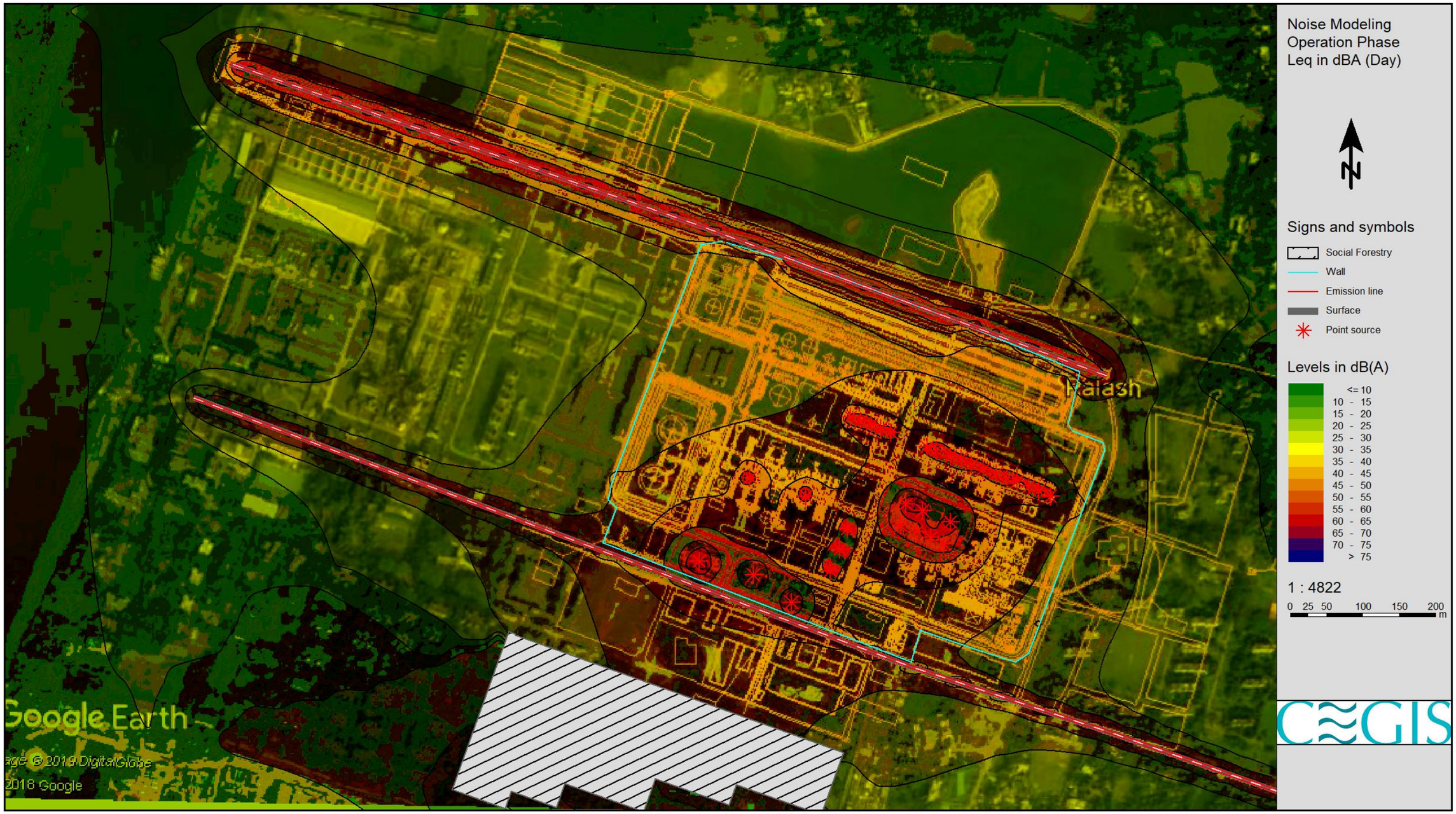


Figure 7.10: Noise Propagation Modeling during Daytime

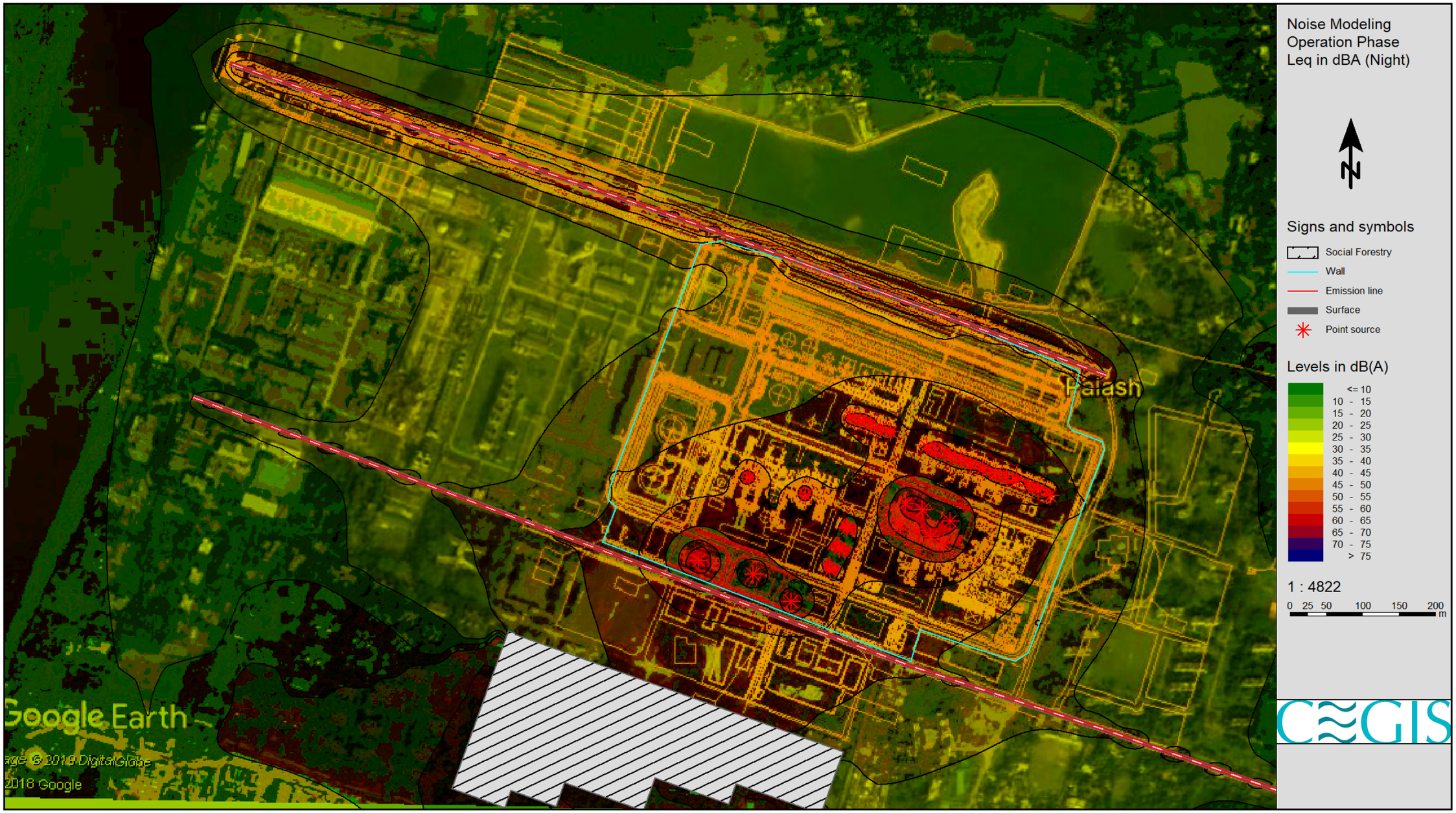


Figure 7.11: Noise Propagation Modeling during Nighttime

597. The predicted noise level at the sensitive receptors will be increased at the locations where the baseline was monitored. During baseline study, the existing noise levels were recorded relatively higher due to operation of fertilizer factories, vehicle movement and other sources. However, the resultant noise levels of the sensitive receptors have been accounted collectively with predicted noise level and existing status in Table 7.18. Since, the baseline noise level was higher, the resultant noise may not be raised significantly during the operation period.

Table 7.18: Predicted noise level in different sensitive receptors in different scenarios

Sl. No.	Location	Predicted Noise Level Leq(dBA)		Baseline Noise level Leq(dBA)		Resultant Noise level Leq (dBA)		Receptors Type ECR 2005	ECR, 2006 Leq (dBA)		IFC, 2008 Leq (dBA)	
		Day	Night	Day	Night	Day	Night		Day	Night	Day	Night
Receptor-1	SE corner of the Lagoon	38.3	35.8	62.4	56.8	62.4	56.8	Com.	70	60	70	70
Receptor-2	NE corner of the Lagoon	29.3	29.0	62.0	54.9	62	54.9	Com.	70	60	70	70
Receptor-3	NW corner of the Lagoon	31.4	29.9	63.4	58.7	63.4	58.7	Com.	70	60	70	70
Receptor-4	PUFFL colony school	31.4	31.3	48.1	42.7	48.1	42.7	Sil.	50	40	55	45
Receptor-5	PUFFL colony mosque	35.6	35.5	60.2	43.1	60.2	43.6	Sil.	50	40	55	45
Receptor-6	PUFFL colony main gate	37.6	37.5	55.6	46.8	55.6	47.3	Res.	55	45	55	45
Receptor-7	UFFL main gate	44.7	38.2	75.6	54.7	75.6	54.7	Ind.	75	70	70	70
Receptor-8	TGTDCL mosque	30.5	30.4	78.1	65.7	78.1	65.7	Com.	70	60	70	70
Receptor-9[22]	GPS main gate	**		68.4	56.8	N/A		Com.	70	60	70	70
Receptor-10	PUFFL main gate	39.1	39.0	56.9	46.7	56.9	18.3	Ind.	75	70	70	70
Receptor-11	UFFL Training Institute	40.5	32.1	61.5	54.4	61.5	54.4	Ind.	75	70	70	70
Receptor-12	Officer's Club	43.5	37.1	60.8	52.7	60.8	52.7	Ind.	75	70	70	70
Receptor-13	UFFL school field	46.1	45.7	55.3	51.6	55.8	52.6	Ind.	75	70	70	70
Receptor-14	Nargana Purbo Para School	22.6	21.8	56.3	46.2	56.3	46.2	Sil.	50	40	55	45

598. Note: Cells with red colour exceed both IFC and national standards whereas orange colour exceed the national standard; SE- Southeast, NE- Northeast and NW- Northwest.At

[22] *** Receptor-09 is located at GPS Main Gate, which is aerially about 1 km far away from the boundary of the GPUFP site. Noise level has been recorded at this receptor during baseline condition. According to the Sound Attenuation- Inverse Square Law, it is found that the generated noise from the GPUFP will be attenuated in course of distance and interference on its propagation path. Therefore, there will be limited or no impact at this Receptor-09 during the operation of GUFFP. For this reason, Receptor- 09 was not considered during Noise level modelling to predict impact of noise at this Receptor location.*

some places, the resultant noise level might be exceeded the standard limit both of ECR, 2006 and IFC 2007. PUFFL colony areas are frequently affected by noise pollution recorded during baseline study. Therefore, the resultant noise level at those areas will be higher. However, the noise level beyond the project boundary will not increase significantly. Generation of impulse noise in short period of time especially during startup and shutdown may affect the community people for a short period of time. In general, persistence exposure to the high level of noise in plant can have adverse health impacts and can increase the level of stress to the susceptible receptors.

7.8.3 Impact on Ambient Air Quality

599. Ambient air quality in the study area will be impacted in the operation stage of the Project. Ambient air quality has been assessed during baseline study. Based on the sensitivity of the locations and impact potentiality, five sampling locations have been selected. However, the ground level concentration of air pollutants varies with the operation of sources, pollutant releasing rate, abnormalities of machine, stack height, atmospheric process, distance from the sources, land status etc. Emission rate from the sources will vary based operation stages and efficiency of pollution control technologies.

