipment in noisy work environment.

Mitigation Measures

- Pumps should be fitted in close room, preferably acoustic enclosure to reduce the noise generation;
- Green buffer should be developed all along the project boundary. Green buffer should compose of the 2-3 rows of plants of variable height and thick canopy so as to form continuous barrier. This will help in reducing the noise level significantly;
- Apart from these after development of economic zone, noise will be generated from the construction of individual industries, operation within in industrial units, running DG sets in each units and traffic movement within EZ zone;
- All industries should obtain clearance from DoE before establishing industrial unit and should comply with all the conditions mentioned in the letter of environment clearance;
- All industries should install the new machinery of modern make which complies with the noise standards prescribed by DoE;

- Job rotations should be practiced for workers in industry to prevent prolonged exposure to high noise level as it may lead to deafness, fatigue, head ache, nausea and drowsiness;
- Noise regulators must put a strong mandate and fine on vehicle operators which are not properly maintained, produce noise (silencers not proper);
- Proper greasing, periodic checkups for frictionless movements;
- Honking should be prohibited within the economic zone;
- Comprehensive hearing conservation programmes identify noise sources, reduce workplace sound levels, and train workers on the hazards of noise exposure and proper use of hearing-protective devices should be conducted;
- Workers exposed to excessive noise should use appropriate PPE including ear plugs, muffs, or both when engineering or administrative controls are not feasible to reduce exposure;
- Acoustic design with sound proof glass paneling will be provided for critical operator cabins/control rooms of individual modules as well as central control facilities;
- Use engineering methods to reduce sound levels by modifying, enclosing and dampening noise sources.
- The monitoring of noise and medical surveillance (i.e., audiometry) assess worker exposure to noise and their resulting loss of hearing. This helps to identify noise problems and evaluate the adequacy of corrective measures.

6.3 Impacts on Water Resources

6.3.1 Pre-Construction Phase

The Bamui Beel is located inside of the project area and connected with Bangshi River. Bangshi River is adjoining in the east site of the project. Since the beel and river is adjoining to the project site, effect from the earth filling activities water level and quality of the river is anticipated. JEZ will not done any activity which will affect beel or river. So, the hydrological and morphological change is not significant for the development of JEZ.

Mitigation Measures: N/A

6.3.2 Construction Phase

JEZ will take steps to protect the bank of beel from landslide. Generally, the project area may affect by flooding by the river during monsoon season.

Ground Water

Significant quantity of water will be required for various construction activities & domestic purpose of economic zone development. Excess withdrawal of ground water may lead to depletion of aquifers. There is a potential for contamination of groundwater resources resulting from improper management of sewage.

Surface Water

The major source of wastewater generation during construction phase is from the construction activity, labour camp and sewage, which will be established for project construction work. There is a potential for contamination of surface water resources resulting from improper management of sewage. The quality of water bodies could also be affected due to surface runoff from contaminated soil (soil contamination due to oil/ fuel spillage and leakages), particularly during monsoon season. The surface runoff carrying the loose top soil will lead to increased sedimentation in the receiving water bodies. Contamination to water bodies may also result due to oil spilling during construction activities and/or surface runoff from the construction site to the nearby water body.

Mitigation Measures

- Avoid land filling and excavation activities during monsoon;
- 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;
- Temporary storm water drains and rain water harvesting ponds should be constructed so as to store rain water for construction activities;
- Regular inspections at site to monitor leakages in water storage tanks;
- Creating awareness among construction workers about the importance of water conservation;
- Covering the water storage tanks at site to prevent evaporation losses.
- Maintaining appropriate flow of water sprinklers at site;
- Construction of adequate nos. of toilets and proper sanitation system to prevent open defecation along the water body/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 water bodies. Alternatively, collect labour camp sewage and connect to nearby municipal sewers;
- 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 in the water bodies;
- Use of licensed contractors for management and disposal of waste and sludge;
- Spill/ leakage clearance plan to be adopted for immediate cleaning of spills and leakages;
- Adequate management of the spent lubricant collection and disposal through contractors who are authorized to recycle or dump in Government approved landfills.

6.3.3 Post Construction Phase

There may be soil runoff from the exposed soil of the land development, loading unloading and cut slopes, and water pollution of the adjoining eel and river is predicted.

In addition, concentrated wastewater generated from industrial operation and from the sewage to have effects. Anti-diffusion membranes will be installed around the construction site to prevent diffusion of turbidity, and these measures will minimize the impact of effluent contamination of beel and river water and underground water. Runoff of exposed soil surfaces into waterbody is expected. Adequate measures to prevent landslide of beel and river bank will be taken.

Central Sewerage Treatment Plant (CSTP) and Central Effluent Treatment Plant (CETP) shall be installed in operations phase of the project to reduce wastewater pollution in the nearby water bodies. In order to reduce the pressure on ground water JEZ should install rain water harvesting system for potable water. Liquid waste from different industries will be significantly affecting the water quality of surface water.

The development of economic zone shall lead to generation of domestic and industrial effluent. The direct discharge of untreated effluent generated from industrial operations and leach ate shall lead to impacts on ground water quality. Also, it is anticipated that surface run-off may significantly increase post development of economic zone which may impact surface water quality. Measures should also be taken to prevent contamination of storm water with any industrial pollutant.

Mitigation Measures

- Usage of water conservation fixtures to minimize water consumption;
- Installation of leakage detection system to minimize the water loss;
- Usage of latest technologies in industries which requires lesser water;
- Provision of dual plumbing system so as CSTP/CETP treated water can be re-used for various purposes as per suitability of the quality;
- Each industry should obtain consent of DoE before construction and operation and should comply to the conditions laid by them;
- No leachate, waste water and waste material should be stored in pervious unlined area/pond;
- 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;
- CETP designed on the basis of effluent quantity and characteristics;
- Common STP (in modules) should be constructed within the EZ to treat sewage from residential and commercial areas;
- Each industry should practice rain water harvesting to minimize the water consumption and reduce run-off from the site;
- Proper management of waste should be done to prevent any contact between the waste and storm water;
- Storm water drains should be lined to separate from effluent drains and inspected & cleaned before monsoon every year;
- Peripheral drain shall also be lined and shall not be connected to internal storm water drainage system;

- The top soil shall be preserved and used for covering the sand layer at EZ site. Vegetation turffing shall be made at the side slops of the EZ areas to prevent erosion and siltation in the river;
- Sewage generated in the terminal and repair operations should be treated in sewage treatment plant and treated effluent should be used for green belt development and utilities;
- Sludge should be dried into cakes and used as manure for green belt;
- Do not discharge leachate directly into the ground without treatment;
- Surface water quality (beel and river) shall be monitored periodically;
- Ground water quality shall be monitored periodically.

6.4 Impacts on Land resources

6.4.1 Pre-construction Phase

It is expected that no soil erosion occurred from the project site as it will be well by the proponent as part of the zone development. Filling materials' quality must be tested before using as filling materials. At the proposed site where the project will be developed, 106 households will be directly affected by the project implementation who own land within the proposed alignment site. So, replacement and resettlement is necessary. But through proper consultation with DC, BEZA and affected people compensation and rehabilitation should be considered as per proper laws and policies.

The land filling may affect the topography and geology of the area around the proposed site. Filling will cause change of land types. Land filling can disrupt the natural drainage pattern and cause drainage congestion which can affect the land resource.

Mitigation Measures

- Proponent should protect the beel side from landslide. Some protection measures against slope sliding especially in rainy season need to be considered.
- Protecting national storm water drainage network and/or creating more drainage network could be a solution of water logging.

6.4.2 Construction Phase

Construction work may affect the topography and geology of the area around the proposed site. Some protection measures against slope sliding especially in rainy season need to be considered. Improper management of activities related to the proposed development such as reclamation of project site, operation of machinery and equipment, generation of solid and hazardous waste, etc. is likely to result in contamination of soil quality in the area. The potential impacts on the soil quality of the study area due to construction activities are discussed below.The impacts on soil due to the project are as follows:

- Leveling activity;
- Soil erosion due to vegetation clearance and excavation activities;
- Topsoil degradation;

- Generation of waste (hazardous and non-hazardous) from site clearance, excavations, civil works and activities of construction workers (general waste and sewage); and
- Possible contamination of soil due to potential spills of lubricating oil, fuel oil, concrete etc.

Soil Erosion

During the construction phase, the site clearance activities of EZ including clearing of vegetation, construction of the earth structures, labour camps, storage area and toilets will involve removal of top soil which will result in slope destabilization and the land will be more susceptible to soil erosion. The soil erosion will result in the run-off of the silt to surface water impacting aquatic ecosystem of receiving water bodies with increased suspended sediment load and associated nutrients.

Soil Compaction

During construction activities, there will be compaction of soil in the project area due to construction of the access roads, movement of vehicles/ construction machinery and work force movement. The soil compaction would impact the soil physical properties such as reduction in pore spaces, water infiltration rate and soil strength etc. The extent of soil compaction is primarily limited to the project foot print area and surroundings within 100 m distance. The impact is restricted to the construction phase of the project.

Waste Generation

The construction waste generated onsite comprises of materials such as excavated soil, rocks, concrete, wooden pallets, steel cuttings/filings, packaging paper or plastic, wood, metals etc. Municipal domestic wastes consisting of food waste, plastic, glass, aluminum cans and waste paper will also be generated by the construction workforce and labor camp site. The waste generated during the construction phase will also include hazardous waste such as used oil, hydraulic fluids, waste fuel, grease and waste oil containing rags. If improperly managed, solid waste could create impacts not only to land but also to local air quality, water quality, and human health. It is expected that the generation of the waste oil will be insignificant as the DG sets will be used only during the construction phase and the waste oil will be generated only during the maintenance of DG sets. Waste without proper management will also generate odor.

Soil Contamination

Soil contamination during the construction phase may result from filling activity, leaks and spills of oil, lubricants, or fuel from heavy equipment and wastewater. Such spills could have a long-term impact on soil quality, but are expected to be localized. Storm water run-off from the contaminated area can pollute the downstream soil and water quality of receiving water body. Spill control measures such as the storage and handling of chemicals and fuel in concrete areas with secondary containment will be implemented to minimize impacts in the event of a spill.

The soil characteristics of the native soil may also be changed due to import of soil for filling and leveling purpose. It is envisaged that the filling activity may impact the native soil due to spillages during transportation of soil and run-off during filling and compaction.

Mitigation Measures

- Stripping of topsoil should be scheduled (maintain vegetation coverfor as long as possible) in order to prevent the erosion (wind and water) of soil;
- Vegetation should be planned and maintained for slope stabilization and to prevent soil erosion after construction period;
- The disturbed areas and soil stock piles should be maintained moist to avoid wind erosion of soil;
- The routes for movement of heavy machinery should be designated to avoid the soil compaction in other areas;
- A register of Materials Safety Data Sheets (MSDS) relating to all hazardous will be maintained;
- Transport vehicles and equipment should undergo regular maintenance to avoid any oil leakages; designate routes for bringing construction material and outside soil;
- Construction contractor should designate the sites to be used for disposal of hazardous wastes including waste oils, solvents, paint and batteries;
- Contractor should ensure that no unauthorized dumping of hazardous waste is undertaken from the site;
- Fuel and other hazardous substances should be stored in areas provided with roof, impervious flooring and bund/containment wall.

6.4.3 Post Construction Phase

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. Industries generate significant waste both hazardous and non-hazardous in nature, which can pollute the environment if not managed properly.

Mitigation Measures

- Provision shall be made for proper storage and disposal of industrial waste by individual 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;

- No chemical/hazardous raw material should be allowed to spill overthe 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;
- Use of advanced techniques to control specific portions of the manufacturing process to reduce wastes and increase productivity;
- At present no common hazardous waste handling and disposal unit exists in Bangladesh. A site for disposal of hazardous waste can be identified within the EZ and it should be developed as landfill as per the norms of DoE and Hazardous Waste Management rules of Bangladesh;
- Sludge generated in effluent treatment plant should be sold to authorized recyclers.

6.5 Impacts on Agriculture resources

6.5.1 Pre-construction Phase

Agriculture is the main economic activity in the project area. The land use of the area demarcated for the EZ is predominantly agriculture which is also evident from the crop cultivation practices being followed in the region. Due to development of EZ, the agricultural activity will be impacted.

Mitigation Measures

- Select minimum agricultural land for zone development as much as possible;
- Provide appropriate compensation to affected persons.

6.5.2 Construction Phase

In construction phase after land development, agricultural land converted into industrial land use with construction of different on-site and off-site infrastructure. It will require different amount of temporary construction labor and will absorb from agricultural sector. It can create seasonal scarcity of agricultural labor.

Mitigation Measures

- Engage local and people in construction activities;
- Encourage agricultural activities;
- Avoid the discharge of any waste materials to surrounding agricultural land.

6.5.3 Post-Construction Phase

Different industries will require different amount of permanent semi-skilled and unskilled labor and will absorb from different sectors of labor. It can create scarcity of such labor and boost their wage up. As per national policy low productive agricultural land could be used for industrial development. Project affected community (land owners) should get job in the project with a priority basis.

Mitigation Measures

- Care must be taken to ensure that any solid and liquid industrial wastes shall not be discharged in the local agricultural land;
- Any conflict with local farmers should be avoided and complain from farmers should be manage with priority.

6.6 Impacts on Fisheries

6.6.1 Pre-construction Phase

Land development work converted low lying area into flood free area, where fisheries (seasonal) habitat may reduce.

Mitigation Measures

Filling materials, oil and chemical materials of heavy machines, vehicles, etc. will be stored in an appropriate storage site to prevent any release into the water body. These measures will minimize the impact of fisheries.

6.6.2 Construction Phase

During construction period construction materials may be released to the nearby river or beel from the construction site. This may damage the fisheries ecosystem of the respective water body. Construction materials, oil and chemical materials of heavy machines, vehicles, etc. will be stored in an appropriate storage site to prevent any release into the water body. These measures will minimize the impact of fisheries.

Mitigation Measures

- Proper disposal and management of construction waste;
- No waste should be dumped in water bodies during construction;
- Wastewater from labour camp and construction site should not be disposed off in the waterbodies;
- Septic tank/soak pits should be provided to dispose off the wastewater from construction camp;
- Site should be kept clean so as no pollutant from site should enter the water bodies along withrun-off;
- Excavation activities should not be undertaken during monsoon season;
- Piling of raw material at construction site should be avoided;
- Raw material, debris and fuel should be stored on paved surfaces under covered areas.

6.6.3 Post-Construction phase

Fish demand will be increase in project area due to migrated population. During operation, runoff of exposed soil surfaces and drainage of waste water from industrial operation and sewage drainage into water body is expected which can lead to the contamination of the water body from unexpected substances and it can destroy fisheries ecosystem. Appropriate protection measure from waste water contamination (if any) by functioning CETP and CSTP will be established to control the pollution, save

the fisheries and other aquatic resources of the Project area. Appropriate monitoring system will be devised for desired standard of CETP outlet parameters.

Mitigation Measures

- Adoption of adequate wastewater and industrial effluent management technology, so no untreated sewage is discharged into surface water body;
- Industrial, municipal and hazardous waste should be managed in such a way that no waste is dumped or disposed in surface water body;
- Direct discharge of any effluent or waste should be avoided;
- Over extraction of fishery resources need to be restricted;
- Regular monitoring of fishery resources.

6.7 Impacts on Ecosystem

6.7.1 Pre-construction Phase

The site is considered as 'no trees area', so, there is no vegetation within the zone except some herbs. Some fauna lived and depended on food from the area will lose the habitat and source of sustenance. Plantation will provide them new home and source of sustenance by the Project. The impact on flora and fauna will not be significant for this reason. Since Bamui beel located at the project site and linked to Bnagshi River, any disruption to the water course can harm aquatic flora and fauna. Beside these birds depends on these beel. Their ecosystem will be disturbed due to development of the project.

6.7.2 Construction Phase

During construction period a large number of migrant people will be temporarily reside in the area. Waste generated from the construction work will include waste plastic, waste glass and waste oil. Furthermore, household waste discarded from the camping ground of the workers will include cans, bottles and garbage. If such waste is no adequately handled, flora and fauna can be affected. Segregating waste at collection, recycling and reusing waste will be promoted and non-recyclable waste will be disposed at appropriate sites according to related regulations. Hazardous waste will also be treated accordingly. To reduce the amount of solid waste discharged from the workers during the construction work, efforts will be taken to employ local workers wherever possible, so that the amount of household waste at the workers camp will be minimized. These measures will be taken to ensure protection of aquatic and terrestrial ecosystem.

For site development and construction of access road, it is required to cut some trees and some bushes. These trees and bushes provide habitat to birds, insects, reptiles and small mammals. The cutting of the trees shall disturb the eco-system and the natural habitat of the organisms.

Mitigation Measures

- EZ development should be planned in such a way to avoid or minimize tree cutting;

- Twice the nos. of trees to be fell should be planted as compensatory plantation in affected areas to minimize the impact on the eco-system;
- No waste shall be discharged in to the water body.

6.7.3 Post-Construction Phase

During post-construction period residential worker will live in the area. Household waste discarded from the residence of the workers will include cans, bottles and garbage which can contaminate water and soil. Moreover, hazardous waste from industries can pollute the aquatic and terrestrial eco-system. It is claimed according to the type and nature of unit industries that, no waste water or liquid waste will be generated from the EZ. If any industry produce such waste, will be treated according to the regulations of DoE before disposal. Segregating waste at collection, recycling and reusing waste will be promoted and non-recyclable waste will be disposed at appropriate sites according to related regulations.

Green buffer of 10 m 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. Plantation should also be carried out along the both side of access road. Twice the number of trees fell should be planted.

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 altogether may have overall negative impact on the eco-system of the site and the nearby areas as the air pollutant will impact the existing vegetation and avifauna in the area. If appropriate measures for preventing air, water, soil and noise pollution are taken there will be no significant impact on the eco-system of the area.

Mitigation Measures

- Periodic monitoring shall be carried out as per as the monitoring plan for air, water, noise and soil and ensure that no impact;
- No waste shall be discharged into water bodies;
- Tree survival rate shall be monitored;
- Regular monitoring should be carried out for terrestrial and aquatic ecological and any unexpected effect should be investigated.

6.8 Socio-Economic Impact

6.8.1 Pre-construction Phase

Land Acquisition

Land acquisition is required for the development of the Project. 106 household will be directly affected, so resettlement is mandatory for this project.

Disturbance to Existing Social Infrastructure and Services

Material, equipment and worker transportation may disturb existing road traffic including public transport using the highway and commercial vessels of nearby industries. For movement of vehicles, traffic management system should be developed.

Local Conflicts of Interest

No conflicts will occur with local residence as the land was procured from residents on a willing buyer–willing seller basis. Moreover, consultations with local residents have been conducted in preparing the EIA Report. Local people should be employed for the construction works to the maximum extent possible, and any workers from other places/countries should be taught to respect local customs in order to facilitate good relationships with local people. The lodgings of the project workers should be equipped with sufficient living facilities to keep workers at the project site as much as possible.

Mitigation Measures

- Prepare resettlement plan for affected people;
- Provide adequate compensation for both directly and indirectly affected people;
- Arrange consultation meeting with stockholders and local peoples;
- Conduct baseline survey.

6.8.2 Construction Phase

Impact on Health, Aesthetics and Hygiene

Construction activities lead to generation of dust, unpleasant view, and obstruction in access of public properties due to excavation etc. which may impact the society. Adequate waste management plan, air, soil, noise and water pollution controls are required to be adopted to prevent any impact on society. Also various health hazards are associated with construction activity which may impact the workers if not taken care.

Impact on existing resources

The influx of skilled workers might put pressure on the existing resources like water supply, supply of fuel, provision of basic facilities, waste handling and sewage disposal which might create frictions between them and the resident population of the area.

Employment Opportunities

The construction phase will throw open a varied set of job opportunities for the population belonging to the study area. Direct and indirect job opportunity will be increased especially for unskilled work. Once, the proposed works commences in the construction phase, the land contributors of the project affected area should be given priority in employment (both, skilled and unskilled) opportunities that will arise. This step will help in the required capacity building of the local population as well.

Local Conflicts of Interest

Local conflicts of interest may occur among employers, employees of local community, local mass people and local political leaders. There may be feelings of resentment and reconciliation, as people living around the project will benefit. However, conflicts among local residents may occur if such benefits were unfairly distributed.

Mitigation Measures

- Provision of proper training to all workers for handling the construction equipment;
- Provision of cautionary and guiding signage in Local and English language indicating the hazard associated with the site;
- Employment should be provided preferable to local & affected people;
- Entry to the fuel storage area and construction equipment rooms should be restricted and should be only allowed for trained personnel;
- Wastewater from the toilet should be disposed off in septic tanks and soak pits and should not be allowed to accumulate at labour camp site or construction site;
- Dustbins should be provided at labour camps for collection of waste and waste should be regularly disposed off through the concerned agency;
- Temporary storm water drainage system should also be provided at camp site so as to drain the storm water and prevent accumulation of storm water at site and thus breeding of mosquitoes/flies;
- Arrangement of fire-fighting should be made at site and workers should be trained to use the system in case of fire;
- Provision of personal protective equipment like safety jackets, helmets, gumboots, gloves, face mask, ear buds, goggles, safety shoes etc. as per requirement and nature of job in which they are involved;
- Job rotation should be carried out for workers exposed to high noise and dust areas;
- Provision of first aid facility at the site and the labour camp;
- Labour camps should be located at neat and clean location with no water logging issues;
- Proper sanitation facility including toilets, bathing facility and washing facility should be provided at site and at labour camps for workers;
- Clean drinking water supply should be provided to labour;
- Regular inspection for hygiene and safety in labour camps should be done;
- Compensation should be given to the people as per the policy for the land;
- Entrance to any road/structure should not be blocked for widening of access road;
- 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.

6.8.3 Post-Construction Phase

Impact on existing resources

Due to development activity resource demand will be increased for both industrial work and migrant population.

Employment Opportunities

Vast employment opportunities potentially created by the EZ will reduce poverty via increased income through various livelihood options. By means of industrialization and related trades, diversification of livelihood will occur for all strata of people. Diverse livelihood options for the locals and better wages for the employees of the industrial zone will reduce poverty for many poor households and will contribute to reducing the poverty level in the locality. So, this will enormously benefit cross section of population and both gender.

Development of Infrastructure

The project implementation will help in developing the road accessibility and drainage facility in the area. This will bring about connectivity and accessibility of movement in the area which was minimal prior to the coming of the proposed project in the area. The local population will indirectly be benefitted with the roads that will be developed in the area, thus, making movement to other areas effortless for them. This will also alternatively benefit a certain section of the local population by providing a source of employment to those that will be interested in developing and operating the local (private) transport system in the area.

Local Conflicts of Interest

Local conflicts of interest may occur among employers, employees of local community, local mass people and local political leaders. There may be feelings of resentment and reconciliation, as people living around the project will benefit. However, conflicts among local residents may occur if such benefits were unfairly distributed.

Mitigation Measures

- Extending reach of Corporate Social and Environmental Responsibilities (CSER) Program;
- Communication with local community though community relation department;
- Compliance with the relevant regulations;
- Employ local residents as much as possible;
- Promote communication between workers and localpeople (e.g., join in local events);
- As a mitigation measure the land owner, share croppers, lessee farmers, fishermen will be appropriately compensated as per government rules;
- Training should be provided to the local people for their skill enhancement;
- JEZ should be responsible in giving an orientation to the migrant labourers on the local custom and tradition followed by the local population;
- Prior to engagement of migrant labour, medical check-up should be carried out and copy of the medical certificate should be collected by JEZ, through sub-contractors, and maintained as part of their records;
- Regular medical camps should be conducted amongst the labourers and the local population to make them aware about diseases like Typhoid, malaria, tuberculosis, STD's, HIV Aids etc.;
- The positive impact can be further enhanced by committing an assured engagement level for the local community and by ensuring that priority is given those who contributed the land for project.

6.9 Impact on Traffic

6.9.1 Pre-construction and Construction Phase

Due to the establishment of proposed EZ, the road traffic volume will be increased significantly in the project area which may affect local community. Land traffic accidents during construction work may occur. As prevention measures for land traffic accidents, observation of traffic regulations, training and education on safe driving will be implemented.

Mitigation Measures

- Time traffic flows to avoid periods of heavy traffic along main roads;
- Safe driving training will be mandatory to all drivers;
- Periodic servicing of vehicles will be carried out in accordance with the manufacturer's instructions;
- Avoid vehicle movements during rush hours;
- Adopt a traffic plan to cover all transport arrangements during the construction phase;
- Drivers will undergo medical surveillance;
- Adequate planning of activities to ensure and avoid unnecessary transportation trips. This may include ensuring full loading of trucks for the transport of required building materials to the site where possible;
- A traffic management plan has to be prepared;
- Vehicle speed restrictions should be applied;
- Minimize night time vehicle movement.

6.9.2 Post-Construction Phase

Due to the establishment of proposed EZ, road traffic volume will be increased significantly in the project area which may affect local community. But local people will also get benefit due to development of road.

Mitigation Measures

- Provide a dedicated parking area for private vehicles of project personnel;
- Safe driving training will be mandatory to all drivers;
- Basic maintenance for vehicles will be carried out by the driver/operator;
- Defects found will be repaired before the vehicle is back to service;
- Periodic servicing of vehicles will be carried out in accordance with the manufacturer's instructions;
- Avoid vehicle movements during rush hours;
- Drivers will undergo medical surveillance;
- A traffic management plan for road and river transportation system has to be prepared;
- Provision of a specific river transportation route for vehicles;
- Minimize unnecessary vessel movements, such as propeller thrusting, to avoid sediment disturbance;

- Avoid unnecessary journeys;
- Vehicle speed restrictions should be applied;
- Minimize night time vehicle movement.

6.10 Community Health and Safety

6.10.1 Pre-construction and construction Phase

Public safety, particularly of pedestrians and children can be threatened during construction activities. Improper health and safety (H&S) policy maintained at the site may lead to outbreak of different diseases to the surrounding communities through the sick construction workers.

Mitigation measures

- Construction activities should be timed, and provision for pedestrians should be made;
- Excavated trenches/ditches and freshly cut steep side slopes should be clearly marked and fenced for the safety of passersby and workers alike;
- Project or construction vehicles should be briefed on speed limit within sensitive areas such as schools, commercial and residential areas;
- The community must be informed of the type of activities being undertaken for the project and the health and safety measures that can be undertaken by them as a precautionary measure. Additionally, the emergency response plan must also be communicated to the villages in the vicinity;
- Proper health and safety plan should be prepared during design and take action accordingly during construction to avoid road accidents and health hazards of the surrounding project community;
- Linkage of Communication, Disclosure and Grievance Redressal Mechanism should also cover labourers so that any concerns on working conditions or contractor mal-practices can be managed.

6.10.2 Post-Construction Phase

Due to project activity some possibility of third party accidents with residents near the construction site will be arise. With the inflow of migrant workers and their interaction with the local population, health issues among the local community might emerge. If proper waste management and effluent discharge system does not maintain, local people will be affected. Beside these, excessive air emission or noise generation will be also affected local community.

Mitigation measures

- Safety barrier and warning sign surrounding the construction site;
- Monitor any effect due to operation work on local community;
- Provide security and health facility to local people if any health issue or accident arises due to project activity;
- Establish the plan of site safety and security measures to communities and its implementation;

- Education and instruction to the project personnel and workers on local culture;
- Restricting access to the site with a focus on high risk structures or areas depending on site-specific situations including fencing, signage and communication of risks to the local community;
- Emphasizing safety aspects among drivers;
- Avoiding dangerous routes and times of day to reduce the risk of accidents;
- Dispute settlement among stakeholders in case incidences occur;
- Arrangement of worker's accommodation if necessary.

6.11 Impacts on Occupational Health and Safety

6.11.1Pre-construction and construction Phase

The lack of adequate mitigation measures on the health and safety of the workers will result in accidents and injuries leading to loss of life or property. It is proposed to implement the following mitigation measures to ensure safe work place for the construction labor.

Mitigation measures

- The project owner should ensure that the contractor (make part of contractors contract) have and occupational health and safety plan. Contractor should provide accidental and medical insurance for all the workers;
- The contractor should conduct daily tool box meeting for all workers to discuss potential work related hazards and other safety aspects;
- The contractor should conduct training for all workers on safety and environmental hygiene at no cost to the employees;
- The contractor should maintain first aid facilities for the workers and will instruct and induct all workers in health and safety matters (induction course) including construction camp rules and site agents/foremen will follow up with toolbox talks on a weekly basis. Workforce training for all workers starting on site will include safety and environmental hygiene;
- Fencing on all areas of excavation greater than 1m deep and sides of temporary works should be done. Workers should be careful while going to the river area;
- Workers should be provided with appropriate personnel safety equipment such as safety boots, helmets, gloves, protective clothes, dust mask, goggles, and ear protection at no cost to the workers;
- Contractor should keep the first aid kit at the construction sites at all time;
- To provide temporary shelters to protect against heat stroke during working activities or for use as rest areas as needed;
- Contractor should be responsible for evacuation injured person to the nearest medical center;
- H&S trainings should be provided to all the workers with respect to hazards linked to the activities. Additionally, the workers will be informed of precautions to be taken to avoid impacts to the local community;

- Monitoring of the PPE usage can be strengthened, in that, a mechanism can be adopted whereby defaulters receive a warning on non-usage and stringent actions can be taken on subsequent offences;
- Maintain H&S records of occupational H&S incidents, accidents, diseases and dangerous occurrences;
- Ensure that PPE is available at all times at site;
- In event of accidents, the contractor will be responsible for immediate evacuation of injured person to the nearest medical center. The contractor should bear medical and other expenses of the injured person;
- Undertake daily tool box talk and proper training of the workers regarding health and safety procedures related to solar projects, PPE usage, and regulatory provisions;
- The contractors should ensure H&S standards of labour camps. The labour camps will be established in the proposed site area. Additionally, the PIU team should conduct random spot checks to determine any issues related to improper waste disposal or the living conditions in these camps (i.e. presence of secure shelter and flooring, number of persons per room, number of toilets for the manpower, water availability etc.);
- Strong protocols should be built as part of contractual obligations around zero tolerance of child labour or harassment of women workers and even health and safety aspects. These should also be monitored by supervision and monitoring team; and
- A register of Materials Safety Data Sheets (MSDS) relating to all hazardous substances on board will be maintained.

6.11.2 Post-Construction Phase

The workers who work inside the factory face occupational health hazard due to different operational processes. Safe and good occupational health status of the employees and workers is important for not only the persons working in the plant, but also for the better plant operation and maintenance.

Mitigation measures

- To provide OHS training program and information on basic site rules of work, basic hazard awareness, site specific hazards, safe work practices, and emergency procedure;
- To provide adequate supplies and easy access of drinking water with a sanitary system;
- 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;
- Adequate preventive measures from negative factors such as fire, lighting, safe access, work environment temperature, area signage, labelling of equipment, communicate hazard codes, electrical connections.
- 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;
- Monitoring of the PPE usage can be strengthened, in that, a mechanism can be adopted whereby defaulters receive a warning on non-usage and stringent actions can be taken on subsequent offences;
- Maintain H&S records of occupational H&S incidents, accidents, diseases and dangerous occurrences;
- Ensure that PPE is available at all times at site;
- Additionally a Code of Conduct can be instituted for the operational phase that takes into account (a) health & safety aspects; (b) restrictions on activities – Dos and Don'ts; (c) labour camp regulations; (d) zero tolerance of illegal activities including: unlicensed prostitution; illegal sale or purchase of alcohol; sale, purchase or consumption of drugs; illegal gambling or fighting which will be shared with all contractors for induction of their employees/supervisors/workers;
- Strong protocols should be built as part of contractual obligations around zero tolerance of child labour or harassment of women workers and even health and safety aspects. These should also be monitored by supervision and monitoring team; and
- A register of Materials Safety Data Sheets (MSDS) relating to all hazardous substances on board, will be maintained.

6.12 Emergency Response

Any emergency situation may be arising due to manmade activity (e.g. chemical spillage, fire etc.) or natural cause (e.g. earthquake, land slide, cyclone etc.).

Mitigation measures

- Formulation of chemical management plan for individual industry as necessary;
- Training of safety usage and preparation of the emergency response plans;
- Implementation of the proper storage and record of usage;
- Applying for the acquisition of the license with management plan in accordance with the relevant law, and compliance with the law;
- Provision of protective equipment and clothes to workers as necessary;
- Preparation of the disaster prevention equipment and management manual;
- Installation of adequate number of fire hydrants in important places;
- Provide emergency drill and training;
- Compliance with the National Standard Operational Procedure for building construction to make earthquake resistant;
- Preparation of the disaster prevention plan such as emergency contact list;
- Implementation of suggested Disaster Management Plan (DMP).

6.13 Sanitation and Disease Vectors

Potential sanitation and impacts from disease need to be controlled by maintaining hygienic conditions in the EZ area throughout the operational phase as well during construction by implementing appropriate social and health programs for the project.

Mitigation measures

- Measures to prevent malaria should be implemented by installation of proper drainage to avoid water stagnation, etc.;
- Standing water should not be allowed to accumulate in the drainage facilities or along the warehouse sides to prevent proliferation of mosquitoes;
- Temporary and permanent drainage facilities should be designed to facilitate the rapid removal of surface water from all areas and prevent the accumulation of surface water ponds;
- Malaria controls should be implemented in line with social plans for the project;
- HIV/AIDS awareness and HIV/AIDS education and prevention program should be implemented in line with social plans under the social development work stream.

6.14 Impacts on Climate Change

Bangladesh is one of the most vulnerable countries to climate change. The flood map of Bangladesh shows that the proposed EZ site lie in flood prone area. Bamui Beel is adjacent to the proposed EZ site. The climate change impacts can lead to change in weather conditions, which may increase the vulnerability of site to floods.

Global warming as a consequent of the climate change will most likely increase the precipitation levels in the region thereby heightening the flood risk at the proposed site location. A warmer atmosphere can hold more moisture, and globally water vapour increases by 7% for every degree centigrade of warming. The impact of these changes on global precipitation has not yet been correlated academically, but the total volume of precipitation is likely to increase by 1-2% per ^{0}C of temperature increase.

6.15 Cumulative Impacts

The cumulative impacts of the development of EZ will be both negative and positive. After the development of proposed industries in the EZ, the individual emissions and effluent discharge may be within permissible limits, the cumulative effect of the emission or effluent discharge of different industrial units may lead to deterioration of overall air and water quality in the region. The vehicular movement will also impact the air quality of the region. However, the cumulative beneficial impacts are higher. The cumulative impacts of the projects will be:

- Aid in the development of the human capital in the region as well as the infusion of the financial capital resulting in the increase in contribution to the overall growth of the GDP in the country;

- Employment opportunities for the people thereby increase in standard of living of people;
- Economic integration of the area with the market and trade centers within and outside the districts;
- Improvement of the socio-economic conditions of the local residents.

7 Public Consultation and Disclosure

7.1 Introduction

Community participation always plays a key role for sustainable development. According to the guidelines of the DoE and the development partners, people's participation in planning and implementation phases of category A & B projects (usually red category) is essential to take necessary actions for minimizing any undue socio-cultural, political or any other conflicts and to address environmental issues. People have the right to know about what is going to happen in their surroundings. They must be informed about the positive and negative impacts for obtaining their perceptions, views and feedbacks on the probable changes likely to happen within the study area. Therefore, a series of public consultation meetings (PCMs) and public disclosure (PD) were undertaken with community stakeholders in accordance with the World Bank's Environmental Guidelines.

7.2 Objectives of Public Consultation and Disclosure Meeting

The primary objective of the PCMs and PD is to incorporate the opinions and suggestions of the public and all other stakeholders at the project planning stage to ensure wider acceptability of the project. The key objectives are as follows:

- To provide information on the economic, environmental, and social benefits as well as potential negative impacts from the project;
- To ensure that the potential project affected persons (PAPs), stakeholders, and local communities are engaged in a meaningful dialogue and are well informed prior to the decision of the project proponent as to the nature and extent of social and environmental impacts attributable to the proposed project with respect to planning;
- To ensure that the concerns of, and issues raised by the PAPs, stakeholders, and local communities are incorporated and adequately addressed in the EIA study;
- To engage in a participative exercise with PAPs, stakeholders, and local communities and obtain expertise and local, traditional wisdom and knowledge from them in order to plan the mitigation measures; and
- To facilitate periodic opportunities to the principal stakeholders to offer their inputs on all key components of the project.

7.3 Approach and Methodology of Public Consultation and Disclosure Meeting

7.3.1 Approach of PCM and PD for EIA

PCM and PD offer an opportunity for people to participate in the decision making process for design, development, and implementation of the project. It provides a platform for project affected persons and different stakeholders to express their views

on possible impacts of the proposed intervention on environmental and social parameters. PCM and PD for EIA are planned at two different stages (EIA scoping stage and draft EIA report stage) in order to collect opinions and feedback of the public and to disseminate information on the Project and EIA Study.

a) EIA Scoping Stage

The first stage of the PCM and PD for EIA is conducted at the time of environmental scoping in the initial stage of the EIA study. Information on the Project and scope of the EIA study is disseminated to the public and then comments and opinions are collected to incorporate into the report.

b) Draft EIA Report Stage

The second stage of the PCM and PD for EIA is conducted at the time of preparation of draft EIA report. Information about findings of draft environmental and social impact assessment study and proposed mitigation measures are disseminated to the general public that are directly or indirectly affected by the project. In addition, their feedback and opinions are obtained which are reflected in the EIA report together with their comments and request on the environmental and social mitigation measures, environmental management plan (EMP) and environmental monitoring plan (EMoP).

7.3.2 Methodology of PCM and PD for EIA

The consultant team prepared a checklist for the consultation meetings. The issues on the overall study, planning as well as project interventions and probable impacts of project on the environment, socio-economic condition and institution were incorporated in the checklist. The issues of discussion were also shared with the implementing authority for obtaining their responses and suggestions. The probable places of meeting were selected in consultation with the JEZ officials, local administrative persons and local knowledgeable persons of the study area.

An environmentalist of the EIA consultant team with the help of Deputy Project Director along with the chairman facilitated the consultation process with instantly available local people separately to collect/record opinions and views from their own perspectives. There were a good number of people of various age range gathered by seeing the local authorities. That helped us to get more opinion from the community. The team used maps of the study area during discussion to share about the interventions for the participants of the consultation meetings. The facilitators explained all relevant points and issues in order to enable the participants to comprehend the proposed interventions/ activities properly and to respond accordingly. The team took utmost care in recording opinions and views of the participants relevant to the EIA study. The team also visited the Economic Zone area to observe the possible adverse effects of the projects and also collected the necessary samples to examine it.

7.3.3 Stakeholder Engagement Plan

In order to ensure effective engagement and open, frequent and honest dialogue with local communities and other key stakeholders, a stakeholder engagement plan is

designed throughout the life of the project. This plan is to be developed and implemented in order to identify stakeholder and their issues of concern, establishes the methods for consultation, and provides a specific action plan for stakeholder engagement throughout the life of the Project.

Table 7.1: Stakeholder engagement plan

Key Stakeholders	
Project proponent	Jamalpur Economic Zone (JEZ)
Related organizations/ Local government	Chairman, BEZA
Local people	Land owners, farmers, day labors, teachers, housewives, religious people, women etc.
Private business	Private companies/ factories around the zone
Non-Governmental Organizations	Community Based Organizations (CBOs)
Engagement methods	
EIA phase	Organizing consultation meetings inviting key stakeholders above at draft scoping report and draft EIA report
Pre-construction/ Construction phase/ Regular operation Phase	– Regular communication with local community through personal contact; – Meeting with the representative of village on the quarterly basis; – Participatory meeting with villagers; – Interview survey with villagers.
Information disclosure	
EIA phase: Pre-construction/ Construction phase/ Regular operation Phase	Disclosures of draft scoping report and draft EIA report.
Grievance mechanism process and complaints register	
All phase	– Receiving complaints and opinions from the public on regular basis through the engagement method; – Meeting with the representative of villages; – Participatory meeting with villagers.

7.4 Public Consultation Meetings (PCMs)

Participatory Rapid Assessment (PRA) and Focused Group Discussions (FGDs) were held in major settlement areas of the Project site to inform people about the objectives of the Project. In each of the consultation, participants were encouraged to share their observations, suggestions, and experiences on various environmental and safety issues for establishing the Economic Zone in their locality. They also asked the suitable mitigation and enhancement measures. Issues discussed were:

1. Awareness and extent of the Economic Zone in that area and development components;
2. Benefits of the project for the economic and social advancement of the community;

3. Labor availability in the project area or requirement of outside labor involvement;
4. Necessity of giving employment to the local people as a priority basis based on the capacity;
5. Process of land acquisition in that area and the compensation ways;
6. Process of Collecting soil from the nearby water body (bill/marsh);
7. Local disturbances due to dust, noise generation during construction activities;
8. Necessity of cutting trees and the degree of clearing vegetation at project sites;
9. Water logging and drainage problem;
10. Discharge of polluted water;
11. Possible negative environmental consequences of the project like air quality, water pollution, and human health impacts etc.

The meetings were aimed to:

1. Ensure that the public was provided with opportunities to participate in the decision making process and to influence decisions that would affect them;
2. Identify the widest range of potential issues about the Economic Zone that are establishing in that area as early as possible and in some cases, have those resolved;
3. Ensure that government departments were notified and consulted early in the process; and
4. Ensure a broad range of perspectives were considered in any decision.