600. The proposed Project will produce 2,800 TPD of Granular Urea [CO $(NH_2)_2$], also known as carbamide or carbonyl diamide, is marketed as a solution or in solid form. Most urea solution produced is used in agricultural grade. Most solids are produced as granules, for use as fertilizer in the field. Emissions from urea manufacture are mainly ammonia and particulate matter (AP-42, USEPA). Formaldehyde and methanol, hazardous air pollutants, may be emitted if additives are used. As like present, natural gas (NG) will be used as primary fuel and raw materials for NH_3 production, which have negligible amount of Sulphur (S). Therefore, minuscule or insignificant release of SO_2 may release from the reformer. NOx and PM will be released during generation of electricity. Therefore, NH_3, NOx and PM^{10} has been considered as concerning pollutantsof this Project.

Background Pollutant Concentration:

601. Before operation of the proposed Project, it is necessary to establish a concrete baseline for understanding the status of the Project's airshed. Therefore, around five locations have been selected for ambient air quality monitoring in and around the Project site. In the baseline section, the ambient air quality has been presented for each of the locations. Air quality monitoring has been conducted continuously for 24hr at the sensitive receptor points. Table 7.19 shows the background concentrations of the concerning pollutants (NO_2, NH_3 and PM_{10}).

Table 7.19: Pollutant concentration for 24hr averaging time

Sampling Point	Coordinates		NO_2	NH_3	PM_{10}
	Northing	Easting	µg/m^3		
AQ-1	260876	2654976	35.2	34.8	126.4
AQ-2	260465	2655302	42.4	108.2	119.4
AQ3	259821	2654665	38.7	36.5	96.7
AQ-4	260387	2654930	48.6	733	140.8
AQ-5	260677	2654301	40.3	173.5	145.2
ECR, 1997 & 2005			100 (Annual)	3480 (Sch-8)	150 (24 Hr)
IFC, 2007			-	-	150 (24 Hr)

Source: Field Data, 2019; Note: Modeling used µg/m^3 unit for NH_3 Odor in lieu of ppm as in Schedule-8 ECR, 1997.

Project Area:

602. The area of influence for air dispersion modeling has been considered 20 km around the project center point. In order to cover the airshed atmospheric dynamics, the modeling study has been integrated 40x40km grid for topographical change and weather variation. Included such a large area in the modeling study implies more stability. The geographic coordinates of the Project and emission sources are shown in Table 7.20.

Table 7.20: Project Area and Emission Sources

Model Domain		Easting (m)	Northing (m)
Project Center	UTM: Q46	260387.00	2654930.00
Project Area	North West Corner	260035.68	2655359.76
	North East Corner	260875.24	2655224.14
	South East Corner	261163.43	2654325.44
	South West Corner	260163.05	2654671.11
Boiler	Stack -1	260482.80	2654662.06
	Stack -2	260492.95	2654688.23
	Stack -3	260504.70	2654717.07
Reformer	Stack -1	260641.71	2654651.23
Granulation	Stack -1	260402.98	2654744.59
Power Plant	Stack -1	260430.30	2654624.44
	Stack -2	260447.89	2654618.78

603. For modeling purpose, a schematic drawing has been done over the layout plan. A 3D drawing of major structures and stack points has been shown in Figure 7.12.

Figure 7.12: 3D-Project major components of the proposed Project

Ambient Sensitive Receptors (ASR):

604. Beside the location of maximum ground level concentration (GLC), a number of other points or grid have been ramified for projecting future concentration of pollution of different criteria pollutants. They are: A) Multi-Tier Grid Receptor and B) Discrete Receptors. Grid receptors are spaced based on the point of interest and discrete receptors are identified based on the location sensitivity.

Nested Cartesian Grid Receptors

605. Multi-tier Cartesian grids are nested into smaller size to capture more precise pollutant concentration after dispersion. The gridded receptors are placing based on the following spacing:

- 100 m spacing within 1000m from the center of the Project
- 500 m spacing within 5 km from the center of the Project
- 1km spacing within 10km from the center of the Project.

Discrete Receptors:

606. A number of important settings which are susceptible to air quality deterioration have been recorded around the proposed project area. Sensitive areas have been remarked as those places where people are staying for long time are noted as sensitive receptors. Based on the health effects of children and patients due to air pollution, primary school, heath complex, residential areas around the proposed Project area are included as discrete receptors. Figure 7.13 shows the discreet receptors around the proposed Project. The list of ambient sensitive receptors, their locations and details are given in Table 7.21.

Figure 7.13: Discrete receptors (+) within 5km around the project site

Table 7.21: Details of Ambient Sensitive Receptors

Sl No	Name of Sensitive Receptors	GPS Coordinates UTM:46Q	
		Latitude (E)	Longitude(N)
1	School	259007.62	2653668.5
2	School	261299.91	2654854.58

Sl No	Name of Sensitive Receptors	GPS Coordinates UTM:46Q	
		Latitude (E)	Longitude(N)
3	School	260720.29	2654407.71
4	UFFL Training Institute	259617.59	2654791.2
5	BCIC Residential School	260907.71	2654562.28
6	Ghorasal School	260104.99	2654556.98
7	NE Community	261281.44	2655437.93
8	NW Community	260050.89	2655417.54
9	School (Others side of river)	259249.84	2655162
10	Hospital (Polash)	260915.35	2653955.69
11	Thana Health Complex (Polash)	261940.29	2653384.6

Emission from the Proposed Project:

607. The major sources of emissions are the stacks of boiler, reformer and granulation during the operation of the proposed Project. As a result, the stack emissions would constitute of mainly oxides of nitrogen (NOx), particulate matters (PM_{10}), and ammonia (NH_3). The stack and emission characteristics pertaining to the stacks are proposed by the feasibility study report. Particulate and fugitive emissions might arise from utility services, vents, process activities, grinding, DG set and vehicular movement which are assumed to be insignificant and limited within the Project boundary. During the operation phase, the major sources and emission characteristics are presented in Table 7.22.

Table 7.22: Emission from the Proposed Project

Sources of Emission	Unit	Boiler	Reformer	Granulation	Remark
Number of Stacks	No.	3	1	1	Proponent Supplied
Stack Height	m	35	30	55	
Stack Diameter	m	2.3	3.5	4	
Flue Gas Temperature	K	456	453	319	
Emission rate of NOx	gm/s	6	19.8	-	
Emission rate of PM_{10}	gm/s	2	-	11.7	
Emission rate of NH_3	gm/s	-	-	35.2	
Flue gas velocity	m/s	21	14	25	

Source: MHI (EPC Contractor)

Air Dispersion Modeling:

608. Regulatory agencies rely on dispersion model as part of their approval processes. The Department of Environment (DoE) in Bangladesh does not recommend any specific model for the impact assessment study. Therefore, this study has maintained the USEPA recommended air dispersion model that has been used for assessing the ambient maximum air pollution. The latest version of the USEPA regulatory model AERMOD 8.9.0 has been used to predict the NO_2, PM_{10} and NH_3 dispersion through the simulation of pollutants from major emission sources.

609. The Air Dispersion Modeling for prediction of maximum increment in Ground Level Concentration (GLC) of different air pollutants in the surrounding area due to the emission from stacks present in proposed Project during operation stage. This model is used extensively to assess pollution concentration and deposition from a wide variety of sources over the world. It is a steady-state plume model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of

both surface and elevated sources, and both simple and complex terrain. Given source characteristics, emissions, meteorology and averaging time, the model predicts maximum GLCs of various pollutants.

Meteorological Parameters:

610. Meteorological data has been collected from the Dhaka Station of BMD. Wind speed, wind direction, precipitation, humidity and sunshine hour records have been described in the baseline chapter (Chapter 6). Hourly upper atmospheric data has been collected from LAKES Environment, Canada for the year of 2018. After using the AERMET software of AERMOD the Windrose diagram is shown in Figure 7.14.

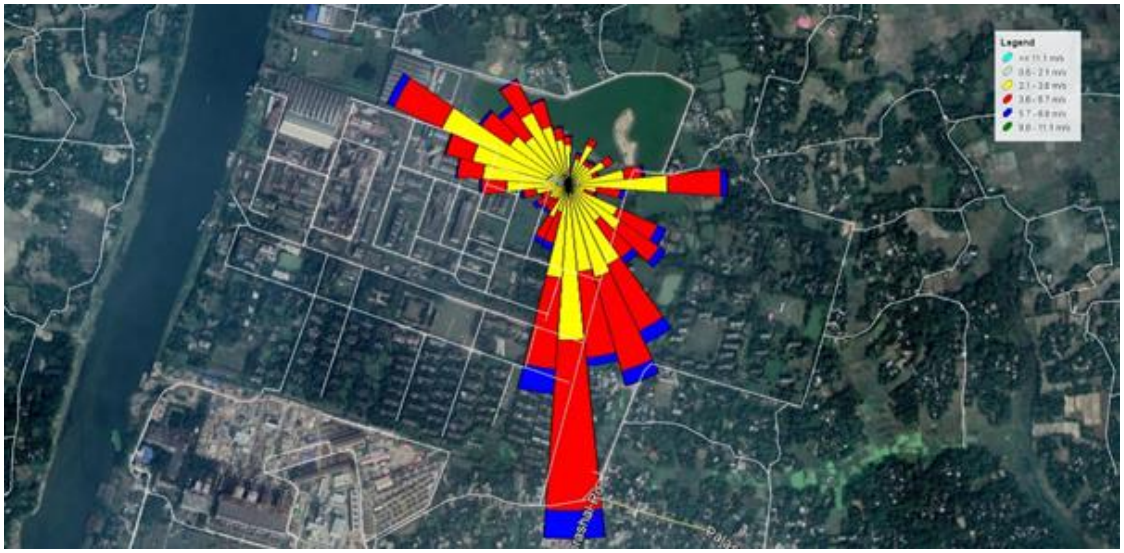


Figure 7.14: Yearly windrose diagram

Modeling Procedure:

611. This mathematical model used for prediction of air quality impact in the study area in ISC-AERMOD View. It is the next generation air dispersion model, which incorporates planetary boundary layer concepts. The AERMOD is actually a modeling system with three separate components: AERMOD (AERMIC Dispersion Model), AERMAP (AERMOD Terrain Preprocessor), and AERMET (AERMOD Meteorological Preprocessor). Moreover, it has the ability to treat the vertical in homogeneity of the planetary boundary layer special treatment of surface releases, irregularly-shaped area sources, a plume model for the convective boundary layer, limitation of vertical mixing in the stable boundary layer, and fixing the reflecting surface at the stack base. Figure 7.15 shows the schematic layout of the project used for modeling purposes.

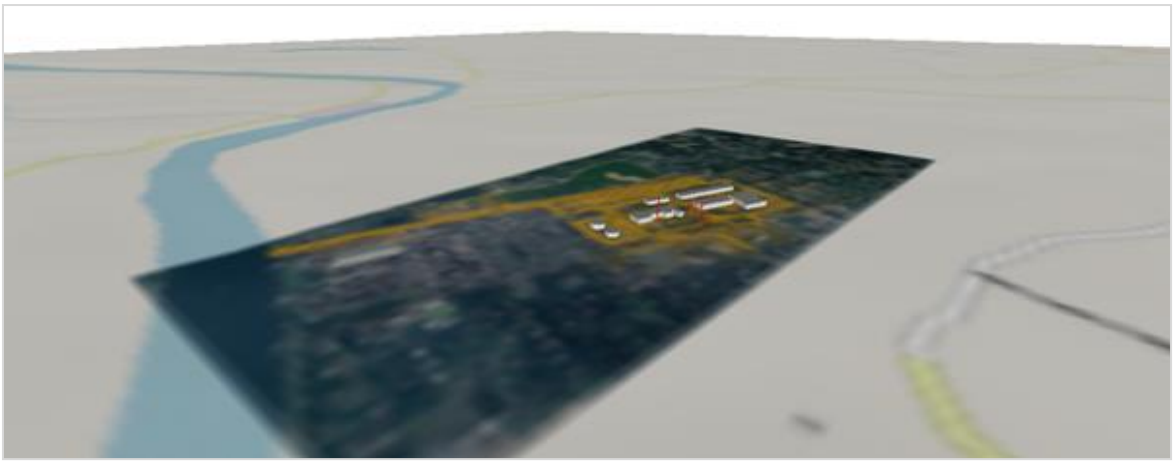


Figure 7.15: Schematic layout of the Project

612. The AERMAP is a terrain preprocessor designed to simplify and standardize the input of terrain data for the AERMOD. Output includes, for each receptor, location and height scale and elevations, used for the computation of airflow around hills. However, the following options have been employed to predict the ground level concentrations due to emissions from the proposed activity.