7.4.1 Proceedings of Public Consultation

The public consultation for the development of proposed Jamalpur Economic Zone was conducted on 01 May, 2019 at Jamalpur Sadar Upazila in Jamalpur District. The JEZ authority along with the chairman requested the stakeholders to attend the public consultation. A good number of community people were present in the meeting of various age ranges by seeing their local administration. The public consultation was attended by the project members, project relevant stakeholders, local communities, Deputy Project Director, chairman and representatives of Shahidul Consultant.

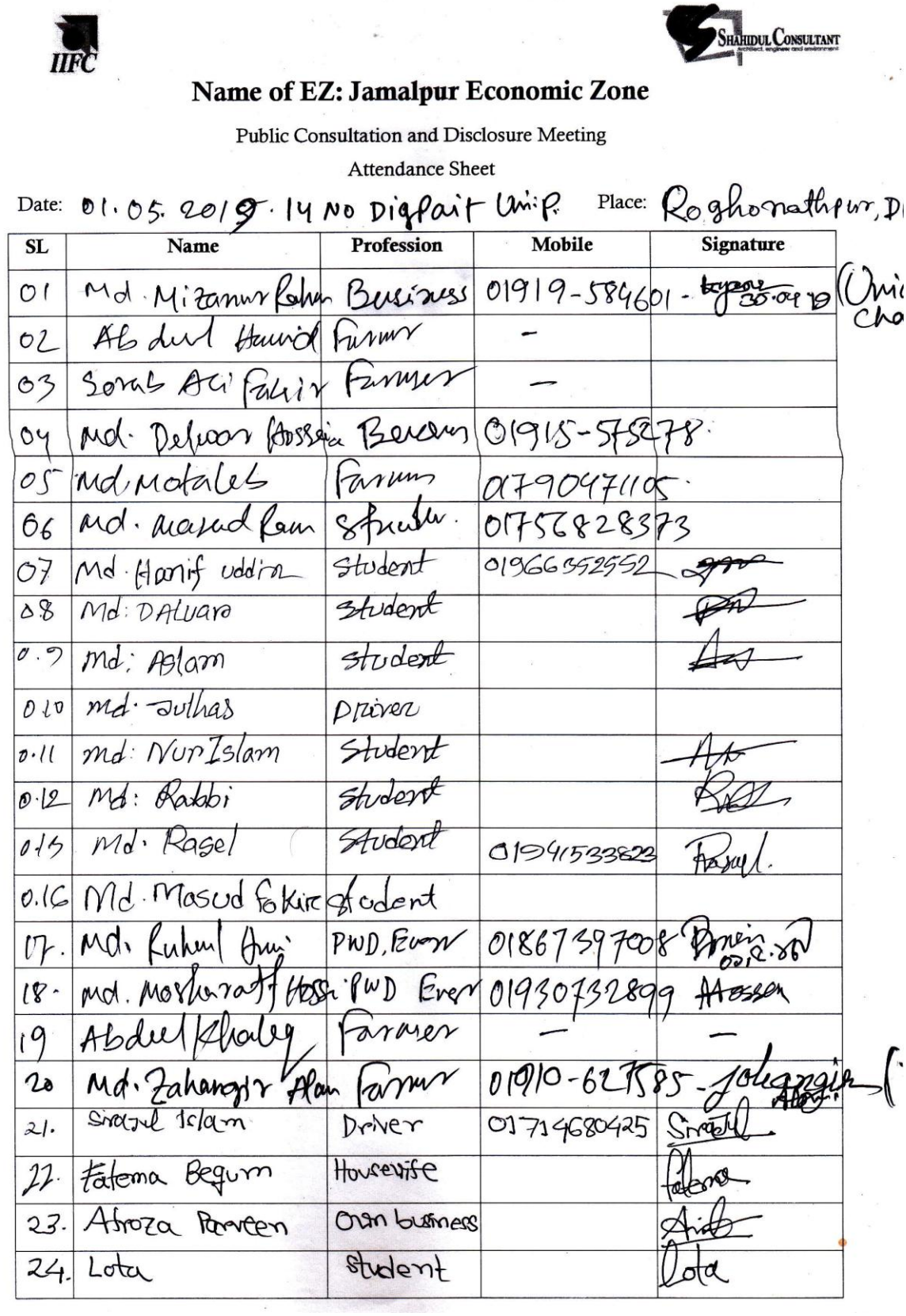
Representatives of Shahidul Consultant explained the proposed project and the environmental assessment of the region which included project background; introduction of the project proponent; institutional and legal framework for the project, project description with brief of project location, its connectivity, land use plan, and other aspects like sources and procedure of soil collection, sources and consumption of water, management of wastewater, source and consumption of electricity, solid waste generation and disposal, and other social and economic development that would emanate from this industrial area. Potential impacts of the development, suggested mitigation measures to mitigate them, environmental and social monitoring program was also explained to the public. Thereafter the representatives of JEJ requested to attend public to convey their suggestions/comments/concerns about the proposed project. Concerns raised during Public consultation conducted for Jamalpur Economic Zone (JEZ) and their response by concerned authorities are presented in the following Table.

Table 7.2: Concerns rose during public hearing and response/solution from the authority

SN	Name of Participant	Concern	Response/Solution
1.	Abdul Hamid, Farmer	He was concerned about the amount of money that he will get from his land that was acquired. He was also concerned about the lengthy procedures for collecting the money.	Representative from the JEZ console him that everybody whose land was acquired will get the money in the right time.
2.	Sirajul Islam Driver	His concern was about the job opportunities at the project side. He was worried that locals were not given priority at times of providing employment. He requested to give priority to the local people in terms of giving employment based on their capability.	It is obvious that all the time project affected people are always get priority at the time of getting employment opportunities. So, JEJ authority response that local will be given priority at the time of giving employment opportunities.
3.	Afroza, Owner of a small grocery store	He discussed about the women empowerment which is not noticed significantly in the project area and hoped women will gradually be engaged in different economic and development activities.	Local women will be given priority as per their skill. In addition, involvement of women in construction and operation activities will be made for the welfare of women and children. JEZ authority will provide necessary set of trainings to women and to aid them to develop their skills.
4.	Sumon Student	He is doing his undergraduate from Anondo Mohon College, Mymensingh. He was asking for a job based on his capability in the project side.	Consultant consoles him that since he is educated enough, he does not need to worry about his job. He can surely manage a job by himself.
5.	Md. Sohel, Business	He was concern about the soil collection procedure that is hampering the nearby waterbodies (bill).	Soil will be collected by maintainingproper procedure so that it won't create any adverse impact for the waterbodies.
6.	Fatema Begum Housewife	This old aged lady also concerned about a job for his grandson and also for herself as they are so needy.	Local people shall get priority in case of job opportunities of the proposed JEZ. Beside this, specific trainings shall be provided to local people by the project proponent. The training modules will vary based on the requirement and the interest of the stakeholders.
7.	Lota Student	She was saying that since the elevation of the project area are comparatively high than the opposite area; in the rainy season water logging problems have seen recently.	After the project work done there will be a good management system for the water to pass so that water not get logged in.

The list of participants attended at the discussion meeting has been given in the Figure below.

Figure 7.1: List of participants attend in the consultation meeting



Name of EZ: Jamalpur Economic Zone

Public Consultation and Disclosure Meeting

Attendance Sheet

Date: 01.05.2019. 14 No Digpait Unit Place: Roghonathpur, D

SL	Name	Profession	Mobile	Signature
01	Md. Mizanur Rahman	Business	01919-584601	
02	Abdul Hamid	Farmer	-	
03	Sorab Ali Fakir	Farmer	-	
04	Md. Delwar Hossain	Beparee	01915-575278	
05	Md. Motalab	Farmer	01790471105	
06	Md. Masud Rana	Student	01756828373	
07	Md. Hanif uddin	Student	01966552552	
08	Md: DALuara	Student		
09	md: Aslam	student		
010	md. Julhas	Driver		
011	md: NurIslam	Student		
012	Md: Rabbi	Student		
013	Md. Rasel	Student	01941533822	
016	Md. Masud Fakir	Student		
17.	Md. Ruhul Amin	PWD, Enam	01867397008	
18.	md. Mosharaff Hossain	PWD Enam	01930732899	
19	Abdul Khaleq	Farmer	-	-
20	Md. Zahangir Alam	Farmer	01910-627585	
21.	Sirazul Islam	Driver	01714680425	
22.	Fatema Begum	Housewife		
23.	Afroza Parveen	Own business		
24.	Lota	Student		

Name of EZ: Jamalpur Economic Zone

Public Consultation and Disclosure Meeting

Attendance Sheet

Date: Place:

SL	Name	Profession	Mobile	Signature
1.	Sufia	housewife		Sufia
2.	Khurshida	student		Khurshida
3.	Rabeya	own business		Rabeya
4.	Helal Uddin	unemployed		helal
5.	[illegible]	housewife		[illegible]
6.	Alo	"		Alo
7.				
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22.				

Public consultation held at the project site has been given in the following Figure.

Figure 7.2: Public consultation meeting held at project area

Source: Field visit

Figure 7.3: Public consultation meeting with the local administrative body of the project area

Source: Field visit

7.4.2 Public Disclosure Meetings (PDMs)

For the implementation of PD at the draft EIA stage, the additional arrangement was made to implement at the draft EIA stage taking into account the opinion received at the scoping stage as follows:

a) Preparation and disclosure of the main part in local language in addition to the documents which are officially required in accordance with EIA procedure;
b) Arrangement of PD before the day of holding PCM;
c) Arrangement for changing PD period i.e., 1 month to 2 weeks; and
d) Distribution of the reports to more places.

7.4.3 Consultation Outcomes

The stakeholders expressed that the development of the Economic Zone will bring social and economic development in the region providing permanent source of income for the PAPs and also to other nearby residential settlements. The land owners were inquisitive of the proposed plan, land acquisition process, whether proper compensation will be provided and whether local residents whose agricultural lands will be impacted be provided any alternative means of employment. The stakeholders sought that the payment of compensation and other rehabilitation measures be completed before the start of any work. They also expressed their desire to hold consultations across the project lifecycle and not just at the initiation phase.

The community perceives that the project will help in increasing better connectivity, promote better and sustained employment opportunities, better service facilities, and better conveyance. They also demand to prioritize the local in terms of giving any employment opportunity; they also wanted local resource based development which will indirectly help the local community. Another aspiration of the community was that to complete the work in time so that it doesn't takes any long time to get the benefit of the project. Apprehensions raised by the community include loss of agricultural lands, loss of house and settlement options for few people putting up within the site area, amount and time for the compensations, factors which will determine the compensation, if resettlement happens what would be the likely location. The likely outcome from the FGDs related with the compensations came out should be paid at market rate and before the beginning of the pre-construction phase of the project.

Further, the analysis of the key positive impacts, apprehensions and perceived negative impacts and the suggestions/recommendations as documented during stakeholder consultations are detailed in below table.

Table 7.3: Positive impacts perceived by the stakeholders

Positive impacts perceived by the stakeholders	Negative impacts
• Increase in direct and indirect employment opportunities for both the genders.	• Loss of homesteads.
• Provision of enhanced basic amenities.	• Impact on agricultural land.
• Facilitate improved access to market centers,	• The stakeholders

Positive impacts perceived by the stakeholders	Negative impacts
educational institutions, healthcare facilities, and offices etc.	expressed their apprehensions regarding the degradation of the waterbodies (bill) for collecting soil.
• The cumulative positive impacts of the project will result in increased mobility, employment generation, and above all better economic integration of the area with the major market and trade centers within and outside the districts.	
• Local people will get the chance to increase their business like hotels, grocery shops in the surrounding place of the project and can make benefit from that. Because after the project there will be a lot of people will be visiting this place for their work purpose in the economic zone.	Possibility of waterlogging problems in the surrounding area. But if proper steps can be taken it can be reduced.

8 Environmental Management Plan and Monitoring Indicators

8.1 Introduction

Environmental Management Plan (EMP) is a site-specific plan developed to ensure that all necessary measures including mitigation and monitoring activities are identified and implemented in order to preserve and protect the environment and to avoid and manage the negative impacts of the project and comply with environmental legislation. The primary objective of the EMP is to provide a guideline for proper management and monitoring of the identified environmental and other impacts due to the project and to offer document to the implementers for accomplishing the institutional requirements of the authority. It will identify the residual impacts and unavoidable impact and its management. As GoB is committed to ensure sound environmental condition, preparation and execution of EMP is mandatory for preparation, implementation and monitoring of environmental protection measures during and after commissioning of the project. EMP indicates how various measures are proposed to be undertaken during different phases of the project including cost components. It consists of various steps including:

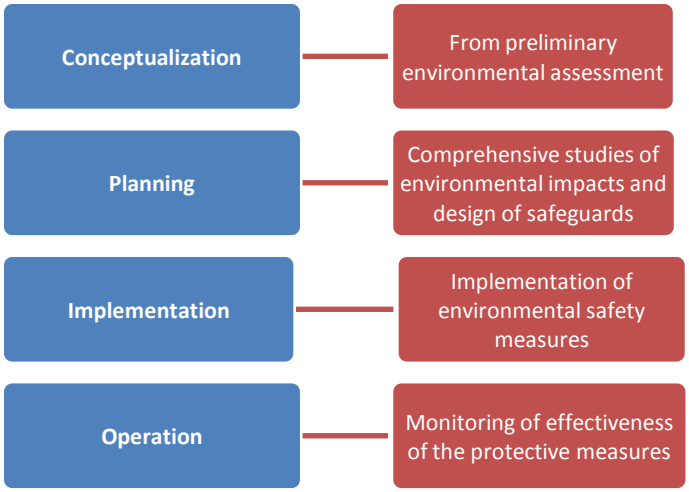

Figure 8.1: Different steps of EMP

The present study clarifies the following proposed EMP:

- The mitigation measures that needs to be taken during construction and operation phases of the project to eliminate or offset adverse environmental impacts, or reduce to acceptable limits;
- The actions needed to implement these measures; and
- A monitoring plan consists of concrete monitoring indicator require to assess the effectiveness of the mitigation measures employed.

Similarly, integrated EMP is a necessary requirement for implementation of the JEZ, which will be a guide for the environmental protection activities. A comprehensive measure for mitigation and monitoring of possible environmental hazards has been

enlisted for ensuring safety measures and minimizing the risks and hazards due to implementation of the project in the study.

8.2 Mitigation Plan

The establishment and execution of proposed JEZ is believed to have a positive impact for sustainable economic growth of the country as well as provision of employment to the local people. However, the project may also have some impacts on the existing local environment, eco-system and socio-cultural activities including land use, soil quality, pollution of water, air, noise, etc. Therefore, a mitigation mechanism has to be established to the affected communities regarding various harmful impacts including the effects on livelihoods, environment, agriculture, water bodies, and surrounding social infrastructures. A detail EMP including health & safety measures has been described in the following table. The Project proponent will be responsible for accomplishing the proposed safety measures mentioned in the proposed EMP.

Following are the main advantages of the environmental mitigation plan:

- Ensure plan for the fulfillment of basic environmental standards essentially required to meet during design, construction, and operation period of the project;
- Provide plan for the development of compensatory actions especially in the form of compensatory forestation, green zone development and landscaping for minimizing the negative ecological impacts due to the project;
- Reduce the potential environmental impacts, causing the biophysical environment in the area to deteriorate and indirectly slow down the economy of local communities by the project.

The EMP for JEZ has been prepared based upon optimum and reasonable costs that are needed for mitigation measures on a “least-cost” basis. Activities that needs to be carried out for the environmental management and monitoring of the proposed EZ could be divided into two phases: during construction phase, and during operation phase.

Table 8.1: Environmental mitigation measures and management plan

Issues	Expected Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Responsibility	
			Implementing	Supervision
Pre-construction phase				
Pollution	Noise and Vibration	• Arrangement of the land allocation for each tenant and the installation of buffer zone with less noise and vibration impacts to the surrounding sensitive as possible.	JEZ/BEZA	BEZA
Social Environment	Land loss and resettlement (106 nos. of household will be directly affected)	• Prepare Resettlement Action Plan for affected people; • Provide adequate compensation to the affected people within short time; • Ensure that every affected person get compensation; • Create job opportunity and give priority to those who lost income; • Provide training to affected people to increase their job opportunity.	JEZ/BEZA	BEZA
	Vulnerable group	• Vulnerable groups are those who have lands in the project sites will be compensated in terms of monetary value.	JEZ/BEZA	BEZA
	Loss of livelihood	• Aim of EZ establishment is to provide and create employment.	JEZ/BEZA	BEZA
	Local Conflict of Interests	• Land acquisition process should be made by discussing with the community people. Also the price of the land should be determined according to the present market price of land of that area.	JEZ/BEZA	BEZA
	Impact on accessibility of existing infrastructure and service to community	• Arrangement of alternative options for infrastructure and service.	JEZ/BEZA	BEZA
	Quality of life for local communities	• Quality of life of the local communities will be improved if everything can be maintained properly.	JEZ/BEZA	
	Water Usage	• Arrangement of alternative water sources near the Project area.	JEZ/BEZA	BEZA
	Cultural Heritage/ Asset	• Not Applicable	JEZ/BEZA	BEZA
Construction phase				

Issues	Expected Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Responsibility	
			Implementing	Supervision
Air Pollution	Emission of dust, PM ($PM_{2.5}$, PM_{10}), gaseous emission like SO_X, NO_X, CO, CO_2 etc. from industrial activities and vehicular activities.	• Closed vehicles can be used to transport hazardous substances; • Using barrier so that dust can't go outside; • Monitoring of wind speed and direction to manage dust-generating activities during undesirable conditions; • Dust suppression should be undertaken where necessary by covering and/or spraying affected land surfaces with water; • Prevent offsite migration of dust using appropriate screens; • Use or establish hard-covered roadways for vehicle movement; • Vehicle speed restrictions should be applied across the project site to avoid excessive dust generation; • Trucks transporting excavated soil and other construction raw material to and from the site to be covered to minimize fugitive dust emission; • Cover all onsite construction material and construction waste storage/stockpiling locations; • Use low sulphur content fuel for machinery and equipment to reduce SO_2 emissions from engines whenever possible; • Modify machinery to reduce NO_X emissions; • All energy consuming and CO_2 generating activities should be done as efficiently as possible to minimize CO_2 emissions; • Adopt a policy of switching off machinery and equipment when not in use; • Appropriate maintenance, engine tuning and servicing of construction equipment to minimize exhaust emissions; • Minimize unnecessary journeys or equipment use.	JEZ/BEZA	BEZA
Noise and Vibration	Noise and vibration from machineries, construction work and vehicular movement.	• Protective measures (ear muffs, ear plugs) will be distributed to the workers; • Low noise generating equipments should be set up; • Active and passive noise controller mechanism have to be set up; • Installation of sound-proofing sheet;	JEZ/BEZA	BEZA

Issues	Expected Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Responsibility	
			Implementing	Supervision
		• Avoidance of construction at night time; • Advanced notice for construction work time near the residential area; • Avoidance of intensive operation of construction machineries; • Speed limit for drivers; • Preventive maintenance of equipment and vehicles; • Unnecessary engine operations to be minimized (e.g. equipment with intermitted use switched off when not working); The following techniques can eliminate the vibrational problems to a greatest extent in the construction phase of the project: • Piles in properly selected patterns also reduce noise and vibration level; • Introducing barriers to the vibration waves in the transmission path can reduce vibrations that reach a building; • Equipment noise will be reduced at source by proper maintenance and repair of construction machinery and equipment. • Other methods are to avoid demolition methods that involve impact, avoid the use of earth moving equipment, vibratory rollers and packers near sensitive areas.		
Water Pollution	Impact on ground water and surface water quality, ground water depletion, drainage cognation.	**Surface water** • No disposal of any wastewater directly into water bodies. • Establish temporary storm water drains and rain water harvesting tank to use it at the time of construction. • Avoiding seepage of wastewater, fuel, oil and oily water; • Vessels will never be overloaded; • Waste disposal to water body are prohibited; • Treat accidental spills on any floating unit with spill containment and clean up (dispersant) materials; and • Provision of septic tank and soak pit;	JEZ/BEZA	BEZA

Issues	Expected Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Responsibility	
			Implementing	Supervision
		• Provide proper drainage facilities. • To minimize loss from evaporation water storage tanks should be covered. **Ground water** • Adapted modern technology that helps us to minimize water requirement for construction. • Minimum extraction of ground water; • Control all onsite wastewater streams and ensure appropriate collection, treatment and discharge; • Prevent discharge of contaminants and wastewater streams to ground water; • Apply high quality control standards to the construction of wastewater storage trenches/tanks to avoid leakage and arrange for frequent discharge to prevent sewage spillage/overflow of the groundwater; • Good housekeeping to prevent leaks and incidental spills; • Adequate management and proper handling and storage of construction materials, oils and fuel to avoid spillages. • Implementation of a continuous and regular site inspection system; • Proper management and disposal of the waste; • Restrict the earth work activities during monsoon season; • Channelize all surface runoff from the construction site through storm water drainage system and provide adequate size double chambered sedimentation tank; • Prevent & mitigate spill of paint/fuel within the construction site.		
Land Resources and Soil Pollution	Disruption of earth surface due to construction work and solid waste generation.	• Earth work should be kept minimum, and adequate drainage system should be developed; • Avoide tree cutting at the time of construction work; • Compensatory tree plantation should be made if trees have been cut off; • Avoide piling of material at site;	JEZ/BEZA	BEZA

Issues	Expected Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Responsibility	
			Implementing	Supervision
		• Follow proper methodology to collect soil from the nearby waterbody (bill); • Debris of the construction should be stored beneath the covered sheds and paved surface and disposed off regularly at the designated place; • Minimizing areas of excavation work as much as possible; • Where possible, excavated material shall be reused during the construction works; • Stockpiling of soils onsite to be kept to a minimum; • Best practices for soil management should be followed; • Control all onsite wastewater streams and ensure appropriate collection, treatment and discharge; • Good housekeeping to minimize spills/leaks; • Minimize onsite storage of potentially contaminating materials; • Proper handling and management of wastes; • Proper handling and storage of potentially contaminating materials (e.g. diesel fuel) and wastes in appropriate secondary containment to avoid accidental release.		
Wastes Generation	Generation of construction wastes and wastes from labour camp.	• Waste management plan to be prepared; • Quantities of construction materials to be accurately estimated to minimize the potential for excess generation of waste; • Construction activities to be appropriately scheduled to minimize the potential for rework; • Sizing of storage areas/skips will be in accordance with the expected waste quantities and the frequency of disposal. Waste skips/containers are to be suitably labelled for easy identification of material. Waste skips will be covered to avoid waste scattering onsite; • Waste bins will be installed clearly marked wherever required. Such places include eating/rest areas, next to operational areas and next to any worker assembly areas;	JEZ/BEZA	BEZA

Issues	Expected Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Responsibility	
			Implementing	Supervision
		• Adequate waste management, awareness and communication through training, tool box talks and posters placed across the site. • Engage licensed approved subcontractors to undertake all waste and recycling activities; • The provision of Central Solid Waste Dumping Station (CSWDS) to safe dumping of all the hazardous and non-hazardous solid wastes.		
Agriculture	Impacts on agricultural production.	• To avoid the discharge of any waste materials to surrounding agricultural land. • Establish agro based industry to compensate the loss and for more benefit generation; • Encourage the farmer to continue their occupation later on for the sustainable growth of the economy and their better future; • Increase the overall agricultural production from the nearby land by using advance technology;	JEZ/BEZA	BEZA
Fisheries	Impact on fisheries of Bamui Beel and Bangshi River.	• Proper disposal and management of construction waste; • Restrict car washing, equipment washing near to the bills; • Minimize any construction work that create disturbance to the sediments; • No waste should be dumped into water bodies during construction; • Wastewater from labour camp and construction site should not be disposed off in the water bodies; • Septic tank/soak pits should be provided to dispose off the wastewater from construction camp; • Site should be kept clean so as no pollutant from site should enter the water bodies along with run-off; • Excavation activities should not be undertaken during monsoon season; • Piling of raw material at construction site should be avoided; • Raw material, debris and fuel should be stored on paved surfaces under covered areas.	JEZ/BEZA	BEZA

Issues	Expected Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Responsibility	
			Implementing	Supervision
Ecosystem	Clearance of existing vegetation, loss of terrestrial and aquatic and agro ecosystem.	• Clear marking of boundary of the project site to restrict the contractor from clearing the vegetation outside of the project site; • Prevent unnecessary clearing or disturbance of native vegetation; • Vehicle tracks and roads should be used to decrease habitat destruction; • Minimizing areas of excavation and active work sites as far as possible; • All work will be undertaken during the day, as much as reasonably practical, to ensure lighting does not impact birds and noise will be reduced as much as reasonably practical to avoid fauna disturbance; • If protected/sensitive species are discovered or suspected, then work will be ceased and inform the relevant authority; contractor will seek expert advice and/or consult the client in order to develop and agree on an appropriate management strategy; • No litter or plastic bags/containers will fly off the site boundaries; • Vegetation removal to be minimal and limited to the zone; • Water sprinkling for dust suppression and provision of dust curtains to reduce the dust emission; • Sanitary toilet has to be provided to prevent contamination of water from the defecation. • Restrict car washing/equipment washing nearby to the canal;	JEZ/BEZA	BEZA
Impacts on Socio-Economy	Impact on health, aesthetics and hygiene, impact on existing resources, create employment opportunities, local conflicts of interest.	• Various environment awareness programmes shall be organized by management committee on regular basis to bring forth the beneficial aspects of the project at local level; • A management committee shall take keen interest in public participation and expectations of the local people for improving quality of life during planning of welfare activities under CESR plan; • The committee shall identify eligible people for jobs in construction and lower level administrative jobs by noting their literacy level, extent of need, availability of means, etc. or the committee should confirm the employment of	JEZ/BEZA	BEZA

Issues	Expected Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Responsibility	
			Implementing	Supervision
		local people by sub-contractors. • Unskilled labor during the project construction phase should besourced from the local community; • The initiatives of the project proponents are likely to be focused on livelihood restoration, income generation, education and provision of health facilities which can further improve the quality of life of the community in the vicinity.		
Impact on Traffic	Increase of traffic volume and possibility of accidents.	• Safe driving training will be mandatory to all drivers; • Periodic servicing of vehicles will be carried out in accordance with the manufacturer's instructions; • Avoid vehicle movements during rush hours; • Adopt a traffic plan to cover all transport arrangements during the construction phase; • Training and licensing industrial vehicle operators of specialized vehicles such as forklifts, including safe loading/unloading, load limits; • Vehicle speed restrictions should be applied; • Minimize night time vehicle movement.	JEZ/BEZA	BEZA
Community Health and Safety	Third party accidents with residents near the construction site or accidents with local people by the traffic of construction vehicles, disputes among local people and migrated workers.	• Construction activities should be timed, and provision for pedestrians should be made; • Excavated trenches/ditches and freshly cut steep side slopes should be clearly marked and fenced for the safety of passers and workers alike; • Community must be informed of the type of activities being undertaken for the project and the health and safety measures that can be undertaken by them as a precautionary measure. Additionally, the emergency response plan must also be communicated to the villages in the vicinity; • Proper health and safety plan should be prepared during design and take action accordingly during construction to avoid road accidents and health hazards of the surrounding project community; • Linkage of Communication, Disclosure and Grievance Redressal Mechanism	JEZ/BEZA	BEZA

Issues	Expected Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Responsibility	
			Implementing	Supervision
		should also cover labourers so that any concerns on working conditions and contractor mal-practices can be managed; • Dispute settlement among stakeholders in case incidences occur; • Arrangement of worker's accommodation if necessary.		
Occupational Health and Safety	Accidents and incidents during the work.	• 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 supplies and easy access of drinking water with a sanitary facilities; • 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 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; • 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.	JEZ/BEZA	BEZA
Emergency Situation	Chemical spillage, fire, earthquake, flood, river bank erosion etc.	• Training on safety usage and preparation of the emergency response plans; • Implementation of the proper storage and record of usage; • Applying for the acquisition of the license with management plan in accordance with the relevant law, and compliance with the law; • Provision of protective equipment and clothes to workers as necessary;	JEZ/BEZA	BEZA

Issues	Expected Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Responsibility	
			Implementing	Supervision
		• Preparation of the disaster prevention equipment and management manual; • Installation of the fire hydrants; • Implementation of emergency drill; • Compliance with the National Standard Operational Procedure for building construction; • Formulation of chemical management plan as necessary; • Preparation of the disaster prevention plan such as emergency contact list; • Implementation of suggested Disaster Management Plan (DMP).		
Climate Change	Impact in the increase of GHGs by vehicle traffic operation of tenants in the construction phase.	• 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.	JEZ/BEZA	BEZA
Post-construction phase				
Air Pollution	Emission of dust, PM, gaseous emission like SO_X, NO_X, CO, CO_2, Volatile Organic Compounds (VOCs), Hazardous Air Pollutants (HAPs) etc.	• Regular monitoring and maintenance of all equipment, generators etc. • Using latest technology will help to reduce the air emission; • Keep adequate stack height (higher than the nearest building to) disperse the emission; • Adopted energy conservation procedure by using alternate energy options like using solar power and other energy efficient technologies; • Using clean fuel like Liquefied petroleum gas and low Sulphurdiesel; • Use of cyclones (tertiary cyclones, multi cyclones) to abate particulate emissions. Besides, electrostatic precipitators, wet flue gas scrubber etc. should be used to control PM emission from each industry. • Ensure that air emissions from point sources will meet all relevant national and international standards; • Besides point source monitoring, air quality monitoring should be carried out in specific locations;	EHS officer/ JEZ/BEZA	BEZA/DoE

Issues	Expected Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Responsibility	
			Implementing	Supervision
		• Use low Sulphur content fuel for machinery/equipment, modify machinery, and switch off machinery/equipment when not in use. • Use portable leak detection equipment to identify and prevent fugitive emissions; • Any leak once detected will be immediately reported; • Bag filters shall be applied to control PM emissions and scrubbers can be used to control gaseous emissions; • In order to reduce SO_Xconcentrations, De-SOx catalyst additive, feed desulphurization and flue gas desulphurization methods must be followed; • Minimize unnecessary journeys and equipment use and adopt a policy of switching off machinery and equipment when not in use; • Use best available technologies for emissions reduction of NO_X like Fuel De-nitrification, FCC NO_X control, Diluent injection, Flue Gas recirculation, Steam or water injection, Low NO_X burners, Selective non-catalytic reduction and selective catalytic reduction etc. • Provision for covering/Pressurizing of API separators with or without vapor recovery for controlling VOCs. • Preparation of feasible mitigation measures, such as, energy use efficiency, process modification, selection of fuels or other materials, the processing of which may result in less polluting emission, application of emission control techniques, if necessary; • Development of greenbelt and planting trees around the each industrial plot.		
Noise and Vibration	Noise and vibration from machineries and generators will cause negative health impacts and reduce machineries and equipment's efficiency.	• Avoiding continuous (more than 8 hrs) exposure of workers to high noise areas; • Provision of ear muffs at the high noise areas; • Ensuring preventive maintenance of equipment; • Provision of use noise reducing technology and noise barriers; • Provide hearing checkup regularly to workers;	EHS officer/ JEZ/BEZA	BEZA/DoE

Issues	Expected Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Responsibility	
			Implementing	Supervision
		• During operational phase, it is recommended that routine maintenance procedures will put in place to ensure that vibration is minimized. This measure includes inspection and maintenance of mountings to isolate machinery that is prone to vibrations and the balancing or reciprocating and rotating machinery.		
Water Pollution	Deterioration of water quality due to wastewater discharge, chemical/oil spillage, solid waste dumping etc. into nearby water bodies.	**Ground Water** • Proper maintenance and management of each industry during operation to minimize the risk of spillage and leakage; • Regular inspection of pipes and other potential sources of leaks for the early detection of possible seepage; • Store and manage potentially contaminating materials according to best environmental practices; • Implement a comprehensive Waste Management Policy which ensures the safe storage and timely treatment and removal of waste; • Install groundwater monitoring wells and implement a continuous monitoring and sampling program, as part of the environmental monitoring plan, to detect any impacts to groundwater quality; • Formulate a spill contingency plan. **Surface water** • Keeping liquid effluents to minimum as applicable; • Temperature, salinity and other qualities will be regularly monitored and documented at the outfall; • Avoiding taking or disposing water at known sensitive, breeding or nesting areas; • Avoiding swimming and fishing from navigation routes; • The provision of a Central Effluent Treatment Plant (CETP) with good cushion to meet the hydraulic and pollution load during operating the plants. The project authorities should ascertain at planning stage and further evaluate at commissioning stage so that the treated effluent would have characteristics of	EHS officer/ JEZ/BEZA	BEZA/DoE

Issues	Expected Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Responsibility	
			Implementing	Supervision
		prescribed limits of National and International standards. The performance of CETP should be continuously monitored and any deviation in performance should be corrected on priority basis; • Regular monitoring of effluent from different treatment units and also combined final discharge of treated wastewater is recommended. Performance evaluation of effluent treatment plant as well as sewage treatment plant should be undertaken at regular intervals for all relevant parameters covered under this study • The project authority should establish a Central Sewerage Treatment Plant (CSTP) in order to treat and proper management of Sewages produced during operation phases.		
Land Resources and Soil Pollution	Contamination of Soil	• Store and manage potentially contaminating materials according to best environmental practices to avoid spills and leaks; • Regular monitoring, maintenance and using best available techniques; • Compensate the soil loss from the nearest Bamui bill by taking different technologies like vegetation or buffer strip; • Formulate a spill contingency plan and have appropriate response equipment available onsite; • Implement a comprehensive Waste Management Policy which ensures the safe storage and timely treatment and removal of waste. Wastes should be properly managed and disposed of in accordance to the waste management plan. • Waste and contaminated water should be treated and if possible reuse it to minimize soil contamination.	EHS officer/ JEZ/BEZA	BEZA/DoE
Wastes Generation	Impact of waste generated from factories and offices.	• Executing national 3R strategy (reduce, reuse and recycle) to minimize both solid and liquid waste; • Provision of services that ensure waste are being treated before safe disposal like pretreatment of the process fluids before discharge it to the Effluent Treatment Plant schemes;	Waste Collectors/EHS officer/ JEZ/BEZA	BEZA/DoE

Issues	Expected Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Responsibility	
			Implementing	Supervision
		• Provide adequate amount of training about the Environmental training and awareness to the workers; • Waste bins will be installed wherever required; • Different types of wastes shall not be mixed into one container; • Provide proper disposal methods for each waste stream; • Maintain a record of waste leaving the site (description and volume) e.g. use of waste manifests; • Light bulbs and fluorescent light fittings to be treated at an approved hazardous waste treatment facility.		
Odor	Odor from wastes and different manufacturing process.	• Regularly collect waste from bens and dispose of into selected place; • Maximize the opportunities for reuse and recycling of materials to minimize solid waste generation; • Waste bins will be installed wherever required; • Different types of wastes shall not be mixed into one container; • Provide proper disposal methods for each waste stream; • Maintain a record of waste leaving the site (description and volume) e.g. use of waste manifests; • Light bulbs and fluorescent light fittings to be treated at an approved hazardous waste treatment facility; • Spent catalysts will be returned to the manufacturer.	Waste Collectors/EHS officer/ JEZ/BEZA	BEZA/DoE
Agriculture	Deterioration of surrounding soil quality will be affected production. But the impact will not so high.	• Care must be taken to ensure that any solid and liquid industrial wastes shall not be discharged in the local agricultural land; • Any conflict with local farmers should be avoided and complain from farmers should be manage with priority basis;	JEZ/BEZA	BEZA/DoE
Fisheries	Impacts on fish production of Bamui bill and Bangshi River.	• Avoiding swimming and fishing from navigation routes as much as possible; • Restrict car washing/equipment washing nearby to the canal; • Fishermen will be informed about the project and their feedback to be taken	JEZ/BEZA	BEZA/DoE

Issues	Expected Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Responsibility	
			Implementing	Supervision
		on seasonality and routes. • Adoption of adequate wastewater and industrial effluent management technology so no untreated sewage is discharged into surface water body; • Industrial, municipal and hazardous waste should be managed such that no waste is dumped or disposed in surface water body; • Direct discharge of any effluent or waste should be avoided; • Over extraction of fishery resources need to be protected;		
Ecosystem	Change of ecosystem	• Machinery and generators with 'quiet', 'muffled' or 'silenced' running should be used where available; • Site noisy equipment (e.g. generators) away from receptors where possible; • Use acoustic insulation, where appropriate; • Sanitary toilet has to be provided to prevent contamination of water from the defecation; • Restrict car washing/equipment washing nearby to the canal; • Fitting vehicles with effective exhaust silencers, where available; • Minimize machinery operation and vehicle movements, particularly during the night hours; • Restrict working hours for particularly loud or intrusive activities; • Recommended measures to avoid inappropriate waste disposal include the implementation of a comprehensive Waste Management Policy which ensures the safe storage and timely treatment and removal of waste; • Development of green belt throughout the periphery of the zone and all the unpaved vacant spaces of the zone; • Inspection will be undertaken to identify the potential of leak/spills in the different offshore components, including pipelines, and to implement corrective action if necessary; and regular monitoring to ensure water discharged complies with national limits; • Oily water separator to be installed at the point of surface run-off discharge ;	JEZ/BEZA	BEZA/DoE

Issues	Expected Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Responsibility	
			Implementing	Supervision
		• Suggestions from Spill Contingency Plan to be strictly implemented in case of spillage; • Regular monitoring should be carried out for terrestrial and aquatic ecological and any unexpected effect should be investigated.		
Natural Resources	Impacts on natural resource availability.	• Optimize and reduce the use and consumption of fossil fuels and diesel; • Water consumption will be optimized by identifying and implementing water conservation; re-use measures rainwater harvesting; • Optimize and reduce the use of electrical sources; • Provide training to all employees on resource conservation methods; • Use resource conserving technology.	All Employees/ JEZ/BEZA	BEZA/DoE
Impacts on Socio-Economy	Nuisance and disturbance to the nearby population, employment opportunities, development of infrastructure etc.	• Extending reach of Corporate Social and Environmental Responsibilities (CSER) Program; • Communication with local community though community relation department; • Compliance with the relevant regulations of child labour; • Employ local residents as much as possible; • Promote communication between workers and local people (e.g., join in local events); • As a mitigation measure the land owner, share croppers, lessee farmers and the salt pan workers will be appropriately compensated as per Government Rules; • Training should be provided to the local people for their skill enhancement; • JEZ should be responsible in giving an orientation to the migrant labourers on the local custom and tradition followed by the local population; • Prior to engagement of migrant labour, medical check-up should be carried out and copy of the medical certificate should be collected by JEZ authority, through sub-contractors, and maintained as part of their records; • Regular medical camps should be conducted amongst the labourers and the	JEZ/BEZA	BEZA/DoE

Issues	Expected Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Responsibility	
			Implementing	Supervision
		local population to make them aware about diseases like Typhoid, malaria, tuberculosis, STD's, HIV Aids etc.; • The positive impact can be further enhanced by committing an assured engagement level for the local community and by ensuring that priority is given those who contributed the land for project.		
Impact on Traffic	Nuisance and disturbance to the nearby population, accidents, disturbance to ecology.	• Provide a dedicated parking area for private vehicles of project personnel; • Safe driving training will be mandatory to all drivers; • Basic maintenance for vehicles will be carried out by the driver/operator; • Defects will be repaired before the vehicle is back to service; • Periodic servicing of vehicles will be carried out in accordance with the manufacturer's instructions; • Avoid vehicle movements for supply and product distribution during rush hours; • Drivers will undergo medical surveillance; • Training and licensing industrial vehicle operators of specialized vehicles such as forklifts, including safe loading/unloading, load limits; • Adequate planning of activities to ensure and avoid unnecessary transportation trips; • Provide driver safety training; • Prepare a traffic management plan; • Minimize night time vehicle movement.	JEZ/BEZA	BEZA/DoE
Community Health and Safety	Accidents with local people by the traffic of construction vehicles and any operation activities, disputes among local people and migrated workers, possibilities of disease	• Safety barrier and warning sign surrounding the construction site; • Monitor any effect due to operation work on local community; • Provide security and health facility to local people if any health issue or accident arises due to project activity; • Establish the plan of site safety and security measures to communities and its	Doctors/EHS officer/ JEZ/BEZA	BEZA/DoE

Issues	Expected Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Responsibility	
			Implementing	Supervision
	outbreak.	implementation; • Education and instruction to the project personnel and workers on local culture; • Restricting access to the site with a focus on high risk structures or areas depending on site-specific situations including fencing, signage, and communication of risks to the local community; • Emphasizing safety aspects among drivers; • Avoiding dangerous routes and times of day to reduce the risk of accidents; • Dispute settlement among stakeholders in case incidences occur; • Arrangement of worker's accommodation as necessary.		
Occupational Health and Safety	Accidents and incidents during the operation phase.	• To provide adequate health care facilities and first aid in every industry and facility; • 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 supplies and easy access of drinking water with a sanitary means; • To arrange for provision of clean eating areas where workers are not exposed to the hazardous substances where there is potential for exposure to substances poisonous by ingestion of food as necessary; • 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 line etc. • 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.	Doctors/EHS officer/ JEZ/BEZA	BEZA/DoE

Issues	Expected Impacts	Proposed Environmental Mitigation Measures and Environmental Management	Responsibility	
			Implementing	Supervision
Emergency Situation	Chemical spillage, fire, earthquake, flood, river bank erosion etc.	• Training of safety usage and preparation of the emergency response plans; • Implementation of the proper storage and record of usage; • Applying for the acquisition of the license with management plan in accordance with the relevant law, and compliance with the law; • Provision of protective equipment and clothes to workers as necessary; • Preparation of the disaster prevention equipment and management manual; • Installation of the fire hydrants; • Implementation of emergency drill; • Compliance with the National Standard Operational Procedure for building construction; • Formulation of chemical management plan as necessary; • Preparation of the disaster prevention plan such as emergency contact list; • Implementation of suggested Disaster Management Plan (DMP).	Doctors/EHS officer/ JEZ / Local Government Service Providers/BEZA	BEZA/DoE
Climate Change	Impact in the increase of GHGs by vehicle traffic and emission from operation work.	• 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.	JEZ/BEZA	BEZA/DoE

8.2.1 Green Belt Development

Development of a greenbelt/tree plantation along the boundary and internal roads will be beneficial. The tree plantation will have the following objectives:

- Restoration of green cover lost due to tree felling and shrub cutting during land clearance activities;
- Restoration/preservation of genetic diversity;
- Attenuation of noise pollution from EZ to surroundings;
- Creation of aesthetic environment.