- Defining the area of interest (sensitive receptor) especially 5 km around the stacks for the projects
- Hourly micrometeorological data has been included
- Land use and all terrain dispersion parameters are considered
- Selection discrete and grid receptors based on the sensitivity and point of interest.
- Determination of the emission rates from the sources which is assumed to be maximum as constant during the entire period
- The predicted GLC concentration of the criteria pollutants have been added with the ambient measured pollutant concentration
- Checking the resultant maximum ambient air quality with respect to standard in the airshed and determining the project contribution.

Modeling Results:

613. The predicted 24-hourly and annually maximum incremental Ground Level Concentration (GLC) along with isopleths plot of concentration for NOx, PM_{10} and NH_3 in the study has been predicted sequentially.

Oxides of Nitrogen (NOx)

614. Emission of NOx from the boiler stacks and reformer has been predicted for hourly and annual average time period. Highest concentration of NOx would reach to the ground level depending on the worst-case meteorological situation. The peak ground level concentration of NOx has been shown in Table 7.23.

Table 7.23: Air Quality Modeling Data-NOx

Pollutant NOx	**Concentration (µg/m³)**		**GPS Coordinates (UTM:46) (m)**		**ECR, 2005**	**IFC, 2007**
	Avg. Time	Max. GLC	East	North	(µg/m³)	(µg/m³)
Project Contribution	1-hr	141.4	260687.00	2654730.00	-	200
	Annual	4.7	260487.00	2655130.00	100	40

Source: Findings of AERMOD model done by CEGIS, 2019

615. The Project will contribute NO_2 by 141.4 µg/m³ for 1-Hr and 4.7µg/m³ for annually in the ambient environment. Therefore, only this project will not breach the standard limit of national and international standard. Figure 7.16 and Figure 7.17 show predicted 1hr NO_2 and Annual NOx concentration respectively during operation of this Project only.

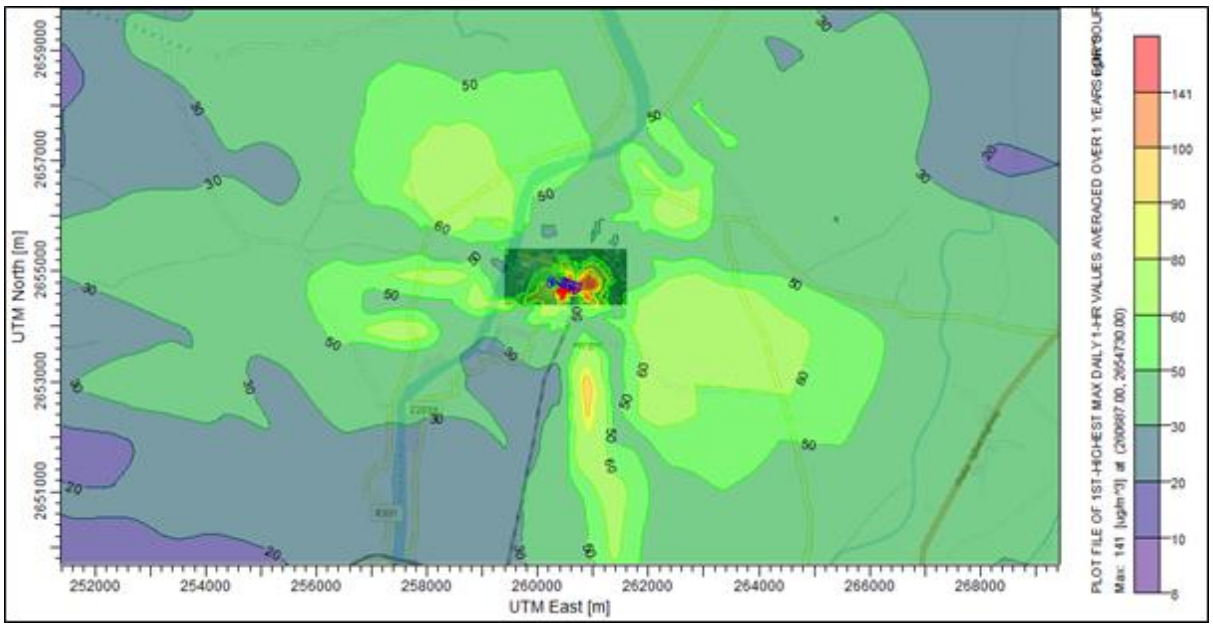


Figure 7.16: Predicted maximum GLC of NO_2 for 1-Hr

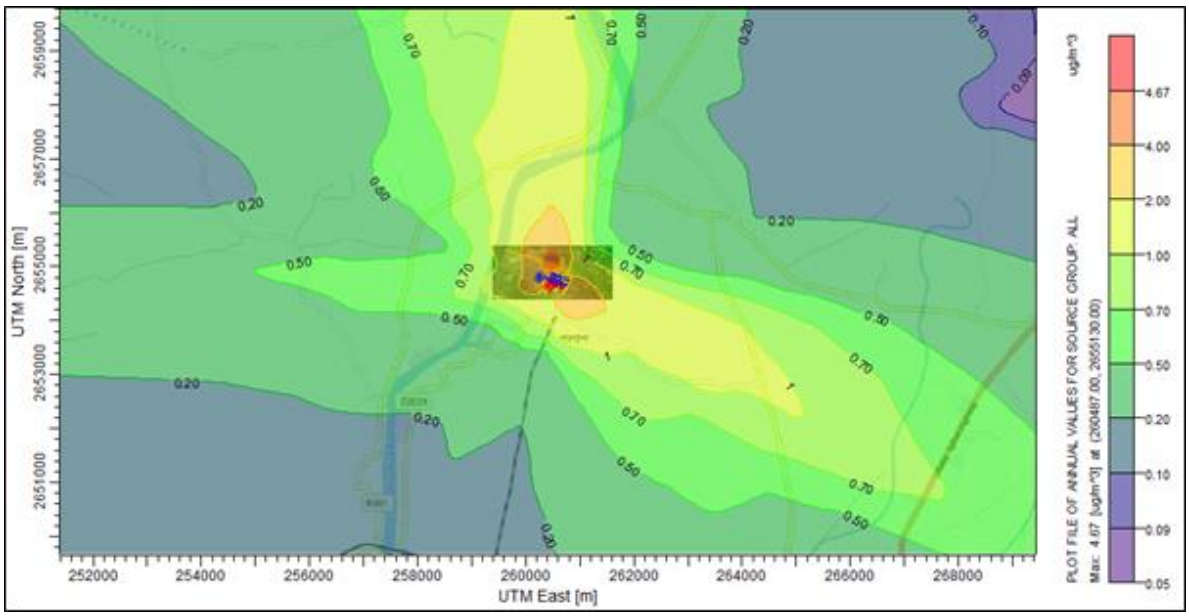


Figure 7.17: Predicted maximum GLC of NOx for annual

616. Five locations have been monitored during the baseline study. The baseline data was collected during the normal operation status of the UFFL and PUFFL. After modelling study, the predicted GLC of NO_2 at that the same monitoring locations for 24 hr have been presented in Table 7.24. Moreover, the worst case maximum GLC has also been shown in the same table. The resultant concentration at each of the monitoring location and the worst case status are predicted. However, the resultant concentration during operation of the proposed Project will not breach the national and international standard.

Table 7.24: Resultant GLC of NO_2at the monitoring locations

Sampling Point	Measured NO_2 Concentration	Predicted NO_2 Concentration	Resultant NO_2 Concentration	ECR, 2005	IFC, 2007
	24- Hr (µg/m^3)	1 –Hr (µg/m^3)	Max (µg/m^3)	1-Hr (µg/m^3)	1-Hr (µg/m^3)
AQ-1	35.2	91.6	126.8	-	200
AQ-2	42.4	49.4	91.8		
AQ3	38.7	49.9	88.6		
AQ-4	48.6	46.4	95.0		
AQ-5	40.3	46.9	87.2		
Max GLC	48.6	141.4	190.0		

Source: CEGIS estimation based on Model findings, 2019

Particulate Matter (PM_{10})

617. The particulate matters are also estimated during the baseline monitoring study. The highest concentration of PM_{10} for 24-hr has been predicted 7.8 µg/m^3 and annual averaging time has been predicted 1.8 µg/m^3 only for this Project. The maximum concentration of PM_{10} would only be found in the ground level for the worst-case meteorological situation. The predicted maximum GLC of PM_{10} for different averaging time period has been shown in Table 7.25.

Table 7.25: Air Quality Modeling Data-PM_{10}

Pollutant - PM_{10}	**Concentration (µg/m³)**		**GPS Coordinates (UTM:46)**		**ECR, 2005**	**IFC, 2007**
	Avg. Time	Max. GLC	E	N	(µg/m³)	(µg/m³)
Project Contribution	24-Hr	7.8	262887.00	2653430.00	150	150 (IT-1)
	Annual	1.8	260387.00	2655230.00	50	70 (IT-1)

Source: Findings of AERMOD model done by CEGIS, 2019

618. Actually, this prediction reflects that the ambient PM_{10} concentration will not increase significantly due to use of natural gas as fuel and low emission of dust from granulation stack. However, it is expected that $PM_{10}$for 24hr and annual average may not cross the national standard limit. Therefore, only this project will not breach the standard limit for PM_{10} of national and international standards. Figure 7.18 and Figure 7.19 show predicted 24hr PM_{10} and Annual PM_{10} concentrations during operation of this Project only.