New trees can be planted to make up the gaps devoid of trees. Greenbelts have to be made across the periphery, vertical and horizontal stretches. The selection of trees and plants for greenbelt/tree plantation should be those which could grow in the existing agro climatic conditions. They should be able to survive in the local soil conditions.

Based on the above considerations and also due to loss of trees on the site, the plant species should be native (especially those which are cut from the site and for road widening) in nature. The selected plant species would need minimum level of maintenance including fertilization and other soil amelioration.

Apart from trees, the shrubs removed from the site, and other herbaceous species may also be planted in between the trees along the boundary wall. This will act as green cover, prevent soil erosion by increasing the binding capacity of the soil, and importantly act as noise barrier together with trees.

Tree plantation also need to be taken up along the roads such as approach road to the EZ, internal road reaching administration building, on the vacant land of administration building, etc.

8.2.2 Corporate Social and Environmental Responsibility (CSER)

The concept of corporate social responsibility is based on the idea that not only public policy but companies, too, should take responsibility for social issues. In more recent approaches, CSER is seen as a concept in which companies voluntarily integrate social and environmental concerns into their business operations and into the interaction with their stakeholders. The idea of being a socially responsible company means doing more than comply with the law when investing in human resources and the environment.

Under the CSER framework, BEZA has proposed action plans for the benefit and welfare of the society as well as environmental sustainability of the project which is given below:

Proposed Action Plans

- At policy level, the CSER trust needs to allocate a considerable resource on alternative livelihoods. The CSER trust guidelines of BEZA if any shall clearly define project role and participation in the alternative livelihoods implementation plan. The project may contribute to the alternate livelihoods plan under their CSER networks.

- The CSER trust shall engage an external agency to conduct a market study to identify livelihood options. A phased alternative livelihood plan along with financial feasibility shall be developed for all the affected villages. If required, an external agency shall be contacted to implement the livelihood plan.
- A monitoring committee shall be formulated to ensure proper implementation and documentation of the alternative livelihood plan.
- A sustainable environment friendly green belt may be proposed under the CSER fund throughout the periphery of the project area and all the unpaved open spaces if present.

Environmental and Social Management Plans to be Prepared

This Section of the EIA report provides recommendations for environmental and social management measures based on the available information at this stage of the project. However, it is planned that at a later stage, namely detailed design phase, JEZ will prepare detailed management plans and procedures to address potential social and environmental impacts identified within this EIA and ensure implementation of the measures contained therein. Recommended management plans and/or procedures are presented in the following table. These individual plans or procedures may be stand-alone documents or combined into a larger environmental management plan addressing a range of environmental aspects, according to project needs. They may be prepared by or in collaboration with project contractors. Each management plan will document applicable legal requirements (if existing), criteria, standards, and mitigation and management commitments for the project. Monitoring and reporting requirements will be included to (1) increase baseline information, (2) confirm predicted impacts and (3) identify unforeseen impacts, thus enabling continuous improvement and adaptive management where required.

Table 8.2: Recommended management plans

Plan	Content/Objectives
Emergency Response Plan	Includes safe working procedures for staff, designation of safety zones and measures to protect sensitive receptors.
Waste Management Plan	Provides detailed descriptions and quantities of wastes expected to be produced by the project, direct waste flows and outline project waste collection and disposal frequencies.
Traffic Management Plan	Includes a baseline transport study and impact assessment, expected traffic movements throughout construction and operations, assessment of optimum traffic routing, recommendations for upgrading local infrastructure, recommendations for road safety education, and other procedures to mitigate and manage traffic impacts.
Noise, Dust and Light Management Plan	Includes an inventory of all noise, dust, particulate matter and light generating activities, and details control methods to be used during construction and operations.
Chemicals and	Outlines procedures for storage and use of chemicals and

Plan	Content/Objectives
Hazardous Materials Handling Plan	hazardous materials, including access and security, provision of PPE and distribution of MSDS information.
Decommissioning Plan	Outlines procedures for decommissioning project facilities.

8.2.3 Enhancement Plan

A detailed EMP with possible mitigation measures during pre-construction, construction and operational phases have been proposed in the present study. So, as a part of enhancement plan, some following measures are proposed to carry out for reducing the potential risks:

i. Development of green belt by tree plantation of native flora within and around the entire location of the zone;
ii. To prevent the pollution of water, air and soil, discharging industrial gaseous effluent, solid wastes, waste water before releasing out;
iii. Maintain national and international environmental, social, health & safety standard to build trust and confidence among workers as well as foreign investors;
iv. All the unpaved open places throughout the zone premises, if have, can be made greener by planting trees in order to enhance the aesthetic view of sites as well as long term environmental sustainability with the aid of CESR fund.

8.2.4 Contingency Plan

A contingency plan is an essential guideline for undertaking the immediate need-based response in a well-designed, organized and coordinated manner for facing any adverse incident during an emergency. Contingency plan will guide to identify the victims at risk (who, what extent, when), responsible authority and the materialistic & natural disruptions (what extent). Nature of emergency & hazardous situations may be of any or all of the following categories:

a. Emergency

- Fire, burn injury
- Accidental injury
- Electric shock
- Explosion
- Any Medical emergency

b. Natural Disasters

- Flood
- Earthquake
- Storm/tornados/cyclone

c. Other External Factors: manmade disaster, sabotage, war etc.

The objectives of having an Emergency Response Plan (ERP) are to:

- Guide the authority/emergency response team (ERT) in determining the appropriate response to emergencies;

- Provide respondents/ERT with planned strategy and recognized measures;
- Guide to notify the appropriate ERT personnel and regulatory authorities;
- Manage public and media relations;
- Notify the next-to-kin of accident victims;
- Promote inter-section communications to ensure an "EZ-wide" coordinated emergency response to minimize the effects of troublesome events;
- Reducing recovery time and costs;
- Respond to immediate requirements to safeguard the environment and the community.

Generally following steps of responses can be followed to combat any emergency:

Step-1: Risk determination& immediate measures

(i) Identification of potential hazards associated with the emergency episode due to the natural events or regular activities.
(ii) Taking appropriate measures by the ERT/authority for determining the type, quality, extent of involvement.

Step-2: Local investigation: Determination of the source/reason of the event resulting to the emergency and prevent further losses.

Step-3: Detail assessment: Conduct an assessment of the incident site for any further information on hazards and taking necessary actions for remedies.

Step-4: Rehabilitation: Initiating restoration/rehabilitation measures.

Step-5: Reporting: Reporting of the occurrence of the incidence with all the details including the measures undertaken to the appropriate authority taking initiative for further steps including financial assistance etc. to the appropriate authority.

Step-6: Risk Communication: Taking steps for mass communication with addressing public and media regarding concerns and issues including human lives, property and the environment and responses to resolute the stress of the community and the country.

Functioning of following units can be helpful to combat any emergency in the industrial area. Emergency Response Cell with an:

a. Well trained emergency response team (ERT)
b. Emergency preparedness plan
c. Provision of periodic drill of emergency rescue operations; e.g. Firefighting services;
d. Emergency medical services
e. Provision of emergency transfer of patients

Health, Safety and Safe Work Environment

In accordance with the requirement of DoE, JEZ must have a plan to take adequate measures against accidents and to meet the emergency. A contingency plan should be in place to deal with any emergency or natural calamities. There should be trained emergency response teams, specific contingency plans and incidence specific equipment packages in place to deal with these types of emergencies. In case of an emergency incident occur, immediate action must be taken to mitigate the impacts. In order to minimize the possibility of injury to the responders and others it is important

that emergency responders follow the steps of emergency response plan to avoid missing of any events.

The Health and Safety Management Guideline of JEZ is attached in Annex-7.

Work plays a central role in people's lives, since most workers spend at least eight hours a day in the workplace, whether it is on a plantation, in an office, factory, etc. Therefore, work environments should be safe and healthy. Yet this is not the case for many workers. Every day workers all over the world are faced with a multitude of health hazards, such as:

- Dusts;
- Gases;
- Noise;
- Vibration;
- Extreme temperatures.

Unfortunately, some employers assume little responsibility for the protection of workers' health and safety. In fact, some employers do not even know that they have the moral and often legal responsibility to protect workers. As a result of the hazards and a lack of attention given to health and safety, work-related accidents and diseases are common in all parts of the world.

Costs of Occupational Injury/Disease

Work-related accidents or diseases are very costly and can have many serious direct and indirect effects on the lives of workers and their families. For workers some of the direct costs of an injury or illness are:

- The pain and suffering of the injury or illness;
- The loss of income;
- The possible loss of a job;
- Health-care costs.

It has been estimated that the indirect costs of an accident or illness can be four to ten times greater than the direct costs, or even more. An occupational illness or accident can have so many indirect costs to workers that it is often difficult to measure them. One of the most obvious indirect costs is the human suffering caused to workers' families, which cannot be compensated with money.

The costs to employers of occupational accidents or illnesses are also estimated to be enormous. For a small business, the cost of even one accident can be a financial disaster. For employers, some of the direct costs are:

- Payment for work not performed;
- Medical and compensation payments;
- Repair or replacement of damaged machinery and equipment;
- Reduction or a temporary halt in production;
- Increased training expenses and administration costs;
- Possible reduction in the quality of work;
- Negative effect on other workers.

Some of the indirect costs for employers are:

- The injured/ill worker has to be replaced;
- A new worker has to be trained and given time to adjust;
- It takes time before the new worker is producing at the rate of the original worker;
- Time must be devoted to obligatory investigations, to the writing of reports and filling out of forms;
- Accidents often arouse the concern of fellow workers and influence labor relations in a negative way;
- Poor health and safety conditions in the workplace can also result in poor public relations.

Overall, the costs of most work-related accidents or illnesses are very high to the workers and their families and to the employers as well. On a national scale, the estimated costs of occupational accidents and illnesses can be as high as three to four per cent of a country's gross national product. In reality, no one really knows the total costs of work-related accidents or diseases because there are a multitude of indirect costs which are difficult to measure beside the more obvious direct costs. JEZ will ensure health, safety and safe work environment for the officials and workers.

8.3 Compensation Plan

A standard compensation plan has to be developed for securing the legal demand of the individuals or households who are willing to give their land due to development of the proposed EZ project. It essentially needs to provide necessary compensation as per the law of land. Workers who develop any disease/injury during construction or operational phase of the proposed project should be treated accordingly with ensuring necessary compensation by the responsible authority.

8.4 Monitoring Plan

The main purpose of a monitoring plan for the potential environmental parameters during the construction and operation phases in this project is:

- To provide a standard guideline for comparing the baseline environmental conditions (data observed/collected during the study period) and other factors with that of the construction and operational phases.
- To evaluate the effectiveness of the mitigation measures for preservation of the natural environment.
- To detect any disruption of environment according to national standards.

Several environmental components can be affected during the construction and operation of the project. Following plan has been formulated for monitoring and evaluation of environmental components with potential risk of disruption.

Table 8.3: Monitoring plan for economic zone

Category	Issues	Location	Frequency	Executing Agency	Enforcement Agency
Pre-construction and construction phase					
Air Quality	NOx, SOx, CO, $PM_{2.5}$,	3 points in the	1 week/3	Contractor	JEZ

Category	Issues	Location	Frequency	Executing Agency	Enforcement Agency
	PM_{10} etc.	construction site	months		
Water Quality	Water, temperature, pH, SS, TDS, EC, DO, BOD_5, COD, Total coliforms, Total nitrogen, TotalPhosphorus, Chromium, As, Fe, other metals etc.	Outflow of construction (at least 3 sampling points/mixing point. Well near the construction site (1 point)	Once/2 months	Contractor	JEZ
Wastes	Amount and kind of solid wastes.	Construction site	Once/3 months	Contractor	JEZ
Noise and Vibration	Noise and vibration level, Traffic count	Preservation area such as residence around the proposed construction site (at least 1 point)	Once (24 hours)/3 months	Contractor	JEZ
Ecosystem	Species number	1 point in the construction area	Twice a year in dry and rainy seasons	Contractor	JEZ
Hydrology	Groundwater level, Ground elevation level, consumption of groundwater amount	Well near the construction site	Once/ months	Contractor	JEZ
Socio-economic Condition	The implementation status for CSR activities such as community support program	Around project Site	Once /year	Contractor	JEZ
Risk of Infectious Disease such as AIDS/HIV	Awareness of infectious diseases	Construction site	Once/month	Contractor	JEZ
Occupational Health and Safety	Record of accidents and infectious diseases	Construction site	Once/month	Contractor	JEZ
Community Health and Safety	Record of accidents and infectious diseases related to the community	Around construction site	Once/month	Contractor	JEZ
Operation phase					
Air Quality	NO_X, SO_X, CO, $PM_{2.5}$, PM_{10}, VOCs, HAPs etc.	Representative location inside the project area	1 week each in the dry and rainy seasons (first 3 years after starting of the operation stage)	Individual industries	JEZ /BEZA

Category	Issues	Location	Frequency	Executing Agency	Enforcement Agency
Water Quality	Water temperature, pH, SS, DO, BOD_5, COD, color, odor, Total Nitrogen, Total Phosphorus, Sulphide, Chromium, Arsenic, Copper, Mercury, Cadmium, Lead, and Nickel etc.	At least 3 sampling points/mixing point: discharge water, upstream water, and downstream water)	Every month: Water temperature, pH, SS, DO, BOD_5, COD, color and odor, Every 3 months: all parameters	Individual industries	JEZ /BEZA
Wastes	Amount of hazardous and non-hazardous wastes in the project site.	Project site	Twice/year (submission of the environmental report by the tenants)	Individual industries	JEZ /BEZA
Soil Contamination	Status of control of solid and liquid waste which causes soil contamination.	Project site	Twice/year (submission of the environmental report by the tenants)	Individual industries	JEZ /BEZA
Noise and Vibration	Source noise emissions (Noise level monitoring in db (A) near noise generating equipment's, e.g. Pumps, flare etc.)	Project site	Every 3 months	Individual industries	JEZ /BEZA
Odor	Offensive odor control by the proponent	Project site	Twice/year (submission of the environmental report by tenants)	Individual industries	JEZ /BEZA
Ecosystem	Species number	1 point in the Construction area	Twice a year in dry and rainy seasons	Individual industries	JEZ /BEZA
Socio-economic Condition	The implementation status for CSER activities such as community support program.	Around Project Site	Once /year	Individual industries	JEZ /BEZA
Risks for Infectious Disease such	Status of measures against infectious diseases	Project Site	Twice/year (Submission of the	Individual industries	JEZ /BEZA

Category	Issues	Location	Frequency	Executing Agency	Enforcement Agency
as AIDS/HIV			environmental report by the tenants)		
Occupational Health and Safety	Record of accidents and infectious diseases	Work sites and offices	Twice/year (Submission of the environmental report by the tenants)	Individual industries	JEZ /BEZA
Community Health and Safety	Record of accidents and infectious diseases related to the community	Around the Project site	Twice/year (Submission of the environmental report by the tenants)	Individual industries	JEZ /BEZA
Usage of Chemicals	Record of the type and quantity of chemicals and implementation status of control measures through self-inspection	Project Site	Biannually	Individual industries	JEZ /BEZA

Note: *Air quality monitoring site in the construction area should be selected in consideration of keeping the same location during construction phase.

** Water quality monitoring location should be selected at least three points for one discharge point to confirm the impact of the effluent water from the project site to the existing canals/Rivers/water bodies.

8.5 Monitoring Indicators

Due to establishment of the proposed project several environmental components have potential risk of disruption either during construction or operational phases that needs to be monitored for detection and management of any damage of the environment. Following are the plausible indicators with major significance that should be monitored and evaluated for the potential risks that could be beneficial for carried out proper mitigation measures:

a) Health & safety issues of workers

b) Air quality

c) Water quality (ground water and surface water)

d) Noise level

e) River water level

f) Soil erosion

g) Waste management

h) Existence of terrestrial and marine flora & fauna (compared to the baseline scenario)

8.6 Project Environment Management Cell

It is recommended that the EZ Authority set up an EMC (Environmental Management Cell) to address environmental management concerns. The cell should be manned by qualified persons who will be responsible for regular environmental quality monitoring, proper functioning of CETP, implementation of community development plan, and liaison with regulatory bodies such as DoE. The EMC will be responsible for the following:

- To implement the EHS policy of EZ;
- To coordinate with EZ Trust in relevant activities;
- To ensure that CETP function properly and meet effluent discharge standards;
- To maintain environmental quality analysis laboratory and analyse air, noise, water and soil samples on a regular basis;
- To implement community development plan;
- To coordinate and monitor EZ Trust to regularly check workers health and take appropriate steps;
- To coordinate and monitor EZ Trust on safety conditions at various work environments and take necessary steps to maintain high safety standards;
- To deal with emergency situations;
- To liaison with regulatory bodies;
- To ensure systematic and routine housekeeping of the common areas of EZ;
- To maintain the proposed greenbelt along the boundary.

The EMC may be headed by Manager – Environment, who should be a senior person, should have an overall knowledge of CETP, hazardous waste and their maintenance, environmental laws and standards, and should be able to independently manage the Cell. The EMC in-charge may be supported by Environmental scientist/engineer and a Social Analyst. The scientist will be responsible for environmental quality analysis and should be capable of preparing reports and data sheets. He/she should have sufficient knowledge in sampling and analysis of environmental parameters. The social analyst should have knowledge of community programs and should be able to plan and implement community programs. In addition a part time occupational health specialist and a safety specialist can be appointed. In addition the following staffs at laboratory are required:

- One CETP and TSDF In-charge
- One Chemist cum laboratory in charge
- Three Plant Operators (one per shift) and three TSDF operators

- Laboratory/Field Assistants
- Sampling assistants

8.7 Institutional Arrangement

BEZA has developed Environmental Management Framework with the help of World Bank. The institutional arrangement is aligned as per this framework. JEZ will have an Environmental and social cell which will coordinate with site engineers and PMC.

Overall Project Implementation Arrangements

The overall management of the project will be carried out by JEZ which is the project implementing unit (PIU).

Institutional Set Up For Environment Management

The institutional arrangements for the implementation of various aspects of EMF and environment management of the proposed project envisaged to be implemented as part of the PSDSP comprise the following.

- Project Environment Cell (PEC) at PIU to ensure adequate integration of environmental management measures in the design phase and supervise implementation of EMF and specific requirements of EMP.
- Environmental Management Unit (EMU) at EZ to implement EMP and other regulatory requirements during construction & operation phase of EZ.

Project Environment Management Cell (PEC) at PIU

The project Implementation Unit (PIU) will establish a project Environmental Cell (PEC) headed by a 'Manager –Environment' and supported by environmental engineers. The PEC will function to:

- Supervise implementation of EMF throughout project implementation period;
- Ensure integration of the EA and the EMP measures into the sub-project design and implementation plans such as contract documents, maintenance contracts, tenant lease agreements etc.;
- Supervise the implementation of the mitigation measures by the developers/contractors;
- Assist the engineering staff and other PIU staff in addressing environmental issues during planning, design and implementation of the sub-projects;
- Prepare periodic progress reports on the implementation of the EMP throughout the project period;

Environment Management Unit (EMU)

In order to implement various environmental management measures at EZ, the master developer/contractor/operator will set up an Environment Management Unit (EMU) for the JEZ. The EMU will consist of environmental engineers with relevant experience on environmental issues associated with the development of industry based EZ. The EMU

will function all through construction and operation phase of the EZ and perform the following functions.

- Identify regulatory requirements of the sub-project and initiate necessary actions / studies to ensure compliance to the same;
- Co-ordinate with DoE and PIU and ensure securing SCC and ECC as applicable for the project(s);
- Co-ordinate with the contractors/sub-contractors and all other agencies involved in the development and operation of EZ and ensure that all the requirements of EMP are fully complied;
- Ensure that all the common environmental infrastructure in EZ is operated and maintained in compliance with the regulatory requirements of GoB;
- Liaise with individual enterprise/tenants and ensure that all environmental management conditions of the tenant lease agreement are fully complied;
- Prepare regular reports on environment management and submit to PIU/GoB.

8.8 Training

Training is of much importance in environmental management. Environmental science is a developing subject and the people implementing environmental strategies should remain up to date with the environmental control processes. The person in charge of the environmental monitoring team should attend suitable training courses. Besides, there shall be training programme for the general employees on environmental issues at different level.

Initial safety training is one of the most important aspects of any safety program. All employees and contractors must receive some level of basic training, specific to the facility and nature of the job. It must be ensured that appropriate orientation is given to:

- Employees
- Contactors
- Sub-contractors
- Visitors

The orientation shall also include a review of the following:

- Company safety policy and procedures;
- Specific job hazards safety precautions job responsibilities;
- Regulatory requirements;
- Company enforcement policy, and
- Worker right-to-know and authority to refuse unsafe work.

8.9 Statutory Requirements and Implementation

Each industry needs to meet a number of statutory requirements under Environment Conservation Rules of DoE. JEZ has also commitment to meet the international norms and guidelines. Environment Management Plan shall ensure that these entire statutory requirements are met in time.

8.10 Documentation

Documentation is an important step in implementing Environmental Management Plan. All statutory norms should be kept at one place for quick references. All monitoring results should be kept at selected folders which can be easily accessed. The presentation of the results should also be planned. Graphs and diagrams can be used to show the trend in environmental quality or achievement. Documents should be kept at a declared position.

All accidents and near-miss incidents shall be investigated to determine what caused the problem and what action is required to prevent a recurrence. Employees required to perform investigations shall be trained in accident investigation techniques. The incident/accident investigation should be a fact-finding exercise rather than faultfinding. The investigations will focus on collection of evidence to find out the "root cause" of the incident. The recommendations of the investigation report would be implemented in phases.

Pipeline construction and operation facilities have been and will continue to be designed to comply with the legal elements of both national and international standards, legislation, codes of practice and design specifications, and best practices. As a part of this process, measures to minimize the probability of releases and reduce potential impacts through selection of alternative processes to be considered as an integral part of the development.

Mitigation should reflect the intent and regulatory framework outlined in the GoB environmental policy and in applicable World Bank operational Directives. The purpose of impact mitigation and counter measures is to avoid creating negative impacts wherever possible, to minimize impacts where they may be unavoidable, and to generate opportunities for improvements or positive impacts where appropriate. Documentation will include:

- Major technical information in operation;
- Organizational Charts;
- Environmental Monitoring Standards, Environmental and related legislation Operational Procedure;
- Monitoring Records;
- Quality Assurance Plan for Monitoring;
- Emergency plans.

9 Cost Estimation for Environmental Mitigation Measures and Monitoring

This section describes the budget plans for the environmental management and environmental monitoring by the project proponent. Proponent will take necessary environmental mitigation measures and its expenses for the environmental management not only at the construction and operation phases but also at the closing, termination, and after termination phases in accordance with their EIA study. The costs are approximate and need calibration at the time of detailed design and estimation stage.

9.1 Budget Plan for Environmental Management

Most of the mitigation measures such as, construction of CETP, plans and trainings are already included in the project cost. Main costs for mitigation measures are shown in the Table below. Detailed costs for each mitigation measure are to be calculated at the detailed design stage.

Table 9.1: Cost for main mitigation measures

	Items	Budget (per year)	
		Before/During Construction Phase	Operation Phase
1.	Retention of canals/beel	Will be included in the Project cost	Will be included in the Project cost
2.	Construction of CETP, STP, WTP etc.		
3.	Residential road for the purpose of community accessibility improvement		
4.	Greening area		
5.	Others (sprinkle water, waste disposal, training and education)		

9.2 Budget Plan for Environmental Monitoring

In terms of budget for environmental monitoring before/during construction and operation phases, main monitoring cost related with field measurements such as air, water, and noise quality. Annual costs for field measurements in the construction phase by contractor and in the operation phase by the proponent are estimated, respectively, as shown in the Table below.

Table 9.2: Estimated annual costs for monitoring in the construction and operation phases

	Parameters	No. of Samples/Sites (per year)	Unit cost @ (BDT)	Total cost (BDT)/year
1.	Ambient Air Quality (SPM, $PM_{2.5,}$ PM_{10}, SOx, NOx, CO_2, CO)	16	10,000	1,60,000
2.	Surface Water Quality: BOD, COD, DO, pH, TDS, TSS, Ammonia, Nitrate, TC, FC, heavy metals and other pollutants	08	15,000	1,20,000
3.	Ground water quality (Arsenic, Iron, etc.)	08	15,000	1,20,000
4.	Noise Quality	16	5,000	80,000
5.	Wastewater (C/ETP, C/STP)	08	15,000	1,20,000
6.	Environment, health and safety training for staff development and ESMP evaluation	02	5,00,000	10,00,000
			Total Cost Per Year	**16,00,000**

Note: *Each individual industry inside the economic zone should carried out their environmental quality monitoring as per as DoE regulations.*

Table 9.3: Estimated annual cost for manpower environmental management and monitoring

	Designation	Number	Cost BDT. (per month)	Cost BDT. (per year)
1.	Environmental Specialist	1.00	1,00,000.00	12,00,000.00
2.	Social Analyst	1.00	50,000.00	6,00,000.00
3.	Occupational health specialist and a safety specialist	1.00	50,000.00	6,00,000.00
4.	ETP In charge	1.00	50,000.00	6,00,000.00
5.	Field-Surveyor	1.00	25,000.00	3,00,000.00
6.	Support staff	2.00	10,000.00	2,40,000.00
			Total	**35,40,000.00**

10 Emergency Response Plan & Disaster Impact Assessment

10.1 Introduction

Accidental risk involves the occurrence or potential occurrence of some accident consisting of an event or sequence of events resulting into fire, natural calamities like flood and cyclone, explosion or toxic hazards to human health and environment. Risk Assessment (RA) provides a numerical measure of the risk that a particular facility poses to the public. It begins with the identification of probable potential hazardous events at an industry and categorization as per the predetermined criteria. The consequences of major credible events are calculated for different combinations of weather conditions to simulate worst possible scenario. These consequence predictions are combined to provide numerical measures of the risk for the entire facility. MCA stands for Maximum Credible Accident or in other words, an accident with maximum damage distance, which is believed to be probable. MCA analysis does not include quantification of the probability of occurrence of an accident. In practice the selection of accident scenarios for MCA analysis is carried out on the basis of engineering judgement and expertise in the field of risk analysis especially in accident analysis. Detailed study helps in plotting the damage contours on the detailed plot plan in order to assess the magnitude of a particular event. A disastrous situation is the outcome of fire, natural calamities and explosion or toxic hazards in addition to other natural causes that eventually lead to loss of life, property and ecological imbalances.

10.1.1 Methodology of MCA Analysis

The MCA analysis involves ordering and ranking of various sections in terms of potential vulnerability. The data requirements for MCA analysis are:

- Operating manual
- Flow diagram and P&I diagrams
- Detailed design parameters
- Physical and chemical properties of all the chemicals
- Detailed plant layout
- Detailed area layout
- Past accident data

Following steps are involved in the MCA analysis:

- Identification of potential hazardous sections and representative failure cases.
- Visualization of release scenarios considering type and the quantity of the hazardous material.
- Damage distance computations for the released cases at different wind velocities and atmospheric stability classes for heat radiations and pressure waves.
- Drawing of damage contours on plot plan to show the effect due to the accidental release of chemicals.
-

10.1.2Past Accident Data Analysis

Analysis of events arising out of the unsafe conditions is one of the basic requirements for ensuring safety in any facility. The data required for such an analysis has either to be generated by monitoring and/or collected from the records of the past occurrences. This data, when analysed, helps in formulation of the steps towards mitigation of hazards faced commonly. Trends in safety of various activities can be evaluated and actions can be planned accordingly, to improve the safety.

10.1.3Hazard Identification

Identification of hazards is an important step in Risk Assessment as it leads to the generation of accidental scenarios. The merits of including the hazard for further investigation are subsequently determined by its significance, normally using a cut-off or threshold quantity. Once a hazard has been identified, it is necessary to evaluate it in terms of the risk it presents to the employees and the neighboring community. In principle, both probability and consequences should be considered, but there are occasions where it either the probability or the consequence can show to be sufficiently low or sufficiently high, decisions can be made on just one factor. During the hazard identification component, the following considerations are taken into account.

- Chemical identities;
- Location of process unit facilities for hazardous materials;
- The types and design of process units;
- The quantity of material that could be involved in an airborne release;
- The nature of the hazard (e.g. airborne toxic vapours or mists, fire, explosion, large quantities stored or processed handling conditions) most likely to accompany hazardous materials spills or releases.

10.1.4Fire and Explosion Index (FEI)

Fire and Explosion Index (FEI) is useful in identification of areas in which the potential risk reaches a certain level. It estimates the global risk associated with a process unit and classifies the units according to their general level of risk. FEI covers aspects related to the intrinsic hazard of materials, the quantities handled and operating conditions. This factor gives index value for the area which could be affected by an accident, the damage to property within the area and the working days lost due to accidents.

10.1.5MCA Analysis

MCA analysis encompasses defined techniques to identify the hazards and compute the consequent effects in terms of damage distances due to heat radiation, toxic releases, vapour cloud explosion etc. A list of probable or potential accidents of the major units in the complex arising due to use, storage and handling of the hazardous materials are examined to establish their credibility. Depending upon the effective hazardous attributes and their impact on the event, the maximum effect on the surrounding environment and the respective damage caused can be assessed. Hazardous substance, on release can cause damage on a large scale. The extent of the damage is dependent

upon the nature of the release and the physical state of the material. In the present report the consequences for flammable hazards are considered and the damages caused due to such releases are assessed with recourse to MCA analysis.

Flammable substances on release may cause Jet fire and less likely unconfined vapour cloud explosion causing possible damage to the surrounding area. The extent of damage depends upon the nature of the release. The release of flammable materials and subsequent ignition result in heat radiation wave or vapour cloud depending upon the flammability and its physical state. Damage distances due to release of hazardous materials depend on atmospheric stability and wind speed. It is important to visualize the consequence of the release of such substances and the damage caused to the surrounding areas.

10.1.6Fire and Explosion Scenarios

Combustible materials within their flammable limits may ignite and burn if exposed to an ignition source of sufficient energy. On process plants, this normally occurs as a result of a leakage or spillage. Depending on the physical properties of the material and the operating parameters, the combustion of material in a plant may take on a number of forms like jet fire, flash fire and pool fire.

10.1.7Flash Fire

A flash fire is the non-explosive combustion of a vapour cloud resulting from a release of flammable material into the open air, which after mixing with air, ignites. A flash fire results from the ignition of a released flammable cloud in which there is essentially no increase in combustion rate. The ignition source could be electric spark, a hot surface, and friction between moving parts of a machine or an open fire. Flash fire may occur due to its less vapour temperature than ambient temperature. Hence, as a result of a spill, they are dispersed initially by the negative buoyancy of cold vapours and subsequently by the atmospheric turbulence. After the release and dispersion of the flammable fuel the resulting vapour cloud is ignited and when the fuel vapour is not mixed with sufficient air prior to ignition, it results in diffusion fire burning. Therefore the rate at which the fuel vapour and air are mixed together during combustion determines the rate of burning in the flash fire.

The main dangers of flash fire are radiation and direct flame contact. The size of the flammable cloud determines the area of possible direct flame contact effects. Radiation effects on a target depend on several factors including its distance from the flames, flame height, flame emissive power, local atmospheric transitivity and cloud size. Most of the time, flash combustion lasts for no more than a few seconds.

10.1.8Natural Calamities

Natural calamities like flood, earthquakes etc. can occur within the zone. The project site falls under the earthquake zone-3 which indicates high intensity of earthquake.

10.2 Disaster Management Plan (DMP)

10.2.1 Approach to Disaster Management Plan

Onsite Emergency or disaster is an unpleasant sudden event of such a magnitude which may cause extensive damage to life and property, due to in-plant emergencies resulting from deficiencies in operation, maintenance, design and human error; natural calamities like flood, cyclone and earthquake; and deliberate and other acts of man like sabotage, riot, war etc. It is important for every industry to have a well-documented Emergency Plan to meet any major untoward incident or disaster. In view of this, an approach to Disaster Management Plan (DMP) to tackle the emergencies, JEZ has been delineated in the following sections. Roles and responsibilities of key personnel have also been defined in the plan.

10.2.2 Formulation of DMP and Emergency Services

JEZ will formulate a Disaster Management Plan for better and safe management of their plants. The DMP is related to the final assessment and it is the responsibility of the plant management document including the following elements.

- Assessment of the size and nature of the events foreseen and the probability of their occurrence;
- Formulation of the plan and liaison with authorities, including the emergency services;
- Procedures for raising the alarm and communications both within and outside the works;
- Appointment of key personnel and their duties and responsibilities, especially for works incident controller and works main controller;
- Emergency control centre;
- Action on-site;
- Action off-site.

The plan is prepared to set out the way in which designated people at the site of the incident can initiate supplementary action both inside and outside the works at an appropriate time. An essential element of the plan must be the provision for attempting to make safe the affected unit, for example by shutting it down. On a complex site, the plan includes the full sequence of key personnel to be called in from other sections or from off site.

10.2.3 Need for Disaster Management Plan

Different types of industries will produce a lot of toxic, highly reactive, explosive or inflammable chemicals which are potentially hazardous not only to the human beings, flora and fauna but also to all forms of property and our environment as a whole. Thus, extreme care is essential in handling such chemicals in any form and at all stages of manufacture, processing, treatment, package, storage, transportation, use, collection, destruction, conversion or sale. Several agencies of the Government are entrusted with the responsibility of ensuring safe handling and management of hazardous chemicals under acts and rules made for the purpose. In spite of these measures, the possibility of accidents cannot be ruled out. Human errors and mechanical, electrical, instrumental or

system failures have, on occasions, led to severe disasters. Accidents occurred at Bhopal, Mexico and other parts of the world have made people concerned with the dangers of chemical accidents. Occurrence of such accidents makes it essential that the Governments as well as the local authorities are fully prepared to mitigate the sufferings and meet the eventualities resulting from any unfortunate occurrence of chemical accidents in our country.

Following are the general types of Emergency /Disaster which lead to preparation of disaster management plan:

- Fire in storage area
- Large oil spillage which may escape outside the plant boundary
- Major fire / explosion in unit area
- Toxic gas release
- Major Earthquake above 7 Richter Scale
- Flood or river bank erosion.

10.2.4Objectives of Disaster Management Plan

The purpose of DMP is to give an approach to detail organizational responsibilities, actions, reporting requirements and support resources available to ensure effective and timely management of emergencies associated to production and operations in the site. The overall objectives of DMP are to:

- Ensure safety of people, protect the environment and safeguard commercial considerations;
- Immediate response to emergency scene with effective communication network and organized procedures;
- Obtain early warning of emergency conditions so as to prevent impact on personnel, assets and environment;
- Safeguard personnel to prevent injuries or loss of life by protecting personnel from the hazard and evacuating personnel from an installation when necessary;
- Minimize the impact of the event on the installation and the environment, by:
    - Minimizing the hazard as far as possible
    - Minimizing the potential for escalation
    - Containing any release
- To provide guidance to help stack holders take appropriate action to prevent accidents involving hazardous substances and to mitigate adverse effects of accidents that do nevertheless occur.

10.2.5Different Phases of Disaster

Warning Phase

Emergencies/disasters are generally preceded by warnings during which preventive measures may be initiated. For example release of light hydrocarbons, uncontrollable build-up of pressure in process equipment, weather forecast give warning about formation of vapour cloud, cyclones, equipment failure etc. This is the phase when emergency/disaster actually strikes and preventive measures may hardly be taken. However, control measures to minimise the effects may be taken through a well-

planned and ready-to-act disaster management plan. The duration may be from seconds to days.

Rescue Phase

This is the phase when impact is almost over and efforts are concentrated on rescue and relief measures.

Relief Phase

In this phase, apart from organization and relief measures internally, depending on severity of the disaster, external help should also be summoned to provide relief measures (like evacuations to a safe place and providing medical help, food clothing etc.). This phase will continue till normalcy is restored.

Rehabilitation Phase

This is the final and longest phase. During which measures required to put the situation back to normal as far as possible are taken. Checking the systems, estimating the damages, repair of equipment's and putting them again into service are taken up. Help from revenue/insurance authorities need to be obtained to assess the damage, quantum of compensation to be paid etc.

Key Elements

Following are the key elements of Disaster Management Plan:

- Basis of the plan
- Accident/emergency response planning procedures
- On-site Disaster Management Plan
- Off-site Disaster Management Plan.

10.2.6Basis of the Plan

Identification and assessment of hazards is crucial for on-site emergency planning and it is therefore necessary to identify what emergencies could arise in production of various products and their storage. Hazard analysis or consequence analysis gives the following results.

- Hazards from spread of fire or release of flammable and toxic chemicals from storage and production units.
- Hazards due to formation of pressure waves due to vapour cloud explosion of flammable gases and oil spill hazards.

10.2.7Emergency Planning and Response Procedures

Emergency rarely occurs; therefore activities during emergencies require coordination of higher order than for planned activities carried out according to fixed time schedule or on a routine day-to-day basis. To effectively coordinate emergency response activities, an organizational approach to planning is required. The important areas of emergency planning are organization and responsibilities, procedures, communication, transport, resource requirements and control centre. Offsite emergency requires additional planning over and above those considered under onsite plans, which should be properly integrated to ensure better coordination.

The emergency planning includes anticipatory action for emergency, maintenance and streamlining of emergency preparedness and ability for sudden mobilization of all forces to meet any calamity.

10.2.8On-site Disaster Management Plan

Onsite emergency/disaster is an unpleasant event of such magnitude which may cause extensive damage to life and property due to plant emergencies resulting from deficiencies in operation, maintenance, design and human error, natural calamities like flood, cyclone and earthquake; and deliberate and other acts of man like sabotage, riot and war etc. an onsite disaster may occur all of a sudden or proceeded by a major fire. Purpose for the on-site disaster management plan is-

- To protect persons and property of processing equipment's in case of all kinds of accidents, emergencies and disasters;
- To inform people and surroundings about emergency if it is likely to adversely affect them;
- To inform authorities including helping agencies (doctors, hospitals, fire, police transport etc.) in advance, and also at the time of actual happening;
- To identify, assess, foresee and work out various kinds of possible hazards, their places, potential and damaging capacity and area in case of above happenings. Review, revise, redesign, replace or reconstruct the process, plant, vessels and control measures if so assessed.

In order to handle disaster/emergency situations, an organizational chart entrusting responsibility to various personnel of the plant and showing their specific roles should be available. Following fire protection facilities are available to combat the emergencies and depending upon the type of emergencies any one or combination of the facilities are applied.

- Fire Water System
- Carbon Dioxide System
- Foam System
- First Aid Fire Fighting Equipment
- Mobile Fire Fighting Equipment
- Gas / Fire Detection and Alarm System.

Before Crisis

- Prepare a plan of the storage, handling and pumping stations premises and surroundings showing therein the areas of various hazards like fire, explosion, toxic releases and also location of assembly points, fire station or equipment's room, telephone room, first aid or ambulance room, emergency control room, main gate, emergency gates, normal wind direction, outside fire station, hospital and other services. Mention their distances from proposed activities.
- The fire protection equipment shall be kept in good operating condition at all the time and fire-fighting system should be periodically tested for people functioning logged for record and corrective action.
- The fire-fighting training shall be provided to all officers, truck drivers and other employees who are likely to be present in installation.

- There should be regular mock fire drills once a month record of such drills shall be maintained.
- Every employee or authorized person working in the production shall be familiarized with the fire alarm signal and shall know the location of fire alarm point nearest to place of work.
- Assign key personnel and alternate responsible for site safety.
- Describe risk associated with each operation conducted.

During Crisis

- Monitor the behaviour of entrant for any effects that suggests they should be evacuated;
- Evacuate the space if any hazard that could danger the entrant is detected;
- Perform no other duties that may interfere with their primary responsibilities;
- Notify the attendant if they experience any warning signs or symptoms of exposures or detect a dangerous condition;
- Exit the permit space when instructed by attendant;
- Reporting Procedure.

In the event of fire from accidental release of flammable gas or liquid, a person seeing the incident will follow the laid down procedure in the plant and report as follows:

- Will dial the nearest telephone;
- Will state his name and exact location of emergency;
- Will contact affected officers on duty;
- People reporting the accident will remain near the location to guide emergency crew arriving at the scene.

In case fire emergency person should activate the nearest available push button type instrument which will automatically sound an alarm in fire control room indicating the location of fire.

After Crisis

- Report injuries or blood or body fluid exposures to the appropriate supervisor immediately.

Assembly points:

Assembly points shall be set up farthest from the location of likely hazardous events, where pre-designed persons from the works, contractors and visitors would assemble in case of emergency. Up-to date list of pre-designed employees shift wise must be available at these points so that roll call could be taken. Pre-designated persons would take charge of these points and mark presence as the people come into it.

- Wash wounds and skin sites that have been affected with soap & water;
- Workers should be seen as soon as possible by a health professional;
- Provide information to the relevant public authority and community including other closely located facilities regarding the nature of hazard and emergency procedure in event of major accident;

- Record and discuss the lessons learned and the analysis of major accidents and misses with employees and employee representative.