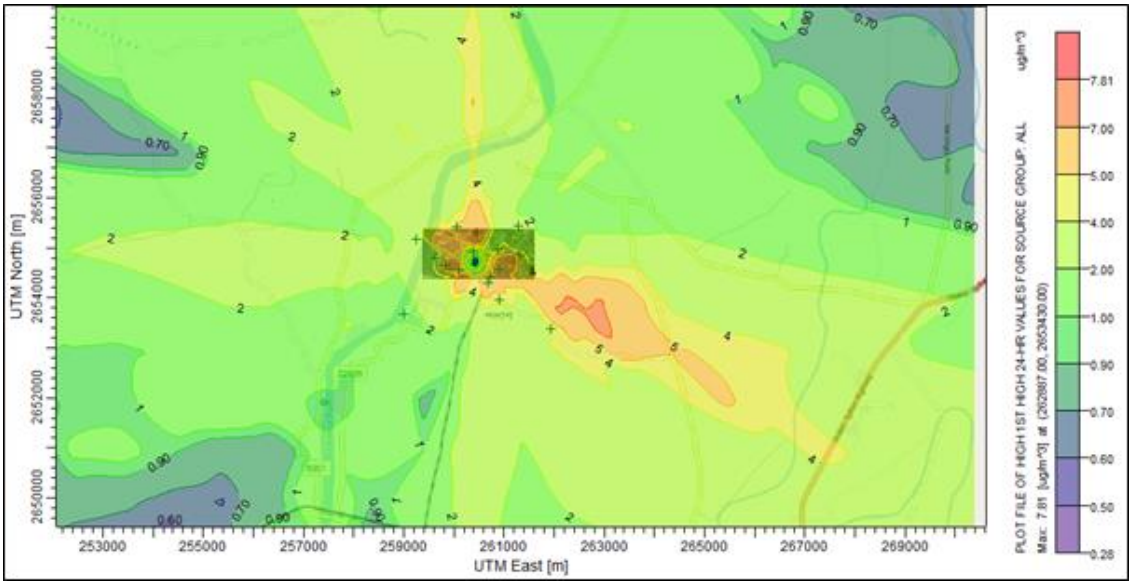


Figure 7.18: Predicted Maximum GLC of PM10 for 24-Hr

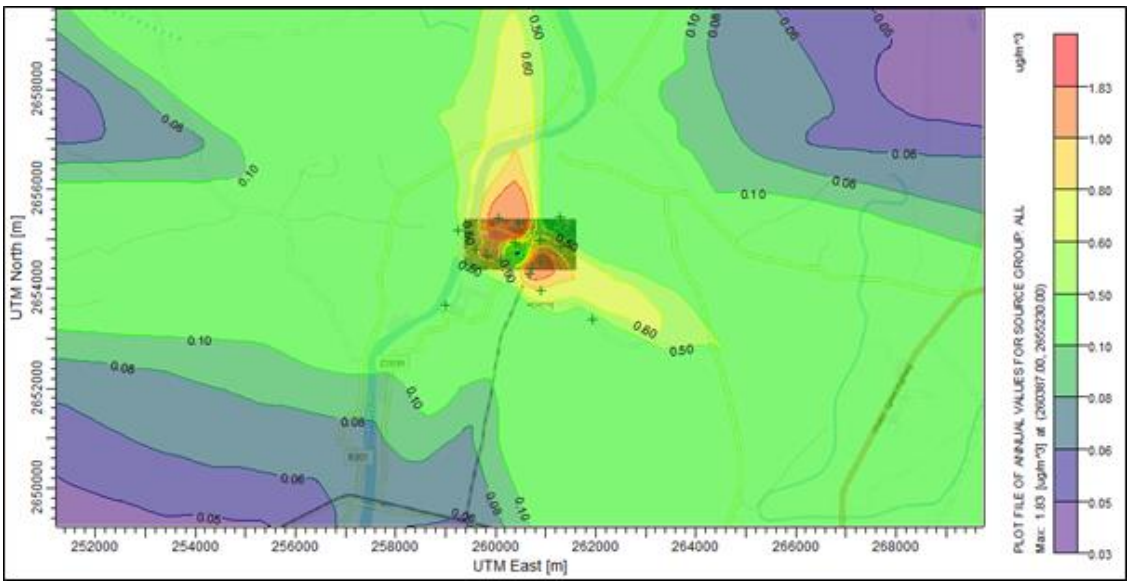


Figure 7.19: Predicted Maximum GLC of PM10 for Annual

619. Five sensitive locations have been monitored for PM_{10} concentration during the baseline study. The baseline data were collected during the normal operation status of the existing fertilizer factories. After modelling study, the predicted GLC of PM_{10} at the same monitoring locations for 24 hr have been presented in Table 7.26. Moreover, the worst case maximum GLC has also been shown in the same table. The resultant concentration at each of the monitoring locations and the status of worst casesis predicted. However, the resultant concentration during operation of the proposed Project will not breach the national and international standard.

Table 7.26: Resultant GLC of PM_{10}at the monitoring locations

Sampling Point	Measured PM_{10} Concentration	Predicted PM_{10} Concentration	Resultant PM_{10} Concentration	ECR, 2005	IFC, 2007
	24 –Hr (µg/m³)	24 –Hr (µg/m³)	24 Hr (µg/m³)	24Hr (µg/m³)	24Hr (µg/m³)
AQ-1	126.4	4.0	130.4	150	150
AQ-2	119.4	7.3	126.7		
AQ3	96.7	5.0	101.7		
AQ-4	140.8	2.4	143.2		
AQ-5	145.2	5.7	150.9		
Max GLC	145.2	7.8	153.0		

Source: CEGIS estimation based on Model findings, 2019

Ammonia (NH_3)

620. Granulation tower is the main source of NH_3 emission. The remaining sources like vents, duct leakage and fugitive emission of NH_3 have not been accounted in this modelling process. Implementation of ETP, closing the existing lagoon and operation of state-of-art machine will certainly reduce the NH_3 wastage which subsequently emit to the ambient environment. However, emission of NH_3 from the granulation stack has been predicted for 8-hourly and 24 hr averaging period. Highest concentration of NH_3 would reach to the ground level depending on the worst-case meteorological situation. The peak ground level concentration of NH_3 has been shown in Table 7.27.

Table 7.27: Air Quality Modeling Data-NH_3

Pollutant NH_3	Concentration (µg/m³)		GPS Coordinates (UTM:46) (m)		ECR, 1997
	Avg. Time	Max. GLC	E	N	(µg/m³)[23]
Project Contribution	8-Hr	46.4	262387.00	2653930.00	3480
	24 -Hr	19.2	262887.00	2653430.00	

Source: Findings of AERMOD model done by CEGIS, 2019

621. During operation of the proposed Project, NH_3 will be released from the granulation tower and disperse to the atmosphere. The maximum GLC of NH_3 would be 46.4 µg/m³ for 8-hr and 19.2 µg/m³ for 24 Hr. Emission from the granulation stack will not contribute significantly to increase the maximum GLC. However, this project will never significantly increase the NH_3 concentration to the adjacent environment. Figure 7.20 and Figure 7.21 show predicted 24hr NH_3 concentration and Annual NH_3 concentration during operation of the Project only.

[23] Standard of NH_3 odor in ECR, 1997 is given in ppm but air quality modeling is done by transforming ppm value into µg/m³.

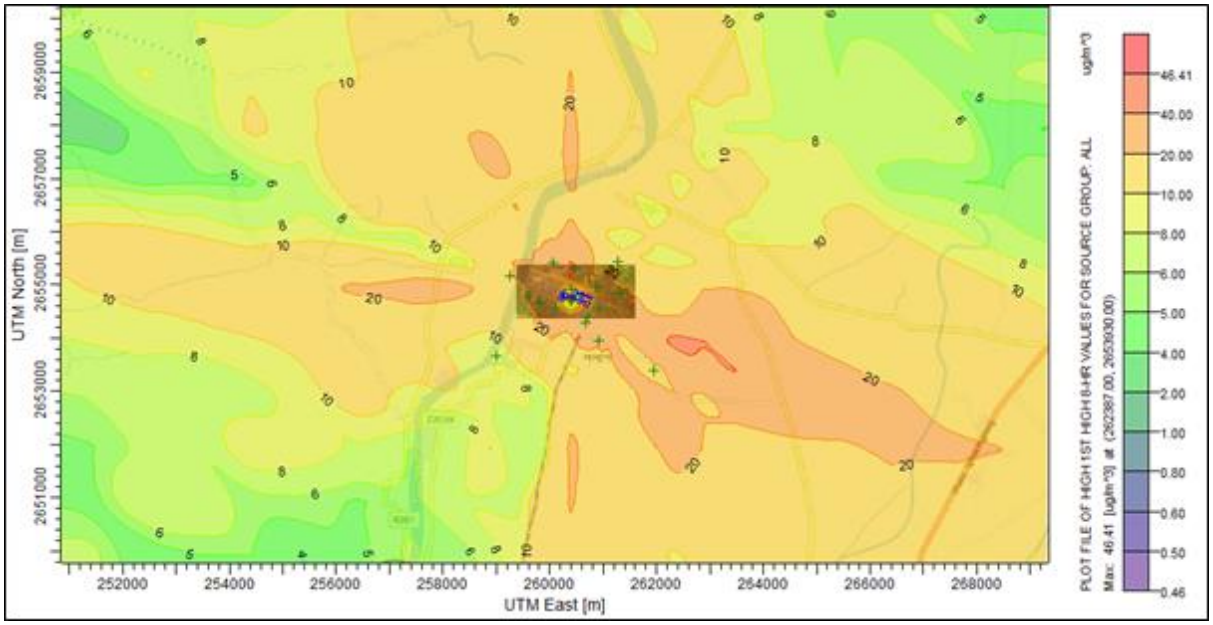


Figure 7.20: Predicted Maximum GLC of NH_3 for 8-Hr

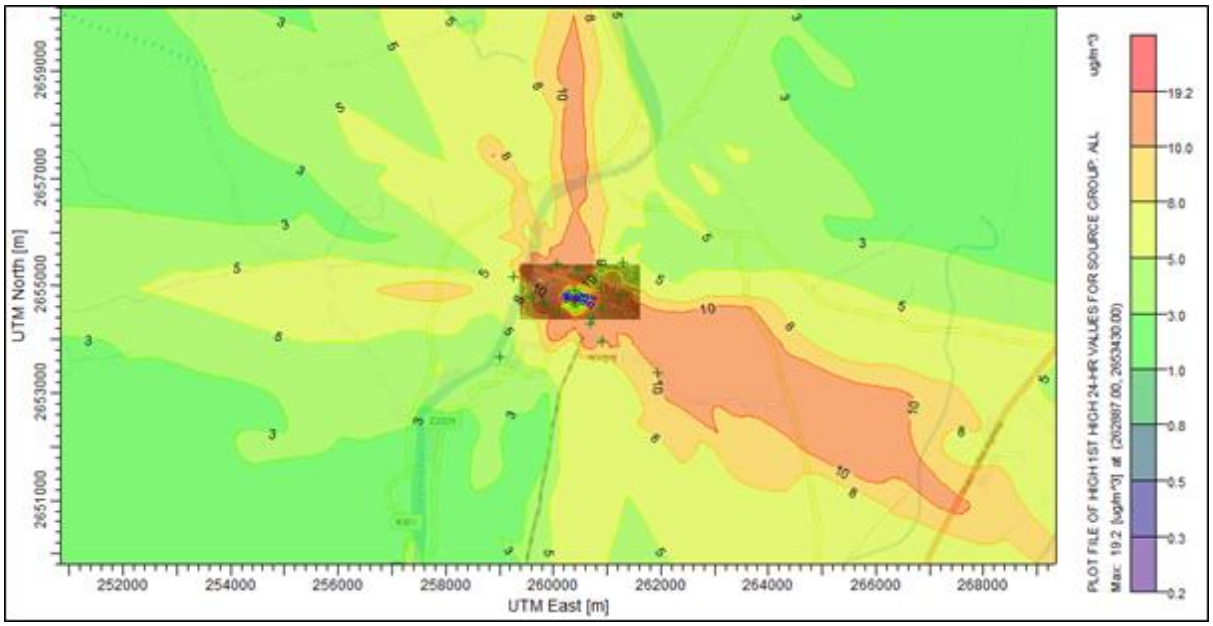


Figure 7.21: Predicted maximum GLC of NH_3 for 24-Hr

622. Baseline NH_3 concentration has been monitored for 24hr at five locations based on the impact potentiality of NH_3 sources and sensitivity of the community. However, the baseline data were collected during the normal operation status of the fertilizer factories. After modelling study, the predicted GLC of NH_3 at the same monitoring locations have been predicted (Table 7.28) Moreover, the worst case maximum GLC of NH_3 has also been shown in the same table. The resultant concentration at each of the monitoring locations and the worst case status are predicted. However, the resultant concentration during operation of the proposed Project will not breach the national and international standard. Moreover, it will be reduced after shutting down the existing UFFL and PUFFL fertilizer factories.

Table 7.28: Resultant GLC of NH_3 for annual at the monitoring locations

Sampling Point	Measured NH_3 Concentration	Predicted NH_3 Concentration	Resultant NH_3 Concentration	ECR, 1997
	24 –Hr (µg/m^3)	24 –Hr(µg/m^3)	24 Hr(µg/m^3)	(µg/m$_3$)
AQ-1	34.8	9.6	44.4	3480
AQ-2	108.2	18.2	126.4	
AQ3	36.5	12.6	49.1	
AQ-4	733	5.3	738.3	
AQ-5	173.5	13.2	186.7	
Max GLC	733	19.2	752.2	

Source: CEGIS estimation based on Model findings, 2019

Modeling Results at ASR:

623. Eleven sensitive locations have been preselected as per the importance of the locations. During operation of the proposed Project, it will emit NO_2, PM_{10} and NH_3 at different sources. This pollutant will disperse to the adjacent ambient sensitive receptors (ASR). This Project contribute the maximum GLC at the sensitive receptors significantly. Table 7.29 shows the maximum GLC of NO_2, PM_{10} and NH_3 at the ASR for different averaging period.

Table 7.29: Maximum GLC of air pollutants emit from the proposed Fertilizer Plant

Sl. No.	Name of Sensitive Receptors	NO_2 (µg/m^3)		PM_{10} (µg/m^3)		NH_3 (µg/m^3)	
		1-hr	Annual	24-hr	Annual	8-hr	24-hr
1	School	24.4	0.4	1.6	0.2	8.5	3.9
2	School	57.4	1.4	4.7	0.6	26.7	11.6
3	School	48.2	2.8	5.9	1.2	36.4	13.6
4	BCIC Training Institute	37.2	1.4	3.8	0.8	23.7	9.7
5	BCIC residential School	90.6	3.0	6.0	1.2	31.0	13.9
6	Ghorasal School	72.7	2.4	4.5	0.7	21.5	9.2
7	NE Community	33.2	0.7	2.6	0.3	15.4	6.4
8	NW Community	35.3	2.2	4.9	1.3	32.6	12.5
9	School (Others side of river)	23.7	0.8	2.9	0.4	17.8	7.0
10	Hospital (Polash)	44.6	1.8	4.0	0.8	23.2	9.6
11	Thana Health Complex (Polash)	61.5	1.0	4.0	0.4	16.6	10.0

Source: Findings of AERMOD model done by CEGIS, 2019

8. Mitigation of Impacts

8.1 Preamble

624. The proposed Project is an environment friendly chemical complex by replacing the existing old-aged PUFFL and UFFL as described in Chapter 5. The Project will be constructed with state-of-art-technology and existing plants will be decommissioned and dismantled. Operation of the proposed Project and demolition of existing plant components require particular attention to harmonize the activities. Specific designs proposed in this Project are presented in the following sections.