10.2.9Emergency Organization Structure

Following are the key personnel and the units in the plant which are responsible to take appropriate actions during emergencies.

Site Main Controller

President/SSM - (the senior most functionary available at site).

The President/Site Shit Manager (SSM) will be designated as the Site Main Controller at the time of an emergency and report at the Emergency Control Centre (ECC) which will be the Primary Command Post. He will be the Chief Co-ordinator and take overall command of the emergency management. He will be assisted by other coordinators as designated for various functions. The Site Main Controller will provide all decisions support and resources support to the Site Incident Controller at the incident site for initiating appropriate actions for emergency control. He will also liaise with mutual aid members and all outside agencies including Local Crisis Management Committee, District Contingency Plan Committee (District Collector), Police, Civil Defense, Factories Inspectorate, etc. to seek assistance/help and provide necessary information to them. Normally, the SSM is available on round the clock duty at the site to coordinate overall manufacturing activities and management of emergency (if any). In the event of an emergency, the Site Shift Manager (SSM) will assume the charge of the Site Main Controller till the Executive or the President arrives.

Site Incident Controller

AVP/GM/DGM/Sr. Mgr. /Mgr. - (next lower to the senior most functionary of operation available at site).

The next lower to senior most functionary of operation available at site will be Site Incident Controller. On receiving information about the emergency, he will report at the incident site and take over from the Deputy Incident Controller (shift-in-charge). He will take overall command of the emergency control operation as the Site Incident Controller and will take decisions in co-ordinations with Site Main Controller for controlling emergency situation. He will co-ordinate with all the key personnel, fire-fighting and rescue team leaders and other support services and provide necessary information and advice to them for effectively managing control measures / actions.

Deputy Incident Controller

The shift-in-charge is available on round the clock duty in every plant. He is competent for plant operation and responsible for all activities related to production/maintenance including prevention/control of incidents and handling emergencies (if any) in the plant. He will be designated as the Deputy Incident Controller. In the event of an emergency in the plant, he will immediately assume the charge of the site Incident Controller and take decisions in consultation with the Site Main Controller. To initiate immediate

actions for controlling/mitigating emergency situation at the incident site till the Site Incident Controller (next senior personnel in production) arrives.

Co-ordinators

(The senior most functionaries available in the respective services)

The senior most functionaries available at site in the respective services will be the co-ordinators at the time of an emergency. They will report at the Emergency Control Centre (ECC), known as the Primary Command Post, unless and otherwise instructed by the Chief Co-ordinator (The Site Main Controller). They will assist and advise the Site Main Controller in all matters for effectively managing control measures and mitigating operations.

Emergency Control Centre (ECC) (The Primary Command Post)

In the event of an emergency, SSM Office will be designated as the Emergency Control Centre, which will be known as the Primary command Post. If, the SSM office is likely to be affected due to unfavourable wind direction or any other reasons, the Emergency Control Centre will be shifted to the Construction Conference Room which will be having necessary facilities to connect communication links as provided in the SSM Office.

Field Command Post (Incident Site)

An emergency requires co-ordination of numerous activities beyond spill containment and countermeasure efforts from a safe location at the incident scene. The Field Command Post will be established in the "Cold Zone" for staging deployed apparatus, resources and equipment with means of communications and manning to effectively co-ordinate control efforts.

Assembly Points

- Two alternate locations for safe assembly points have been earmarked at all the operating plants. These locations are designated for assembling non-essential workers, visitors, and other persons who are not required in the plant site at the time of emergency but they are to be moved to safe places. These locations have been provided with sign boards displaying "Assembly Points" for easy identification.
- The persons required to be assembled at the assembly point should choose safer assembly point out of the two, considering the wind direction at that time. The plant control room will also announce the same on the plant PA system, if possible
- The person assembled at the assembly point shall follow the instruction for evacuation of the plant area and move to safe locations as directed. They should move in the cross wind direction or up-wind direction, whichever is safer.

10.2.10 Role and Responsibilities

Site Main Controller

The Site Main Controller will be the chief co-ordinator and shall be assisted by other co-ordinators (senior most functionaries in the respective disciplines). He will take overall command of the emergency management and his duties and the responsibilities are as below:

He will:

- Report at the Emergency Control Centre as soon as he gets information about the emergency at site and will assume overall responsibility if taking decisions and directing actions as necessary for mitigating the situation and managing the emergency effectively with due consideration and priorities for personnel safety, safety to the company's property and the environment.
- Assess the magnitude of the situation in co-ordination with the Incident Controller / Dy. Incident Controller and decide whether major emergency exists or is likely to develop, requiring external assistance. Accordingly, he will decide to inform Local/District emergency Chief and other emergency control groups for help and the nature of help required including assistance from mutual aid members and declare on-site emergency.
- Decide the safe route of entry for external assistance/help to reach at site of the incident considering wind direction and the place of the incident and also the place of reporting such assistance. He will also direct the security to guide them properly.
- Ensure that the Key Personnel and Co-ordinators are called in.
- Ensure that all non-essential workers, visitors, contractors are safely moved to assembly points and direct for search and rescue operation within the affected areas, if necessary.
- Be in constant communication with the Site Incident Controller to continuously review and assess the situation and possible developments.
- Direct actions for safe shut down of plant(s) or section of the plant and evacuation of plant personnel and other necessary action is in consultation with the other co-ordinators.
- Exercise direct operational control over areas in the complex other than those affected in consultation with other co-ordinators.
- To liaise with the local meteorological office to receive early notification of changes in wind direction and weather conditions.
- Liaise with the senior officials of Police, Fire Brigade, Medical and Factories Inspectorate and pass on information on possible effects to the surrounding areas outside the factory premises and necessity of evacuating the area and moving the people to safe places.
- Liaise with various co-ordinators to ensure that various teams are functioning well, casualties are receiving attention and traffic movement within the works is well regulated.
- Arrange for a log of the emergency to be maintained in the Primary Command Post.

- Release authorized information to press through the media co-ordinator.
- Control rehabilitation of the affected persons and the affected areas after cessation of the emergency.

Site Incident Controller

The Site Incident Controller is the Key Personnel for operations function reporting at the incident site and will take the overall command of actions for emergency control operation on his arrival at the incident site. He will be supported by other key personnel representing various emergency services and initiate emergency control actions under the direction of the Site Main Controller (Primary Command Post). The duties and the responsibilities of the Site Incident Controller include the following:

He will:

- Report at the incident site immediately after getting information about an emergency. Upon his arrival at the site, he will assess the scale of emergency in consultation with the Deputy Incident Controller and evaluate, if a major emergency exists or is likely to develop and inform Emergency Control Centre (primary Command Post) accordingly asking for assistance and indicating kind of support needed.
- Take overall control of handling the emergency at site and take action for isolation of source of containment loss to the extent feasible. Simultaneously, in case of fire organize appropriate fire response in coordination with Key personnel (Fire & Safety) to get the situation under control and to prevent its escalation.
- Set up communication point (Field Command Post) and establish contact with Site Main Controller (Primary Command Post) and keep him informed about the development.
- Keep on assessing the emergency situation at the site and communicate to the Site Main Controller (Primary Command Post) and keep him informed about the development.
- Co-ordinate the activities of other key personnel reporting at the Field.
- Command Post, under his overall command.
- Direct all operation with the affected areas giving due priorities for safety of personnel and to minimize damage to environment, plant and property.
- Provide advice and information to fire fighting and rescue personnel, external fire services and other emergency services/teams as and when they arrive at the incident site and co-ordinate with them for effective control actions.
- Ensure that all non-essential workers and staff within the affected area are evacuated to appropriate assembly points and that areas are searched for casualties.
- Organize rescue teams for search of casualties in the affected areas (if any) and send them to safe areas / medical centre for first aid and medical relief.
- Seek additional support and resources as may be needed through Primary Command Post.

- Send decision support from the Primary Command Post for decision such as precautionary shut down of neighbouring facilities, precautionary evacuation of people in the neighbouring facilities, activating mutual aid plan, etc.
- Be in constant liaison with the Site Main Controller and keep him informed about the situation at the incident site.
- Preserve all evidences so as to facilitate any inquiry into the cause and circumstances, which caused or escalated the emergency (to arrange photographs, video, etc.).
- Arrange for head count after the emergency is over with respect to the personnel on duty in the affected areas.

Deputy Incident Controller

Normally, the Shift-in-charge of a plant being always available at the plant site and well aware of the plant operating conditions at all times will be designated as the Deputy Incident Controller and assume the charge of the Site Incident Controller at the time of an emergency till the Site Incident Controller arrives at the incident site, he will assist the Site Incident Controller on his arrival and work under his direction in emergency control operation.

The responsibilities and duties of the Deputy Incident Controller will be as defined for the Site Incident Controller. In addition he will ensure the following:

He will:

- In the event of an emergency, caused due to any incident in the plant, he will immediately actuate plant level emergency siren (hooter) to warn the field personnel, contractors, employees, etc. and also arrange for announcement about the emergency and necessary instruction for them for assembling at the safe assembly point or evacuation, etc.
- Ensure that the SSM and senior plant personnel have been informed about the emergency.

Fire Services Personnel

Main role of Fire Services personnel is fire-fighting and rescue operations, helping in operations like, prevention of loss of containment of hydrocarbon, spill/leak containment, etc. Their main responsibilities and duties are described specifically as below:

Chief of Fire (or next senior most fire personnel available)

- He will be the Key Personnel for the Fire and Safety Services at the incident scene and co-ordinating and commanding all the related operations in consultation with the Site Incident Controller.
- He will report at the Field command Post (Incident Site) immediately after receiving the information about an emergency at site, contact the Site Incident Controller and the first turn out leader for necessary information/advice to decide control strategies.

- He will take overall command of fire-fighting/rescue operations and other measures as necessary to control and mitigate the situation and lead the fire-fighting crew including outside/mutual aid fire-fighting teams.
- He will assess the severity/magnitude of the situation and decide the level of the emergency in consultation with the Site Incident Controller and inform the Site Main Controller (Primary Command Post) at ECC. He will also advise him for declaring on-site emergency (if necessary).
- He will call for additional resources/help from other Depts. (AFS personnel), mutual aid members, etc. through Primary Command Post as necessary and deploy them appropriately for fire-fighting and rescue operation at the incident scene. He will also co-ordinate with other key personnel.
- He will ensure that sufficient personnel protective equipment, masks, Breathing Air sets, Spare Breathing Air, Cylinders etc. are available at the field Command Post for use by the crew members and ensure that no one access the "Hot Zone" without adequate personnel protection. He will call for logistic support (mobilising additional supplies through Primary Command Post (Site Main Controller/HSE&F Co-ordinator).
- He will keep constant contact with Primary Command Post and seek decision support from the Site Main Controller in critical matters/operations and also inform him, if other plants in the complex or surrounding population are likely to be affected.
- He will co-ordinate with Security Key Personnel for access control and barricading the affected area in order to prevent vehicular movement.
- He will assist in rescue and first aid operations.

Shift Fire Officer (Riding Officers)

- Upon receiving emergency call/alarm, he will quickly prepare for the fire turn out and mount the leading fire tender along with the crew members and rush to the incident site taking a safe route of entry considering the wind direction.
- Report to the Dy. Incident Controller/the Incident Controller and Position the Fire Tender strategically at a location in consultation with the Dy. Incident Controller/the Incident Controller.
- He will decide the line of action for fire-fighting and/or other control actions at the scene in consultation with the Dy. Incident Controller/Incident Controller and take appropriate actions for fire-fighting and control Measures.
- He will guide and lead the fire-fighting crew in fire-fighting and rescue operation till the arrival of F&S Key person (the Chief of Fire or next senior most person).
- He will ensure the safety of the crew members and that crew members are fully equipped with necessary personnel protection prior to enter "Hot Zone".
- He will assess the severity of the situation and may call for second turnout/additional help through the Dy. Incident Controller/Incident Controller (Field Command Post).

- He will keep constant contact with the key personnel (F&S) at the Field.
- Command Post and inform about the situation and probable developments.

Firemen on Duty at the Fire Control Room

The fireman on duty at the Fire Control Room will acknowledge the emergency alarm received on the panel and promptly note the plant area/where the incident occurred.

- He will note down the information, if emergency call is received through telephone, hot line or messenger.
- He will sound the fire bell to inform the fire crew to get ready and take their positions, simultaneously brief the Shift Fire Officer about the emergency message.
- He will intimate the Site Shift Manager and the Security Dept. about the emergency giving short description about the occurrence (if known).
- He will actuate emergency siren after receiving instruction from Primary Command Post (Site Main Controller/HSE&F Co-ordinator).
- He will ask telephone operator to pass on to the communication about the emergency to the Auxiliary Fire Squad of all the plants/selected plants on receiving the instruction from HSE&F Co-ordinator/Site Main Controller.
- He will always be ready and alert for receiving any message / instructions from Primary Command Post/Field Command Post.

Auxiliary Fire Squad Members

AFS Members shall be ready on hearing emergency siren and will report to site incident controller at site (Field Command Post) on receiving message from ECC

- They will do the fire-fighting under the instruction of Shift Officer. Help to bring fire-fighting equipment from nearby plants.
- AFS Members of the plant under emergency will immediately go to the emergency site and will start first aid fire-fighting.
- As per the emergency situation they will use the fixed fire-fighting equipment to protect plant equipment from heat exposure.
- They will guide non-essential personnel in case of evacuation.
- They will do monitoring/closing of storm water drains if required.
- They will help key personnel for taking action on site. Help to Security Personnel for traffic Control.

Non-essential Personnel

The plant employees, contractors' employees, visitors, etc., (other than emergency response personnel) present at the incident site are not required to be present at the incident site during the emergency at the site. In the event of declaration of an emergency in the plant/area, these persons shall quickly assemble at the safe assembly point of the plant/area and shall respond as instructed by the Site Incident Controller.

Instruction to the Non-essential Personnel

- Do not panic. Ensure that persons in your immediate vicinity are warned.
- Remain alert for announcement from the Control Room, such "Proceed to Safe Assembly Point" and act accordingly.
- Do not rush to the scene to be a spectator.
- Await instructions at the Assembly Point, report your presence to the superiors/ or the Site Incident controller, inform his whereabouts of your colleagues if they have not arrived.
- Do not engage telephone/talk back system and other communication channels, unnecessarily.
- Do not approach Control Centres without urgent/or important reasons.
- If you are not assigned any specific role, move away as directed.
- Do not offer non-authentic information/unconfirmed facts/fact/or conjecture.

Telephone Operator

At the time of emergency, communications both inwards as well as outward are very essential and telephone operator's swift action becomes very important. He plays very important part in communicating information/messages to the concerned personnel/outside agencies/mutual aid members/staff members etc. and also receiving a large numbers of outside calls. His main responsibilities and duties are as below:

- He will keep the board free to the extent possible for incoming calls.
- He will immediately convey message to the "Key Personnel" and the "Coordinator" about the emergency as per the instruction of the Site main controller.
- The telephone operator will follow instructions from the Site Main Controller/or Media Co-ordinator only, for passing on any information to outside agency about the emergency or direct all such queries to the media co-ordinator for appropriate reply.
- As far as possible he should not entertain unknown/unimportant outside calls/inquiries during initial few hours of the emergency.

HSE Coordinator

- He will report at the Emergency Control Centre (Primary Command Post) immediately after receiving information about the emergency. He will assist the Site Main Controller for taking critical decisions and provide necessary advice and information.
- He will co-ordinate with Key Person (Fire & Safety) and will assist the Site Main Controller for providing decision support and resources support to the Key Persons (F&S), as may be necessary.
- He will arrange for mobilizing off-duty fire personnel from their residence; and call other members of the staff for assistance.

- He will ensure that the AFS members have been called for assistance and liaise with mutual aid members / Fire Brigade for mobilization of additional resources.
- He will co-ordinate with the materials/stores co-ordinator and mobilize additional resources, viz., spillage containment equipment/fire-fighting equipment/material, personal protective equipment, spare breathing air cylinders, etc., as may be required at the incident site for control measures.
- He will liaise with Factory Inspectorate / Pollution Control authorities in consultation with the Site Main Controller and provide necessary information. He will also ask for the help, if necessary to evacuate neighbouring area outside the complex as advised by the Site Main Controller.
- He will organize relieving groups for fire-fighting.
- He will also initiate necessary actions to minimize impact on Environment.

Medical Coordinator

The Chief Medical Officer (or the next in command available at site) will be the Medical Co-ordinator and perform the following duties:

- He will contact the Site Main Controller immediately after receiving the information about the emergency.
- He will report immediately at the Emergency Control Centre (Primary Command Post) or OHC as instructed by the Site Main Controller and contact the Key personnel (Medical) and take stock of the situation.
- He will assist and advise the Site Main Controller in all critical decisions in the area of health/medical services to the affected persons and keep constant liaisons with him.
- Organize rescue and first aid arrangements for the affected persons at the site in the "cold Zone", as may be necessary with essential staff/equipment and post additional ambulance for transporting seriously injured persons.
- Ensure that adequate paramedical staff, equipment and medicines are available at the OHC. He will mobilize additional resources from neighbouring industries, if necessary.
- To liaise with the Local Medical Authorities and City Hospitals, if the causalities are more and situation demands treatment at additional medical centres.
- To co-ordinate with the Transport Co-ordinator for transporting victims to various hospitals
- To arrange for additional ambulances from other hospitals/ Municipal Corporation.
- The Medical Co-ordinator should ensure the upkeep of agreed medical supplies, antidotes and equipment that should always be kept in stock for treating victims of burns and hazardous chemicals. The medical authorities should be aware of the type of treatment to be administered.
- He will liaise with the media co-ordinator for release of news to the press.

Security Co-coordinator

The Chief of Security or the next in command available at site shall be the Security Co-ordinator. He will have the following duties / responsibilities:

- He will instruct and deploy plant security personnel to ensure that the law and order is maintained; and unnecessary gathering of the personnel at the scene of emergency is prevented and ensure control of traffic movement in and out of the factory areas.
- He will instruct the security personnel / Security Gates to direct and guide external emergency vehicles (Fire tenders/ambulances etc.) called for assistance/help from neighbouring industries/Local administration, to the scene of incident.
- He will instruct security personnel who could be spared to assist Site Incident Controller/Key Personnel (fire and Safety) in fire-fighting and evacuation of personnel, at the Incident Site.
- He will take action to regulate traffic movement and prevention of traffic jams inside the works as well as outside the factory gates for proper and speedy movement of the emergency vehicles, ambulances, other vehicles carrying outside resources, etc.
- He will mobilize additional security force for help, as necessary.
- He will liaise with the police and other local authorities for external help, a necessary for evacuation of the neighbouring areas outside the factory premises in consultation with the Site Main Controller.
- If necessary, he will arrange for announcement through the mobile P.A. system for alerting and instructing the population in the surrounding areas as directed by the Site Main Controller.

Engineering Co-ordinator

- He will report to the Site Main Controller at the Emergency Control Centre.
- (Primary Command Post) immediately after receiving information about Onsite emergency.
- He will take stock of the situation and assist/advise the Site Main Controller in deciding control strategies.
- He will mobilize the team from the Maintenance Dept. to assist the Site Incident Controller in control operation at the Field Command Post.
- Arrange isolation of electrical lines from distribution point/substations as required by the Site Incident Controller by calling the Electrical Engineer / Electricians.
- Provide all other engineering support, as may be required.
- Liaise with Key Personnel (Eng. /Maintenance) and co-ordinate with other groups.

Communication Co-ordinator

Communication Co-ordinator plays very important part at the time of an emergency particularly when extensive disruption of services takes place. He has the following duties and responsibilities:

- To ensure all available communications links remain functional.
- To quickly establish communication links between the Field command Post and (if this happens to be in remote off site area) and the Primary Command Post.
- To arrange for announcement on the public address system and maintain contacts with congregation points like canteen, main gate, control rooms etc.
- To ensure that previously agreed inventory of various types of communication equipment is maintained in working condition and frequent checks are carried out and records maintained.
- To maintain voice record of significant communications with timings received/passed from the Primary Command Post.
- To provide additional/alternate communication facilities as required at the site.

P&A Coordinator

He will report at the Primary Command Post (ECC) immediately after getting information about an emergency at the site and assist/advise the Site Main Controller in taking important decisions in the matters related to welfare/necessities/of emergency personnel at site, care/needs of the affected persons. His duties and responsibilities include the following:

- He will ensure that a record of affected personnel is prepared with their local/permanent addresses and telephone numbers.
- He will ensure that the relatives of the affected personnel have been informed.
- Assign officials at the hospitals to look after the needs of the affected personnel under medical treatment.
- Co-ordinate with the Finance Co-ordinator for necessary funds required to cater the needs of affected personnel, emergency purchases and for other requirements.
- To arrange for refreshments, snacks, food, and other needs as may be required for the emergency personnel from time to time.
- Co-ordinate with the Purchase Co-ordinator for necessary emergency procurement of necessary items.
- Ensure that staff personnel as necessary for assistance and help are informed/called from their residences.
- He will co-ordinate with the instruct Key Personnel transport/welfare & canteen for mobilizing additional resources, as may be required.
- To co-ordinate with the neighbouring industries for additional vehicles/ambulances and other resources as may be required.
- To liaise with the Local Administration for additional assistance/help as may be needed.

Transport Coordinator

The Transport Co-ordinator shall perform the following duties, mobilize all available company's vehicles for emergency use along with the drivers:

- Arrange for transport of victims to hospitals/dispensaries.
- Arrange for duty rotation of the drivers to meet the emergency situation.

- To direct re-fueling of the vehicles.
- To co-ordinate with the neighbouring industries for additional vehicles / ambulances as may be required
- To co-ordinate with the neighbouring industries for additional vehicles / ambulances as may be required.
- To arrange for vehicles from outside local transport agencies, if required.
- To keep in contact with the Site Main Controller for evacuation of personnel and transportation of victims.

The Welfare / Canteen Coordinator

The Welfare Co-ordinator will have the following responsibilities:

- Ensure that casualties receive adequate attention and arrange additional help (ex-gratia payment etc.), if required with consultation with the Chief Co-ordinator.
- Inform the relatives of the victims.
- When emergency is prolonged, he will arrange for relieving personnel and organize refreshment / catering facilities and arrangements for their rest (bedding, and other necessities).
- He will arrange to procure and keep stocks of necessary food items and other necessary supplies as may be required for the personnel working round-the-clock.
- He will arrange for hot drinks /snacks and food and other necessary items for emergency response personnel, as required.

Media Coordinator

The Media Co-ordinator will co-ordinate the following under the direction of the Site Main Controller (The Chief Co-ordinator):

- He will liaise with various media and release written statements to the press through prior concurrence of the Chief Co-ordinate.
- He will handle media interview with various media groups make arrangements for televising the information about the incident, the number of casualties, etc.
- He will inform State and Central Government and the statutory bodies of the nature and magnitude of the incident, the number of casualties, etc.
- He will locate himself such that media persons/third parties do not need to go past the complex security gates and that adequate communication links exists.
- Media personnel often insist on visiting incident scene. He will escort media team(s) if such visits are approved by the Chief Co-ordinator.
- He will be in constant contact with the Medical Co-ordinator, and other coordinators to be aware of latest development and closely liaise with the Chief Co-ordinator.

Finance Coordinator

- He will report at the Emergency Control Centre immediately after getting information about the emergency at site.
- He will release finance (cash / cheques, etc.) as directed by the Site Main Controller (Chief Co-ordinator).
- He will assist the Purchase Co-ordinator for emergency procurement.
- He will liaise with Insurance Company personnel as directed by the Site Main Controller.

Purchase Coordinator

- The Purchase Co-ordinator will report at the Emergency Control Centre as soon as he is informed about an emergency at site.
- He will assist the Site Main Controller and arrange for emergency purchase of necessary items as may be required during the emergency.
- He will co-ordinate with the Materials Co-ordinator and other co-ordinator for necessary emergency items to be procured.
- He will mobilize necessary manpower as may be required, etc.

Materials Coordinator

- The Materials Co-ordinator will ensure:
- Availability of the materials required by the Site Incident Controller.
- Arrange issues of materials from the General Stores round-the-clock during an emergency.
- Arrange emergency procurements form local dealers / vendors or from neighbouring industries.
- Arrange transportation of materials from General Store to the Incident Site in co-ordination with the Transport Co-ordinator.

10.2.11 Off-site Disaster Management Plan

Emergency is a sudden unexpected event, which can cause serious damage to personnel life, property and environment outside the boundary wall of the refinery as a whole, which necessitate evolving Off-site Emergency Plan to combat any such eventuality. In Offsite disaster management plan, many agencies like Revenue, Public Health, Fire Services, Police, Civil Defense, Home Guards, Medical Services and other Voluntary organization are involved. Thus, handling of such emergencies requires an organized multidisciplinary approach.

Evacuation of people, if required, can be done in orderly way. The different agencies involved in evacuation of people are Civil Administration (both state and central), non Govt. organizations, factory Inspectorate and Police authorities.

Fire

Effects of fire on population will be mainly due to thermal radiation. In such cases, houses situated to the proximity of disaster need to be evacuated, although a severe smoke hazard due to fire is to be reviewed periodically.

Explosion

An explosion will give a very little time to warn population and areas affected may be much longer than that in case of fire. The effects of explosion on population will be mainly due to shock waves, flying splinters, collapse of structures and exposure to thermal radiation.

Toxic gas/vapour release

A toxic gas release will generally threat much larger area and population, exposed to the drifting cloud of toxic gases and vapours. The time available for warning population will depend on the point of release, wind direction and velocity.

Huge oil spillage may lead to escape of Oil out-side the factory premises and take the route of our effluent discharge channel. People outside the complex may be warned not to collect oil and provide any source of ignition to create fire in the effluent discharge channel.

The purpose of the off-site disaster management plan is:

- To save lives and injuries and to prevent or reduce property losses;
- To provide for quick resumption of normal situation or operation;
- To make explicit the inter related be suggested if necessary;
- To make explicit inter related set of actions to be undertaken in the event of an industrial accident posing hazards to the community;
- To inform people and surrounding about emergency and disaster if it is likely to adversely affect machinery will be established for this purpose to guide the people in proper way
- To plan for rescue and recuperation of casualties and injuries. To plan for relief and rehabilitation;
- To plan for prevention of harms, total loss and recurrence of disaster. It will be ensured that absolute safety and security is achieved within the shortest time.

Before Crisis

This will include the safety procedure to be followed during an emergency through posters, talks and mass media in different languages including local language. Leaflets containing do's/ don'ts before and during emergency should be circulated to educate the people in vicinity.

- People in vicinity of hazardous installation, and others who are potentially affected in the event of an accident, should be aware of the risks of accidents, know where to obtain information concerning the installation, and understand what to do in the event of an accident.

- Non-governmental Organizations (NGO's) (Such as environmental, humanitarian and consumer group) should motivate their constituents and others, to be involved in risk reduction and accident prevention efforts.
- They should help to identify specific concerns and priorities regarding risk reduction and prevention, preparedness and response activities.
- NGO's should facilitate efforts to inform the public and should provide technical assistance to help the public analyse and understand information that is made available.
- Public authorities (at all levels) and management of hazardous installation should establish emergency planning activities/program's for accidents involving the hazardous substance.
- All parties who will be involved in emergency planning process. In this respect public health authorities, including experts from information centres should be involved in relevant aspects of offsite emergency planning.
- Emergency warning alert system should be in place to warn the potentially affected public, or there is an imminent threat of an accident.
- The system chosen should be effective and provide timely warning. Suitable warning system could include or a combination of for e.g.: sirens, automatic telephone message, and mobile public address system.

During Crisis

Central Control Committee: As the off-site plan is to be prepared by the government a central control committee shall be formed under the chairmanship of area head. Other officers from police, fire, factory, medical, engineering, social welfare, publicity, railway, transport and requisite departments shall be incorporated as members. Some experts will also be included for guidance. The functions of committee should be:

- To work as main co-coordinating body constituted of necessary district heads and other authorities with overall command, coordination, guidance, supervision, policy and doing all necessary things to control disaster in shortest times.
- To prepare, review, alter or cancel this plan and to keep it a complete document with all details.
- To take advice and assistance from experts in fields to make plan more successful.
- To set in motion all machineries to this plan in event of disaster causing or likely to cause severe damage to public, property or environment.
- The incident control committee, traffic control committee and press publicity committee will first be informed, as they are needed first.

Medical Help, Ambulance and Hospital Committee: This committee consisted of doctors for medical help to the injured persons because of disaster. Injuries may be of many types. As such doctors are rarely available we have to mobilize and utilize all available doctors in the area.

Functions and duties of the committee include:

- To give medical help to all injured as early as possible.
- Civil surgeon is the secretary who will organize his team.
- On receiving information to rush to spot he will immediately inform his team and will proceed with all necessary equipment's.
- First aid and possible treatment shall be provided at the spot or at some convenient place and patients may be requested to shift to hospitals for further treatment.
- All efforts shall be made on war basis to save maximum lives and to treat maximum injuries.
- Continuity of the treatment shall be maintained till the disaster is controlled.

Traffic Control, Law and Order: The committee is headed by District Superintendent of Police. Functions and duties of this committee should be:

- To control traffic towards and near disaster, to maintain law and order.
- To evacuate the places badly affected or likely to be affected.
- To shift the evacuated people to safe assembly points.
- To rehabilitate them after disaster is over.
- Necessary vehicles, wireless sets and instruments for quick communications shall be maintained and used as per need.

After Crisis

At the time of disaster, many people may badly be affected. Injured people shall be treated by medical help, ambulance and hospital committee, but those not injured but displaced kept at assembly points, whose relative or property is lost, houses collapsed and in need of any kind of help shall be treated by this welfare and restoration committee. Functions and duties of this committee are:

- To find out persons in need of human help owing to disastrous effect.
- They may give first aid if medical team is not available.
- They will serve the evacuated people kept at assembly points. They will arrange for their food, water, shelter, clothing, sanitation, and guidelines to reach any needful places.
- They will look for removal and disposal of dead bodies, for help of sick, weak, children and needy persons for their essential requirements.
- The team will also work for restoration of detached people, lost articles, essential commodities etc.
- The team will also look after the restoration of government articles.
- The team will also ensure that the original activities, services and systems are resumed again as they were functioning before the disaster.

Police Department

- The police should assist in controlling of the accident site, organizing evacuation and removing of any seriously injured people to hospitals.

- Co-ordination with the transport authorities, civil defense and home guards.
- Co-ordination with army, navy, air force and state fire services.
- Arrange for post mortem of dead bodies.
- Establish communication centre.
- Fire Brigade.
- The fire brigade shall organize to put out fires and provide assistance as required.

Hospitals and Doctors

- Hospitals and doctors must be ready to treat any injuries.
- Co-ordinate the activities of Primary Health Centres and Municipal.
- Dispensaries to ensure required quantities of drugs and equipment's.
- Securing assistance of medical and paramedical personnel from nearby hospitals/institutions.
- Temporary mortuary and identification of dead bodies.

Media

- The media should have ready and continuous access to designated officials with relevant information, as well as to other sources in order to provide essential and accurate information to public throughout the emergency and to help avoid confusion.
- Efforts should be made to check the clarity and reliability of information as it becomes available, and before it is communicated to public.
- Public health authorities should be consulted when issuing statements to the media concerning health aspects of chemical accidents.
- Members of the media should facilitate response efforts by providing means for informing the public with credible information about accidents involving hazardous substances.

Non-governmental organizations (NGOs)

NGO's could provide a valuable source of expertise and information to support emergency response efforts. Members of NGOs could assist response personnel by performing specified tasks, as planned during the emergency planning process. Such tasks could include providing humanitarian, psychological & social assistance to members of community and response personnel.

Duties of NGOs are listed below:

- Evacuation of personnel from the affected area;
- Arrangements at rallying posts and parking yards;
- Rehabilitation of evacuated persons;
- Co-ordination with other agencies such as police, medical, animal husbandry, agriculture, electricity board, fire services, home guards and civil defense;
- Establishing shelters for rescue, medical, fire-fighting personnel.
- Evacuation of personnel from the affected area;

- Arrangements at rallying posts and parking yards;
- Rehabilitation of evacuated persons;
- Co-ordination with other agencies such as police, medical, animal husbandry, agriculture, electricity board, fire services, home guards and civil defense;
- Establishing shelters for rescue, medical, fire-fighting personnel.

10.2.12 Mock Drills

As per the industrial major accident hazard rules-

a) The occupier shall ensure that a mock drill of the on-site emergency plan is conducted every six months.
b) A detail report of the mock drill conducted shall be made immediately available to the concerned authority.

Accordingly, Onsite Disaster Mock Drills are conducted once in six months. Also, Major Fire and Minor Fire mock drills are conducted once in three months and one month respectively.

Lessons Learned System for Mock Drills

Performances during the mock drills are reviewed by CEC Co-coordinators and other involved persons including observers. Observations/shortcomings are reviewed and recommendations are made for improvements which are followed by F&S for compliance. The action points from the mock drill observations should be circulated to all concerned for liquidation.

All Clear / Re-entry Procedures

Chief Emergency Controller (CEC) will declare "All Clear" after control of the Incident and arrange measures required for post Disaster control period and ask Fire Station to Blow 2 minutes straight run siren.

After incident normalization, CEC would ask Unit in-charge to visit and check the incident site along with representatives of Inspection and F&S and also Maintenance (Electrical / Mechanical / Civil/ Instrumentation/ Rotary) as needed. Standard Checks particular to a unit will be provided by respective Area Managers. Based on feedback of the team, CEC would allow re-entry / resumption of operations at the incident site.

Evacuation Plan

Purpose

To establish method of systematic, safe and orderly evacuation of all the occupants in case of fire or any emergency, in the least possible time, to a safe assembly point through nearest safe means of escape. Additionally to use available fire appliances provided for controlling or extinguishing fire and safeguarding of human life.

Fire Escape Drill Procedure

- In the event of fire condition or on hearing the fire alarm all the occupants of the building shall immediately leave the work area and proceed towards

nearest safe escape route. A care should be taken before leaving the workplace so that the escape route shall not be blocked due to chairs or other similar object.

- Security In-charge will ensure the access control system is defeated for safe evacuation of all the occupants from the affected building.
- The occupants will have to leave the affected area / block / building in a speedy and orderly manner.
- Before leaving the workplace occupants will switch off electrical gadgets such as AC, Computers, Water heaters, etc. The area owner of the building will ensure electric supply cut off to the affected building.
- The emergency exit / normal exit if not affected due to fire and / or smoke shall be used for speedy evacuation.
- All occupants will follow in a row while escaping from the block / building. Unnecessary haste and crowding shall be avoided on the escape route. Panic actions of the occupants will definitely delay the evacuation.
- The occupants having visitors shall ensure the safe evacuation of the visitor along with them to the safe assembly point.
- Efforts shall be made to control or extinguish the fire with the help of available fire extinguishers in that area.
- Building / block in-charge shall ensure the safe escape and orderly evacuation of all the occupants.
- All occupants after being evacuated shall assemble at designate safe assembly point. Block/building in-charge will arrange for head count to ensure that all the occupants have been safely evacuated.
- Security in-charge shall ensure that all the visitors have been evacuated as per visitor entry register/gate pass register. The visitors shall evacuate from the building / block along with the occupants and report to security in charge.
- The missing/suspected trapped occupants will be searched and rescued by the fire crew.
- Upon All-Clear signal from the incident controller, occupants can go back to their work place.

Do's

- Leave your workplace immediately and rush through safe escape route.
- Evacuate in a speedy but orderly manner.
- Help elderly and handicapped persons for evacuation.
- Assemble at safe assembly point and report to your floor coordinator.

Don'ts

- Panic.
- Re-enter in the affected building.

Training

On job training to the engineers on various facets of risk analysis would go a long way in improving their horizon which in turn is expected to reflect in the operation of plant, especially from the safety stand point. In order to combat with emergency situations arising out of accident release of hazardous chemicals, it is necessary for industries to prepare an exhaustive offsite and onsite emergency preparedness plan. The fire crew belonging to the fire-fighting department shall be given intensive training for the use of all equipment and in various fire-fighting methods for handling different types of fires.

10.2.13 Checklist for Capability Assessment

The checklist will help in assessing the preparedness, prevention and response resources capabilities. The points included in the checklist are only indicative and there is a need to closely examine the local requirements while preparing the checklist.

For good control and management of an incident, there are three important requisites.

- Defined organization
- Effective means
- Trained people

The organization has to be properly structured for routine as well as emergency purposes with clear understanding of duties and responsibilities. The structure has to consider an execution and speedy implementation of the response plans; while at the same time, it should be flexible enough to tune itself to the fast changing situations. All plans and procedures for emergency handling should be established. Checklists in the form of Do's and Don'ts of preventive maintenance, strengthening of HSE, manufacturing utility staff are listed in the subsequent subsections. Work permit check list is described below:

Table 10.1: Work permit check list

	Precaution to be taken	Yes	No
1.	Electrically isolated and fuse removed. Lock out-Tag out (LOTO) followed		
2.	Flow isolated by closing valves		
3.	De-pressurized – vacuum released		
4.	Vessel cooled		
5.	Drained fully and drain kept open		
6.	Vent kept open		
7.	Manhole kept open		
8.	Vessel purged with steam		
9.	Vessel purged with water		
10.	Vessel purged with nitrogen/ air		

	Precaution to be taken	Yes	No
11.	Vessel free from toxic gases/vapours/ flammable substances		
12.	Gas test shows > 20% oxygen inside vessel		
13.	Safety tags card placed wherever required		
14.	Personal PPE's provided		
15.	Exhaust / ventilation inside vessel is sufficient		
16.	Caution boards placed		
17.	Tools and tackles checked as per specifications		
18.	Head count of the area known to relevant persons		
19.	Trained Site supervisor nominated		
20.	Safety measures such as hydrant, alarms, sensors checked		

11 Conclusion and Recommendation

11.1 Conclusions

Overall the impacts from both construction and operation phase have limited adverse environmental impacts and can be readily addressed through mitigation measures as provided in EMP. BEZA, formed under EZ Act, 2010 is overall agency for implementation of EZ projects for rapid economic development of Bangladesh. BEZA will invest in land and related off-site infrastructure development so as to make zone accessible and resourceful. Thereafter economic zone development will be responsibility of private developers. Other facilities proposed to be developed by JEZ include development of administration building, boundary wall, electrical supply, water supply, ETP, access road etc. The project falls under Red category as per ECA, 1995 and requires prior environment clearance from DoE, Bangladesh.

As to the results of the EIA study for the industrial area of JEZ project, the following items are found:

- In terms of living environment, most of the impacts are controlled and limited in and around of the project area. The key negative impacts such as emission of gas and dust, deterioration of water quality, generation of noise and vibration are expected. However, implementation of appropriate mitigation and management plan, such as to spray water to bare areas for dust prevention, and to avoid the incentive operation of the construction machinery for prevention of emission gas, noise and vibration during construction phase, and to provide the commuter bus by proponent and to comply with the tentative target value of effluent water flowing out of the wastewater treatment plant during operation phase, will minimize these impacts.
- In terms of natural environment, there is no key negative impact as the EZ will be established on 'no trees area'. So, there is no sensitive ecological protection area. However, implementation of appropriate mitigation measures, such as planting trees, vegetation and sodding of public spaces as soon as possible, and keeping the environmental conditions along the existing canal and river will minimize the impact on the surrounding ecosystem.
- In terms of social environment, JEZ shall ensure the compliance with provisions of all relevant ordinances relating to compensation and rehabilitation issues properly. On the other hand, some positive impacts of the project such as increase in job opportunity and improvement of social infrastructure are also expected.
- In terms of health and safety, some impacts on occupational/community health and safety and increase in number of accidents are expected. However, implementation of appropriate mitigation and management plan, such as to manage working conditions during the construction work and to provide security and maintain safety prevention measures during construction/operation phase will minimize these impacts.

- 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 each phase of the Project: Pre-Construction, Construction and Operation Phase.

It was confirmed that the environmental, social and health impacts of the Project were assessed and the EMP was formulated properly. In the process of EIA, opportunity of public involvement was ensured and comments from the public were reflected into the final report. Thus, the EIA was completed in accordance with the requirements of the EIA procedure properly; in that case Project proponent will follow EMP accordingly.

11.2 Recommendations

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

- Construction activities for the development of project facilities should be started after obtaining environment clearance certificate from DoE.
- Proposed EMP and EMoP should be implemented strictly during construction and operation phase of the project.
- JEZ should install and maintain CETP and CSTP for the treatment of waste water and maintain `zero' discharge provision for minimizing water pollution.
- National 3R Strategy for Waste Management (Reduce, Reuse, Recycle) should be followed for the management of solid waste.
- Development of a green belt surrounding the area should be considered with due importance.
- Rain water harvesting should be carried out to reduce the pressure on surface and ground water resources.
- Roof top of all infrastructures should be managed for the purpose of harvesting rain water, photovoltaic solar energy and gardening.
- All infrastructures should be built based on the seismic design consideration to avoid potential hazard risk.
- To avoid hazard due to any disaster, warning system, emergency evacuation system, construction of ground floor at an elevated level, provision of emergency equipment should be considered.
- Safety Management guideline for workers should be strictly followed to minimize occupational health hazards.
- Proper training of environmental management, health and safety should be given to project management unit in both construction and operation phase.
- Eligible local people should be considered on priority basis that will be helpful for minimizing the socio-economic disruption.

- The JEZ should be applied the concept of ''Corporate Environmental and Social Responsibilities (CESR)'' in order to hold the responsibility for the JEZ's actions and encourage a significant positive impact through its activities on the environment, consumers, employees, communities, stakeholders and all other members of the society.
- Before development, separate environment impact assessment study should be carried out by individual industries proposed to be developed in the EZ.