8.2 Change in the project layout

625. It is proposed to consider the following temporary facilitiesduring construction stage the project layout developed by the EPC Contractor:

- An on-site secured hazardous waste (asbestos cement sheet) disposal facility near the existing Jetty/lagoon;
- A storm water drainage system around the proposed Project and the hazardous waste disposal facility; and
- A temporary storage area for scrap materials of existing old structuresafter demolition in the northwest side of project site.

8.3 Mitigation Measures for MajorImpacts

580. The following sections present the mitigation measures for the major impacts identified in Chapter 7 of the EIA report. Minor and some moderate impacts will be managed and mitigated using environmental code of practices (presented in Appendix 9.1) and Contractors' good practice.

8.3.1 Pre-Construction Stage (A)

A1. Hazardous and non-hazardous waste generation[24]

Mitigation Measures: A large quantity of debris and rubbles amounting about 27,400 tons including 15 tons of asbestos cement sheet would be generated during dismantling and demolition of civil structures. Following measures should be taken for the management of hazardous and non-hazardous waste generation. The measures include: demolition waste (debris and rubbles) should be carried away by covered dump trucks to the landfill area; a confinement area should be developed for temporary storage of asbestos cement sheet and rods; auction of asbestos cement sheet and rods and carry away the sheets and rods by the Vendor; water spraying for dust suppression during demolition and debris hauling; asbestos containing waste material should be managed following Hazardous Waste and Ship Breaking Waste Management rules 2011 guideline and deposited with proper labeling and packaging; asbestos washed water should be collected in a suitable pit and release in the open

[24] A denotes Pre-Construction Stage and A1 denotes the serial number of impact in Pre-Construction Phase.

environment with due treatment; and the labour contractor must follow the OHSAS 18000/18001 guidelines, etc.

A6. Faunal habitat and biodiversity

626. *Mitigation Measures*: During vegetation clearance for site preparation following measures should be taken for protecting faunal habitat and dependent biodiversity. The measures include: land optimization during engineering design and vegetation clearance should be limited to as low as possible; wildlife pass should be created for their unscared scaping to nearby similar habitats; bush cover should be created around the fertilizer factory area and also outside the project site to create suitable habitat; night time activities should be limited to land preparation; use light on an "as and when needed" basis; direct lighting toward the ground on working areas, reducing the height of lighting to the extent possible and minimizing the number of lights required through strategic placement; follow lighting plans; halogen bulb/light can be used for its longevity, higher efficiency, cost reduction etc.

A8. Terrestrial vegetation cover

627. Mitigation Measures: During vegetation clearance for site preparation following measures should be taken for reinstating as much as possible the previous nature of terrestrial vegetation cover. The measures are: following the tree felling guidelines of the DoE it needs to plant five trees for cut down of one tree; green belt should be developed with native plant species of different types for creating vegetation cover surrounding the Project site; plantation should be done around the playground, dormitory, roadside, etc. outside the project site under Corporate Social Responsibility (CSR). This will enhance the capacity to absorb more carbon from the atmosphere.

A13. Employment generation

628. Enhancement Measures: The Project will generate employment opportunity for about 600 local skilled, semi-skilled and unskilled people during site preparation in addition to 400 employment during demolition period. For enhancing the benefit to the local people emphasis should be given on the followings: local people particularly the Project-affected Persons (PAPs) directly or indirectly should be given priority in employing workforces in different Project activities; labour wage should be fixed based on the labour market and commodity prices of the area; gender issue should be considered in employing labour; EPC Contractor should abide by the rules and regulations of BLA, 2006; ILO, 1998; EP-III and IFC PS-II; workforce should be trained up before starting the real work.

8.3.2 Construction Stage (B)

B11. Employment Generation

629. *Enhancement Measures*:B11. The construction phase of the Project will generate employment opportunity for 4,000 people of different working levels and expertise. This beneficial impact may be enhanced by implementing following measures, such as local people particularly the Project-affected Persons (PAPs) directly or indirectly should be given priority in employing workforces in different Project activities; labour wage should be fixed based on the labour market and commodity prices of the area; gender issue should be considered in employing labour; EPC Contractor should abide by the rules and regulations of BLA, 2006; ILO, 1998; EP-III and IFC PS-II; workforce should be trained up before starting the real work.

8.3.3 Operation Stage (C)

C3: Surface water availability

630. Mitigation Measures: Gross water intake will be about 0.567 m^3/s and net water intake for the operation of the Project will be about 0.283 m^3/s whereas lowest discharge of the Shitalakhya River is about 83 m^3/s in dry season. On the otherhand, the specific relative consumption of water (0.567 m^3/s) in GPUFP is less with respect to production of urea in UFFL and PUFFL together by using 0.583 m^3/s. The mitigation measures are: system loss during plant operation should be minimized as much as possible; regular O&M should be conducted; rainwater harvesting system should be installed in the factory level as per DPP provision; regular monitoring of dry season water flow should be ensured.

C8. Fish mortality

631. Mitigation Measures: Water intake at the rate of 0.567 m^3/s would generate velocity of about 0.51 m/s at (considering 24 m diameter of pipeline) inlet may cause entrainment of fish which cannot sustain the resultant velocity. The mitigation measures are: Maintaining minimum water velocity of 0.3 m/s during pre-monsoon and monsoon period avoiding the entrainment of fishes; Strainer with 6 mm mesh size should be placed before the intake of water; an additional reservoir should be constructed with regulated canal for conserving fish when dry down of the basin required; acoustic Air Bubble Curtain using perforated pipe should be installed as a deterrent system for fish in order to be avoiding from water intake point.

9. Environmental Management Plan

9.1.1 Introduction

632. The Environmental Management Plan (EMP) includes several plans for implementing mitigation and enhancement measures, disaster management, spill response, hazardous materials management, emergency response, dust management, occupational health and safety, and Environmental Code of Practices. Generally, the impacts, which are minor or moderate, are to be mitigated by adopting Environmental Code of Practices (ECPs) and Contractor's good practices during project implementation. On the other hand, impacts and risks which are critical or major will be mitigated or prevented by adopting mitigation measures discussed in Chapter 7 and 8 along with specific plans discussed in this Chapter.

9.1.2 Objective of EMP

633. The basic objective of the EMP is to manage adverse impacts of project constructions and operation in a way, which minimizes the impacts on the Shitalakhya River (an ECA), the natural environment and people of the study area. The specific objectives of the EMP are to:

- Facilitate the implementation of the mitigation and enhancement measures identified during the present EIA to comply with regulatory requirements discussed earlier in the document;
- Maximize potential project benefits and control negative impacts;
- Draw responsibilities for project proponent, contractors, machinery suppliers consultants, and other members of the Project team for the environmental management of the Project;
- Maintain essential ecological process, preserving biodiversity and wildlife, where possible restoring and compensating degraded or fragmented natural resources, and livelihood improvement that rely on the Shitalakhya River;
- Make stakeholders aware about implications of the project activities, satiate their concerns and roles and responsibilities of respective quarters;
- Foster and facilitate informed decision making process; and
- Ensure sustainable development.

634. The EMP will be managed through a number of tasks and activities. One purpose of the EMP is to record the procedure and methodology for management of mitigation and enhancement measures identified for each negative and positive impacts of the Project, respectively. The management plan will clearly delineate the responsibility of various participants and stakeholders involved in planning, implementation, and operation of the Project.

9.1.3 Project Components and Various Categories of Mitigation Measures

635. There are five major components of the Project. These are: (i) Ammonia Plant; (ii) Urea Plant; (iii) Granulation Plant; (iv) Power Plant; and (v) Unloading at Plant Jetty. Details of the project components are given in Chapter 4 and Chapter 5.

9.1.4 Various Categories of Mitigation Measures

636. The EMP includes various categories of mitigation measures and plans: (i) general and non-site-specific measures in the form of environmental codes of practices (ECPs) presented in *Appendix9.1* to address general construction and operation matters identified as moderate and minor in significance prior to mitigation in Table 7.4; (ii) project specific and to the extent possible, site-specific mitigation measures discussed in Chapter 7 and summarized in Table 7.4; (iii) Hazardous Materials Management and Spill Response Plan, and (iv) Construction Environmental Action Plan (CEAP) with site-specific and contract-specific management plans to be prepared by the contractor, which include pollution prevention, occupational health, safety and environment, and emergency response.

9.2 Inclusion of EMP in Contract Documents

637. In order to make the Contractors fully aware of the implications of the EMP and responsible for ensuring compliance, technical specifications in the tender documents will include compliance with mitigation measures proposed in the EIA as well as WBG's General Environmental Health and Safety Guidelines. The Contractor must be made accountable through contract documents for the obligations regarding the environmental and social components of the project.

9.3 Environmental Code of Practices

638. A set of environmental code of practices (ECPs) has been prepared for various environmental and social management aspects: ECP 1: Waste Management; ECP 2: Fuels and Hazardous Goods Management; ECP 3: Water Resources Management; ECP 4: Drainage Management; ECP 5: Soil Quality Management; ECP 6: Erosion and Sediment Control; ECP 7: Top Soil Management; ECP 8: Topography and Landscaping; ECP 9: Quarry Areas Development and Operation; ECP 10: Air Quality Management; ECP 11: Noise and Vibration Management; ECP 12: Protection of Flora; ECP 13: Protection of Fauna; ECP 14: Protection of Fisheries; ECP 15: Road Transport and Road Traffic Management; ECP 16: Construction Camp Management; ECP 17: Cultural and Religious Issues; ECP 18: Workers Health and Safety, and ECP 19: Construction and Operation Phase Security. The Contractors will be contractually obligated to comply with these ECPs, presented in *Appendix 9.1*.

639. The Contractors will prepare one Civil Structures Demolition/Demolition Action Plan based on terms and conditions and procedures provided in **Section 9.4.1** Demolition Plan and one Construction Environmental Action Plan to address pollution prevention, occupational health, safety and environment, and emergency response including the requirements of ECPs and EMP. These will be reviewed and approved by Owner's Engineer (OE), EHSU, and PIU before implementation of the construction works.

9.4 Environmental Management Plan during Demolition and Pre-construction

640. The project site is of about 45 hectares (110 acres) of land including old civil structures, 3,750 number of trees (sapling, juvenile and adult), grasses, bushes, warehouses, lagoon, etc. Built up area (Plinth area) of the civil structures are 59,204 sq. meter (Table 4.1in Chapter 4) would be demolished by the project proponent using auction method as per Demarcation committee report (**Annex 4.1**). The type of infrastructures and the area of the structures are as follows:

- Buildings of an area approximately 1,87,404 sq. ft. (17,410 sq. m.),
- Semi-pucca tin-shed building (15 ton asbestos) of an area approximately 94,680 sq. ft. (8,796 sq. m.),
- RCC (brick chips) road of an area approximately 167,494 sq. ft (15,561 sq. m.),
- RCC (stone chips) road of an area approximately 1,680 sq. ft. (156 sq. m.),
- Carpeting road of an area approximately 86,550 sq. ft. (8,040 sq. m.),
- Boundary wall of an area approximately 44,343 sq. ft. (4,120 sq. m.),
- Tin-shed/asbestos/scrap yard/heavy vehicle of an area approximately 10,525 sq. ft. (977 sq. m.); and
- Titas infrastructure of an area approximately 44,587 sq. ft. (4,142 sq. m.)

641. The project site is largely covered by grasses and having different species of trees, shrubs and climbers. Among the trees, the major ones are timber trees followed by fruit and other trees. The major timber trees are: S*hegun, Mahogoni, Raindee Koroi, Kanthal, Sirish, Koro*i, etc. The fruit trees are: *Bel, Supari, Khanthal, Narikel, Batabilebu, Aum, Kajubadam, Jam, Amloki*. Trees fall in other category include *Jhau, Kamini, Debdaru, Neem, Krishnochura, Bot, Daruchini*, etc.

642. As per the demarcation committee's report all the structures in the proposed plant area will be dismantled within 35 days. The total construction wastes after demolition of the structures will generate approximately 27,400 tons as per estimation (Appendix 9.2). These construction debris will be removed within this time frame. The demolition of the civil and other structures should be implemented by following the procedures by the EPC contractor.

9.4.1 Demolition Plan

Demolition Procedures

a) Demolition will be carried out by hand operated pneumatic jack hammer. Oxy-acetylene torch may be used to cut the reinforcement. Mobile air compressor will be placed on the ground floor.

b) Demolition should be started on the roof and proceed down floor by floor to the ground floor. The concrete of each structural element should be broken down gradually. The reinforcement should be left in place until the concrete is broken away and when its support is no longer need.

c) The demolition of other structural element under the building should be executed according to the following:

   i. Cantilevered slabs will be demolished by hand held jack or pneumatic hammer; prior to such demolition, the cantilevered slab should be supported and the area underneath it be protected according to the precautionary measures.

   ii. The cantilevered beams will be demolished by hand held jack or pneumatic hammer; the cantilevered beam will not be demolished prior to demolition of slabs and walls which are supported by the cantilevered beams.

   iii. Demolition of other slabs should be done sequentially and then interior beams and columns would be demolished.

Precautionary Measures during Demolition

a) There should be a provision of covered walk way along the entire length of each property boundary.

b) The catch platform on top of the covered walkway should be placed underneath the balconies to support the cantilevered structures. Steel propping should be installed on all floors underneath the cantilevered slabs and beams. Steel propping will have a bearing capacity of 25kN, spaced at 1.2 m on center.

c) Double row scaffold with nets and tarpaulin will be installed and will cover the external face of the building.

d) Bamboo catchfans will be provided at vertical intervals of no more than 10 m.

e) All existing utilities should be terminated. Sewer services and drainage connections will be disconnected and sealed off at the last manhole.

f) Field Safety Gears for Personal Safety of the labors should be in place.

g) Appropriate cloths (long pants, high visibility jacket), footwear, and gloves should be in place and used as required:

   i. Eye and ear protection;
   ii. Hardhat;
   iii. Respiratory protection;
   iv. Personal meds & Rx drugs;
   v. Bottled water;
   vi. Maps/ GPS device;
   vii. Cell Phone;
   viii. Sunscreen, insect repellant; and
   ix. First aid kit

Demolition Waste Management Plan

Debris handling

i. Existing furniture, door frames, windows, piping and other building services will be removed before demolition. Any salvageable material will be sorted and removed separately.
ii. Building debris will be conveyed through a 800mm x 800mm opening on the floor slabs. Openings shall not cut through structural support elements. Plastic chute will be initiated through the openings to convey the debris to the ground floor.
iii. Demolition debris should be picked up on ground floor with bull dozer and carried away by dump trucks. Debris clearing and transportation should be scheduled to maintain the following conditions:
   - Debris accumulation on the first floor or above will not be higher than 100mm.
   - Debris accumulation on the ground floor will not exceed 1m.
   - No debris will be allowed to accumulate on the cantilevered structures.
iv. Debris waste and other materials should not be thrown, tipped or shot down from a height where these are liable to cause injury to any person.

v. All the glass windows in the light well should be taken out or protected before using the light well for conveyance of debris in order to minimize any dangerous situation.

Special site safety

- The existing staircase will be used as emergency route. The emergency route will be maintained throughout the demolition process. The route will be clear of obstruction at all time. Signs or markings will be installed to clearly identify the route.
- Fire extinguisher or firefighting equipments will be placed in a visible location, adjacent to the staircase, on each floor.
- All flammable materials will be stored in a safe location.

Dust and Noise

- Water spraying will be applied to suppress the dust generated during the demolition operation and debris hauling.
- Super silenced type air compressor will be used during demolition. Demolition works will not be performed within the restricted hours and day.

Training

- All site personnel will go through a training program to understand the project and site safety requirements. The training program will be conducted by a competent trainer. The training program will include the following:
- An induction course at the beginning of the job to circulate information on the proposed method and required safety measures to perform the work,
- Daily safety meetings to maintain and reinforce the safety concept.

Typhoon (Emergency Bell)

- In the case when Typhoon signal is hoisted, the contractor will inspect all scaffolding, protective screen, and externally exposed temporary work and strengthen any loose connections. After the typhoon, all scaffoldings, protective screens and externally exposed temporary works will be inspected and confirmed to be safe by the competent and experienced person.

Maintenance and inspection

- All the precautionary measures, covered walkway, catch platforms, catchfans and temporary supports will be checked by the representatives of PD of the Project, BCIC on a weekly basis and the contractor on a daily basis any accumulation of building debris on the catchfans and catch platforms should be removed. Any deficiency will be repaired when found necessary. The inspection and repair report records will be provided to the PD of the Project, BCIC.
- The contractor will identify and rectify any unsafe conditions such as partially demolished structural elements and damaged temporary supports before leaving the job site each day.

Emergency Plan

- Emergency telephone numbers will be clearly displayed in a selected locations. In the event of any emergency or accident, the contractor will notify the Police and Fire services Department for assistance. The Contractor will also notify the BCIC.
- At the initial warning of the typhoon or a major storm event, the following will be performed:

- Contractor will secure all scaffold, screen, temporary supports and loose elements on site. The scaffold will be taken down to the prevailing top level of the building.
- All flammable materials will be removed or secured in a safe location.
- No unstable and/or partially demolished structural elements will be left on site. If this is unavoidable, the unstable structure will be braced and secured.

Environmental Precautions

643. The general requirements to minimize environmental impacts from construction sites should also be applied to demolition processes. The following sections contain some of the measures to be adopted:

Air Pollution

644. Concrete breaking, handling of debris and hauling process are main sources of dust from building demolition. Dust mitigation measures complying with the Air Pollution Control Regulations should be adopted to minimize dust emissions. Burning of waste shall not be allowed. Diesel fumes generated by equipment during demolition works should be subject to the control of the Air Pollution Regulations.

Noise

645. Noise pollution arising from the demolition works including, but not limited to, the use of specified powered mechanical equipment (SPME), powered mechanical equipment (PME), such as pneumatic breakers, excavators and generators, etc. scaffolding, erection of temporary works, loading and transportation of debris, etc. affects the site. Silent type PME should be used to reduce noise impact as much as practicable. Demolition activity should not be performed within the restricted hours as established by EPC Contractor and approved by PD, BCIC.

Water

646. The discharge of wastewater from demolition should be treated to the standards as stipulated in the Draft Environmental Conservation Rules 2017 before discharge. EPC contractor should maintain proper control of temporary water supply and an effective temporary drainage system.

Hazardous Material

647. In case of removal of asbestos containing material is needed, an Asbestos Investigation Report (AIR) should be submitted to PD, BCIC by EPC contractor. Otherwise all the asbestos (about 15 tons) should be buried in the project area. An Asbestos Abatement Plan (AAP) should be submitted to the Proponent at least 60 days before the asbestos abatement work commences. The asbestos abatement works should be carried out in accordance with the Hazardous Waste and Ship breaking Waste Management Rules 2011 provided by Ministry of Forest and Environment.

648. Other materials such as LPG cylinders in domestic flats. Toxic and corrosive chemicals and any other hazardous materials have to be identified and properly handled and removed prior to the commencement of the demolition of the buildings. The Environmental Protection Department should be consulted if in case of doubt about the waste classification.

Post Demolition

649. The site should be reestablished to eliminate any potential hazard to the public. The following measures should be considered:

- The site will be levelled and cleared of debris after completion of the demolition. Adequate drainage (temporary) should be provided before implementation of construction works.
- In the case of no immediate redevelopment, the site boundary will be completely enclosed to prevent public access.
- For storing the dismantled infrastructure components, spacious scrap site will be required of temporarily stack or sold out to the relevant vendors.
- Damage to pavement, footpath and other elements within the right of way will be repaired to its original condition prior to the completion of the demolition project.

9.4.2 Green Belt Development Plan

650. Greenbelt development policies are important components of ecosystem based infrastructure development. To maintain ecosystem functions in any built-up areas require open space for proper development of greenbelt. The proposed fertilizer factory is located on the left bank of the Shitalakhya River, which is an Ecologically Critical Area (ECA) where ecosystem needs proper care. A large number (Approximately 3,750) of small to big-sized trees (mostly sapling and juvenile trees) will be felled down during site preparation which may cause significant deterioration of floral and faunal habitat quality (for detail impact please refer Section 7.4). Greenbelt development in the project site can play a significant role in reducing and mitigating the deleterious effect on the local ecosystem. There are usually different kinds of animals and plants in the greenbelt that can improve the atmospheric environment, effectively attenuate traffic and factory noise, provide habitat of a wild animal protection area, increase bio-diversity, store carbon, etc.

651. Proper implementation of greenbelt area requires information on available space for plantation. Satellite image analysis and field work observation found that there might be open spaces available in four different landuse classes such as around the Plant Unit area, Pond area, Rural Settlement and River bank areas. In the rural settlement land corridors, 1m buffer strip plantation can be developed using various fruit species. An ecotone zone with the width of 10m buffer can be developed along both sides of the river bank with large and medium canopy tree species. To increase green space around the ponds, 3 m buffer plantation can be developed with mixed species plantation. In addition, 5 m buffer area can be created around the Plant Unit area. An overview of space available for greenbelt development is mentioned in Figure 9.1. Image analysis shows that approximately 18.22 ha of land is available in the project bounding area where 45,550 individual plant can be planted. This will cost approximately USD 22,398 or Tk. 1,881,432 (1 USD=84 BDT) (Table 9.1). Plantation beyond the Project site can be done by the Proponent as a part of their Corporate Social and Environmental Responsibility (CSER) and inside the Project site for the welfare of the employees of the fertilizer factory for the function of noise attenuation and carbon capture. Such plntation will also support the local wildlife and sustain the local ecosystem in the long run. Based on the identified risk and impact, several management plans related to greenbelt are outlined here. Based on the identified risk and impact, several management plans related to greenbelt are outlined here:

- A greenbelt will be developed around the project site with different types of trees according to the guidance of DoE and Forest Department.
- Development of plantation buffer surrounding the Project area, pond area, rural settlement area and river bank area. Locally grown tree species (both wood and fruit tree

species) such as Mahogoni (*Swietenia mahagoni*) [upper canopy], Koroi (*Albizia saman*) [upper canopy], Nageswar (*Mesua ferrea*) [Middle canopy], Jam (*Syzygium grande*) [Middle canopy], Mango (*Mangifera indica*) [lower canopy], Jackfruit (*Artocarpus heterophyllus*) [lower canopy] should be given priority for plantation. It is recommended to maintain mixture of different canopy layer during plantation. This will enhance the capacity to absorb more carbon from the atmosphere as well as increase habitat area for the resident wildlife. In addition, trees around the factory area will attenuate noise.

- Plantation seedling/sapling should be of good quality. To ensure good quality and cheaper price seedlings, forest department nursery can be considered.
- 2x2 m spacing should be maintained between seedling/sapling so that each individual species have enough space to grow.
- Need to initiate plantation activities outside the project component area such as surrounding the play ground, dormitory lounge and grass land available within the project component area. This will enhance the capacity to absorb more carbon from the atmosphere. This will enhance the capacity to absorb more carbon from the atmosphere and attenuate noise level. Local species with multi-layer canopy species should be given priority.
- Need to create bush cover surrounding the fertilizer industry area to increase habitat area for the wildlife.

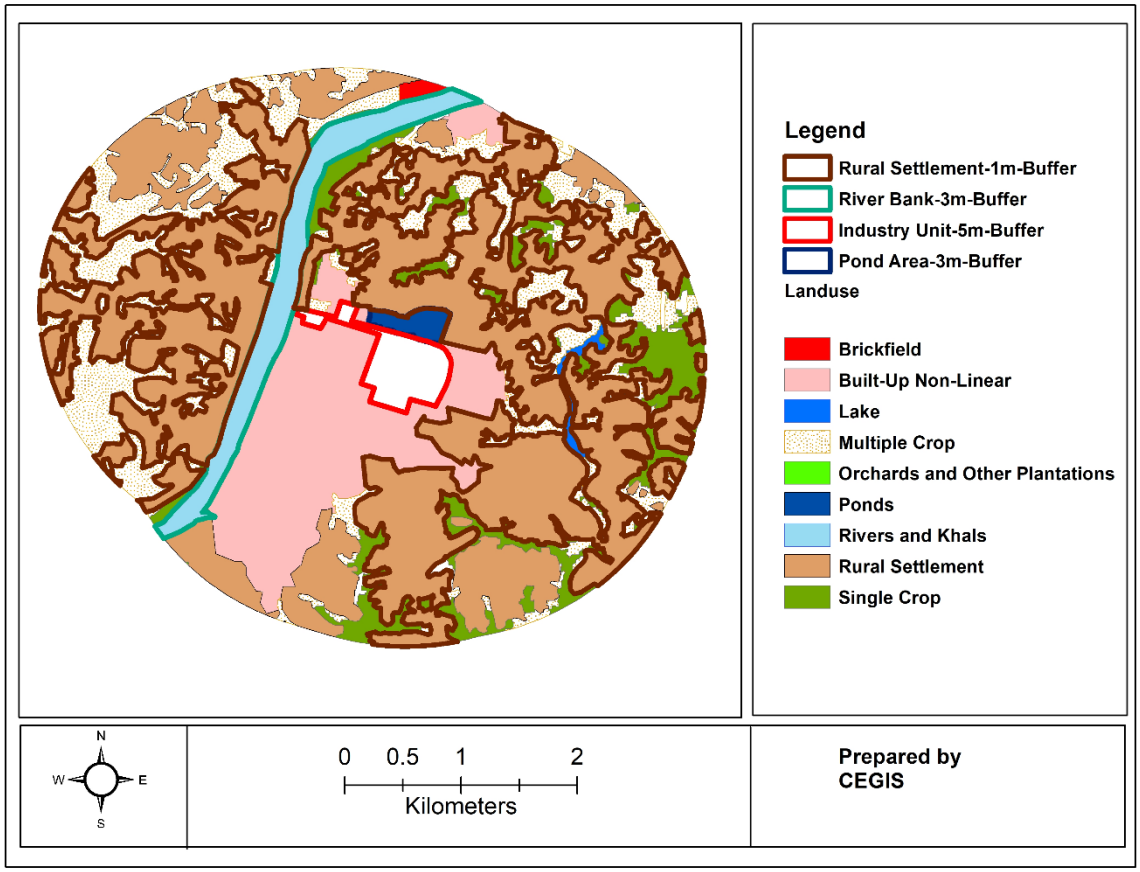


Figure 9.1: Potential Greenbelt Areas in and around the Project site

Table 9.1: Total Cost involves for Greenbelt development activities

Landuse Considered for Greenbelt Development	Plantation Buffer Area (m)	Total Potential Greenbelt Area	Total Seedlings/ha (Considering 2x2 m spacing)	Total Seedlings	Total Cost (USD) [Each seedling Average 0.36 USD regardless of species difference][25]
Rural settlement Area	1 m	12.50 ha	2,500/ha	31,250	11,250
Surrounding the plant area	5m	2.12ha	2,500/ha	5,300	1,908
Surrounding the pond area	3m	0.52 ha	2,500/ha	1,300	468
River Levee	3 m	3.08 ha	2,500/ha	7,700	2,772
Labor Cost for plantation (10 person) [600 USD/Person/3 months]	-	-	-	-	6,000
			Total=	**45,550**	**22,398**

Source: CEGIS estimation based on field findings, 2019

9.4.3 Fisheries Resource

Fish Mortality Management

652. Water intake velocity would be responsible for fish mortality through entraining small sized fishes from the river. For this, maximum 0.3 m/s water velocity should be maintained during the pre-monsoon and monsoon period to mitigate this mortality to some extent. Moreover, double layer strainer should be installed; outer strainer of Strainer with 6-8 mm mesh size should be placed before the intake of water. In addition to these, an additional reservoir should be constructed with regulated canal for conserving fish when dry down of the basin is required. Furthermore, different fish deterrent system could be installed in order to building an environmental barrier for fishes from water intake points. Among the different systems, Acoustic Air Bubble Curtain and Underwater Strobe Lights could be used to protect fish from water intake induced mortality. These technologies are briefly discussed below:

653. **Acoustic Air Bubble Curtains:** Bubble curtains have been used for many years to protect fish from the effects of pressure waves created by explosions from underwater construction (Keevin & Hempen 1997). This system can be deployed in much the same way as a standard air bubble curtain, but its effectiveness as a fish barrier is potentially enhanced by the addition of a sound signal. Bubble curtains are walls of bubbles rising from a bottom-resting bubbler manifold (perforated pipe) supplied with compressed air. When used with sound at an effective frequency, bubble curtains can contain and amplify sounds that repel some species of fish (Kuznetsov 1971; Hocutt 1980). The effectiveness of an acoustic air

[25] This cost is included in the EMP cost estimation in Section 9.7.

bubble curtain depends on several factors, including flow, background noise, and source interactions. Taylor et al. (2005) reported that an acoustic air bubble curtain was 95% effective at holding back bighead carp when tested in a raceway. Overall, little work has been done with bubble barriers relative to other sensory deterrent systems.

654. **Underwater Strobe Lights:** Strobe lights are a widely used type of lighting for fish control. Strobe lights produce flashes of light at rapid rates, depending on the target species and scale of the waterbody and light installation. Small scale systems can consist of an individual cylindrical strobe light (0.16 m length by 0.04 m diameter). Both systems have been shown to alter fish movements in both experimental and field settings for a variety of fish species.

655. The main operating constraints in implementing sensory deterrent systems include flow field conditions, environmental and physical conditions at study sites, cost, scale, and site-specific characteristics. Due to the varying width and depth of a natural stream or river, such a deterrent barrier would need to cover a much wider cross section than just the main river channel; otherwise, may bypass the barrier during high flow conditions. Frequent repair or replacement of underwater equipment for sensory deterrent barriers in channels is anticipated, due to the harsh environment, debris, shifting sand bank and boat traffic.

9.4.4 Rain Water Harvesting Plan

656. Rainwater harvesting is one of the feasible options for fresh water sources in any area of Bangladeshand recently a large number of initiatives were undertaken to promote and install rain water harvestingsystems. These systems are also equally useful in other fresh water 'starved' areas like big cities, hilly areas,arsenic affected areas etc. Dhaka WASA (1998) has shown that rain water can be harvested from the roofareas and used for household use, especially for non-drinking purposes like bathing, washing of clothes, flushing toilets, floor washing etc. It is also found that rain water can be successfully and effectivelyharvested and used in acute water shortage areas of Dhaka city. Rooftop rainwater harvesting (RTRWH) is the most common technique of rainwater harvesting (RWH) for domestic consumption. In rural areas, this is most often done at small-scale. It is a simple, low-cost technique that requires minimum specific expertise or knowledge and offers many benefits.

657. Rainwater is collected on the roof top and transported with gutters to a storage reservoir, where it provides water at the point of consumption or can be used for recharging a well or the aquifer. Rainwater harvesting can supplement water sources when they become scarce or are of low quality like brackish groundwater or polluted surface water in the rainy season. However, rainwater quality may be affected by air pollution, animal or bird droppings, insects, dirt and organic matter. Therefore regular maintenance (cleaning, repairs, etc.) as well as a treatment before water consumption (e.g. filtration or/and disinfection) are very important. UNICEF (2010), showed that such systems can also be built for large communities. Some study also observed thatin severely scarce areas harvested rain water can be used for drinking and cooking leaving other household uses like washing clothes, bathing etc. instead of normal pond water. In a study in thecoastal areas indicated that a 6 m^2 rooftop catchment is able to harvest enough rain water for a family offour. Potential of these systems to be operated commercially.

658. The rainfall pattern over the year plays a key role in determining whether RWH can compete with other water supply systems. Tropical climates with short (one to four month) dry seasons and multiple high-intensity rainstorms provide the most suitable conditions for water

harvesting. In addition, rainwater harvesting may also be valuable in wet tropical climates (e.g. Bangladesh), where the water quality of surface water may vary greatly throughout the year. As a general rule, rainfall should be over 50 mm/month for at least half a year or 300 mm/year (unless other sources are extremely scarce) to make RWH environmentally feasible (HATUM & WORM 2006).

659. It is observed from Figure 6.18 in Chapter 6 that the average monthly rainfall during monsoon (June-September) season from 1980-2017 is 332 mm/month. The variance in the maximum rainfall during monsoon season is 836 mm/month to 552 mm/month, whereas the variance in the minimum rainfall is 136 mm/month to 59 mm/month. This quantity of rainfall deemed sufficient for installation of Rainwater Harvesting System.

Benefits of using rain water:

- Users can maintain and control themselves their systems without the need to rely on other members of the community;
- Local people can easily be trained to build RWH systems themselves. This reduces costs and encourages more participation, ownership and sustainability at community level ;
- Rainwater is better than other available or traditional sources (groundwater may be unusable due to fluoride, salinity or arsenic);
- Costs for buying water and time to extract from the city water supply can be saved;
- Not affected by local geology or topography'
- Almost all roofing material is acceptable for collecting water for household purposes;
- It will greatly help to reduce ground water extraction and drawdown effect;
- The main advantages of a rainwater system are that the quality of rainwater is comparatively good, it is independent and therefore suitable for scattered settlement and the owners/users can construct and maintain the system.

9.5 Mitigation Plan

660. The mitigation plan presented in Table 9.2 which includes various actions, defines responsibilities for implementation, supervision and timing of each actions.

Table 9.2: Mitigation plan

VECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	Supervision
Demolition and Pre-Construction Phase (A)				
Hazardous and non-hazardous waste generation	A1. Generation of approximately 27,400 tons of debris including 15 tons of asbestos cement sheet might create burden on the environment.	▪ Demolition waste (dbris and rubbles) should be carried away by covered dump trucks to the landfill area. ▪ A confinement area should be developed for temporary storage of asbestos cement sheet and rods. ▪ Auction of asbestos cement sheet and rods and take away the sheets and rods by the Vendor. ▪ Water spraying for dust suppression during demolition and debris hauling. ▪ Asbestos containing waste material should be managed following Hazardous Waste and Ship Breaking Waste Management rules 2011 guideline and deposited with proper labeling and packaging. ▪ Asbestos washed water should be collected in a scientific pit and release in the open environment with due treatment. ▪ The labour contractor must follow the OHSAS 18000/18001 guidelines.	Contractor	Owner's Engineer (OE) and Project Implementation Unit (PIU)-BCIC
Ambient air quality	A2. Emission of particulate matte may deteriorate ambient air quality.	▪ Carry out regular dust suppression system at the work site and vehicle movement path; ▪ Introducing vehicular speed limit for controlling dust dispersion. ▪ Ensure using of modern and fuel efficient machinery to avoid incomplete combustion of fuel. ▪ Work site should be surrounded by the gunny sack/tarpaulin/net for safety issue as well as for controlling flying of dust.	Contractor	OE and PIU-BCIC
Ambient Noise Level	A3. Dismantling, demolition, transportation and handling activities may generate noise	▪ Use of modern and low noise generating bulldozer for dismantling of civil structures.	Contractor	OE and PIU-BCIC

VECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	**Supervision**
	and increase the ambient noise level.	▪ Construction of boundary wall around the Project site. ▪ Use low noise generating equipment and process in different activities. ▪ Reduce impulse noise and whistle of vehicles. ▪ Introduce speed limit in and around the Project site.		
Landuse	A4. Modification of ecologically dominant existing industrial landuse to core industrial landuse.	▪ Land optimization should be done during engineering design and vegetation clearance should be limited to as low as possible. ▪ Plantation program should be provisioned as per Forest Department and DoE's Guidelines in the open spaces as per plot layout plan.	Contractor	OE and PIU-BCIC
Waterway traffic	A5. Vessels used for carrying dredged materials might cause conflict with other traffic operations, may create congestion or lead to accidents or disturbance to fishermen.	▪ Notification to communities and river users prior to initiation of transportation of such a large volume of dredged materials to the site; and ▪ Size of the vessel should be compatible with the river conveyance so that collision with other vessels can be avoided.	Contractor	BIWTA and OE-BCIC
Faunal habitat and biodiversity	A6. Existing habitats and animals would be affected during the site preparation activity.	▪ Avoid killing of wildlife during vegetation clearance. ▪ Wildlife pass should be created for their unscared scaping to nearby similar habitat. ▪ Land optimization during engineering design and vegetation clearance should be limited to as low as possible. ▪ Bush cover should be created around the Project area and also outside the project site to create suitable habitat.	Contractor	OE and PIU-BCIC
Terrestrial Vegetation Cover	A8. Loss of vegetation coverage in specific areas of the Project site	▪ Vegetation clearance should be limited to Project Layout area. ▪ Green belt should be developed with native plants for creating vegetation cover surrounding the Project area. ▪ Plantation should be done around the playground, dormitory, roadside, etc. outside the project site under Corporate Social	Contractor	OE and PIU-BCIC

VECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	Supervision
		Responsibility (CSR). This will also enhance the capacity to absorb more carbon from the atmosphere.		
Fish habitat	A9. Disturbances to riverine fish habitat especially during breeding period might be occurred due to carriage of such a huge volume of dredged materials.	▪ Transportation of dredged materials to the Project site should avoid the breeding period (June to August) of fish; and ▪ Bilge water deposited in the vesse hull should not be disposed into the river water. It should be disposed in a pit.	Contractor	BIWTA and OE-BCIC
Food chain	A10. Loosened contaminated dredged materials (sediment) if spilled over into the river water may pose threat to the intervened natural environment (e.g., release of heavy metals into aquatic environment and may enter into the food chain through bio magnification.	▪ Dredged materials to be carried to the site should be tested in the laboratory to determine toxicity levels before transportation to the site; and ▪ If heavy metals are found in the dredged materials, dredging action in the concerned alignment and disposal in the wetland should be avoided for limiting contamination.	Contractor	BIWTA and PIU-BCIC
Employment generation	A11. Creation of direct and indirect jobs (400+) because of hiring staff from the region for demolition activities.	▪ Local people particularly the Project-affected Persons (PAPs) directly or indirectly should be given priority in employing workforces in different Project activities. ▪ Labour wage should be fixed based on the labour market and commodity prices of the area. ▪ Gender issue should be considered in employing labour. ▪ EPC Contractor should abide by the rules and regulations of BLA, 2006; ILO, 1998; EP-III and IFC PS-II.	Contractor	OE and PIU-BCIC
Occupational health and safety	A12. Injuries leading to casualty or death may be caused from the demolition activities. Besides, congested living of workers	▪ Ensure rigorous standards for occupational health and safety are in place. ▪ Establish Occupational Health and Safety (OHS) procedures taking into account the inherent risks for this type of project	Contractor	EHSU/OE-BCIC

VECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	Supervision
	in possible small spaces may cause the break out of contagious disease.	▪ Occupational Health and Safety (OHS) Plan to be implemented based on ECP 13: Workers Health and Safety and World Bank Group's Environment, health and Safety (EHS) Guidelines. ▪ Contractor should establish a labor grievance mechanism and documenting its use for complaints. ▪ EPC Contractor should abide by the rules and regulations of BLA, 2006; ILO, 1998; EP-III and IFC PS-II. ▪ Contractor should also follow relevant IFC Performance Standard (PS) like PS-3 on Resource Efficiency and Pollution Prevention and PS-4 on Community Health, Safety, and Security		
Employment generation	A13. Creation of direct and indirect jobs (600+) because of hiring staff from the region for site preparation activities.	▪ Local people particularly the Project-affected Persons (PAPs) directly or indirectly should be given priority in employing workforces in different Project activities. ▪ Labour wage should be fixed based on the labour market and commodity prices of the area. ▪ Gender issue should be considered in employing labour. ▪ EPC Contractor should abide by the rules and regulations of BLA, 2006; ILO, 1998; EP-III and IFC PS-II.	Contractor	OE and PIU-BCIC
Occupational health and safety	A14. Transportation of construction materials may have different types safety issue including safety from increased traffic, accidents, flying of sand and dust from the carriers, etc.	▪ Schedule of deliveries of material/ equipment should be fixed during off-peak hours. ▪ Depute flagman for traffic control. ▪ Arrange for signal light at night. ▪ Effective traffic management plan by contractor ▪ Local routes will be kept free for use as much as possible.If unavoidable, alternative routes will be identified in consultation with the local community.	Contractor	OE and PIU-BCIC
Construction Phase				
Ambient air quality	B1. Ambient air quality might be deteriorated due to	▪ Carry out regular dust suppression system at the work site and vehicle movement path;	EPC Contractor	OE and PIU-BCIC

VECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	Supervision
	emission of particulate matter from construction works.	▪ Introducing vehicular speed limit for controlling dust dispersion. ▪ Ensure using of modern and fuel efficient machinery to avoid incomplete combustion of fuel. • Work site should be surrounded by the gunny sack/tarpaulin/net for safety issue as well as for controlling flying of dust.		
Ambient Noise Level	B2. Noise emissions resulting from the use of machinery and equipment and vehicle circulation.	▪ Use modern, low noise generating equipment and process, reduce impulse noise and whistle of vehicles ▪ Noise hood should be used where applicable. ▪ Noise generating equipment and machinery should be provided with silencer.	EPC Contractor	EHSU/OE-BCIC
Ground Water Level	B3. Crisis of household level availability of groundwater through hand tube well.	▪ The EPC contractor should ensure use of surface water avoiding groundwater withdrawal. ▪ The proponent should encourage and facilitate introduction of Rainwater Harvesting System (RHS) as a substitute for other local users of GW as part of CSR. ▪ Monitoring should be considered as one of the important components during ground water extraction. ▪ Water supply system should be leakage proof.	EPC Contractor	EHSU/OE-BCIC
Consumptive water requirement (for drinking, washing, bathing, etc.)	B4. Potable water requirement of about 275 m^3 of water per day during construction. This may create extra pressure on the already existing groundwater source.	▪ It is suggested to avoid abstraction of ground water for non-potable and other uses in the labor camp ▪ It is recommended to continue with Reverse Osmosis (RO) Plant throughout the Project period. ▪ Effective and efficient use of water should be ensured. ▪ Reuse of water with due treatment in suitable water use area. ▪ Sludge collection sump should be built.	EPC Contractor	EHSU/OE-BCIC

VECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	Supervision
Sewage/ solid waste management facilities	B5. Generation of about 2,400 m^3 of sewage/ organic solid waste and generation of solid waste (kitchen waste) of about 1,500 kg/day for about 5,530 workers and Project officials) to be generated from the official dorms and labour camp.	▪ The tentatively required dimension of sewage/organic solid waste tank should be 1,750 m^3 capacity of organic solid waste in three years. ▪ The tank should be septic tank for better absorption of liquid by the soil. ▪ Maintain hygienic condition of the water closet (WC) for the next person's use. ▪ Dismantling of septic tank should be done with proper care and release gases arrested in the tank carefully for avoiding casualty. ▪ Proper sanitation should be maintained according to environmental standards.	EPC Contractor	EHSU/OE-BCIC
Drainage congestion	B6. Drainage congestion may be happened	▪ A well engineering designed and modern drainage system should be introduced. ▪ Regular Maintenance of the drainage network should be ensured. ▪ Clearing of drainage network should be done regularly.	EPC Contractor	EHSU/PIU-BCIC
Soil, air and water quality	B7. Solid and liquid waste may be affected by disposal of unplanned solid and liquid waste	▪ Implement ECP 1 Waste Management. ▪ Siting of fuel and hazardous material storage sites, including refueling facilities, batching plants and construction yards are to be located inside the flood embankments. ▪ Hazardous waste will be disposed of following environment friendly manner by designated contractors. ▪ Good housekeeping will be adopted to reduce generation of construction wastes and the potential water pollution.	EPC Contractor	EHSU/PIU-BCIC
Species of conservation significance	B8. Overpressure and sound from pile driving activities may harm riverine animals.	▪ Pile driving should be completed using Best Management. ▪ Conferring with appropriate organizations to determine the preferred timing and methods of the pile driving.	EPC Contractor	EHSU/PIU-BCIC

VECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	Supervision
In-water noise level	B9. Noise from in-water construction along with pile driving generates intense underwater sound pressure waves that will adversely affect riverine organisms including vocalization and behavior of fish, dolphins and other animals.	In case of pre-cast pile driving activities following measures will be applicable: ▪ Use of vibratory hammers instead of impact hammers ▪ Monitoring of underwater noise levels and use of underwater air bubble curtains, metal or fabric sleeves to surround the piles to reduce noise levels if required. ▪ Hydro Sound Damper consists of fishing nets with small balloon filled with gas and foam - tuned to resonant frequencies fixed to it. It can be applied in different ways. ▪ Setting up cofferdam which consists of a rigid steel tube surrounding the pile. Once the pile is stabbed into the cofferdam, the water is pumped out. ▪ Conduct pile driving during low tides in intertidal and shallow subtidal areas. ▪ Implement seasonal restrictions when necessary to avoid construction-related impacts to habitat during species' critical life history stages (e.g., spawning and egg development periods). ▪ Reduce sound pressure impacts during pile installation by using wood or concrete piles, rather than hollow steel piles which produce intense, sharp spikes of sound that are more damaging to fish and dolphins having air cavities. ▪ Underwater noise during piling activities could be carried out with a hydrophone sensor which is normally placed in a water column at least 1 metre deep, with the sensor located at a depth of 0.5 metre above bottom of the water column. 'Reference sound levels from pile driving normally are reported at a fixed distance of 10 meters'.	EPC Contractor	EHSU/PIU-BCIC
Species of conservation significance	B10. Risk of dolphin collision with construction vessels in the river.	▪ Restrict the speed of vessels. ▪ Restrict boat movement within safe distance around the construction site if river width permits. Avoid areas where Dolphins	EPC Contractor	EHSU/PIU-BCIC

VECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	**Supervision**
		are known to congregate (particularly the river pool areas and scouring sites).		
Employment generation	B11. Generation of employment will be maximum 4,000 people of different working levels and expertise.	▪ Local people particularly the Project-affected Persons (PAPs) directly or indirectly should be given priority in employing workforces in different Project activities. ▪ Labour wage should be fixed based on the labour market and commodity prices of the area. ▪ Gender issue should be considered in employing labour. ▪ EPC Contractor should abide by the rules and regulations of BLA, 2006; ILO, 1998; EP-III and IFC PS-II.	EPC Contractor	EHSU/PIU-BCIC
Community health and safety	B13. Increase of equipment carrying heavy vehicle movement on the road may cause noise and vibration affecting workers, project staff and the nearby community.	▪ Construction vehicle movement near settlements will be limited to day time mostly. ▪ High noise producing equipment will be provided with mufflers or acoustic hood/enclosures. ▪ Install acoustic enclosures around generators and install temporary noise control barriers where appropriate to reduce noise levels. ▪ Fit high efficiency mufflers to appropriate construction equipment. ▪ Notify affected communities in advance regarding major noisy operation. ▪ Implement Noise Management Plan.	EPC Contractor	EHSU/PIU-BCIC
Land requirement and dispersion of dust	B14. Quarry/ burrowing activities for river protection works and associated pilling up of extracted earth may require additional land and after being dried up dust particles may be dispersed.	▪ Burrow/quarry areas will be developed close to the project area for extraction of earth material and aggregates for river protection works. ▪ No private lands or agriculture lands will be used for burrowing. ▪ Minimize volume of burrowing material by using dredged material generated from the associated component of the Project.	EPC Contractor	EHSU/PIU-BCIC

VECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	Supervision
		▪ Control of dust and associated air pollution by application of watering method.		
Occupational Health and Safety	B15. Injuries leading to casualty, or death may be caused during transportation of machinery and equipment to site, and their installation/ erection, lifting heavy materials, working at heights, etc.	▪ Proper health and safety training on hazard identification and how to handle hazardous equipment must be provided to the workers before starting any construction activities. ▪ Ensure rigorous standards for occupational health and safety are in place. ▪ Establish Occupational Health and Safety (OHS) procedures taking into account the inherent risks for this type of project. ▪ An on-site medical team should be set up and emergency first-aid kit should be at hand in case of any accidental injuries (burns, cuts, broken bones etc.). ▪ The workers should use the appropriate PPEs. ▪ Ensure workers hygiene and health status. Conduct monthly health check-ups to monitor their health condition and provide appropriate treatment for any ailments. ▪ Need proper danger signs/ posters to prevent accident from occurring at the construction site. ▪ Contractor will establish a labor grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal. ▪ Provide health insurance for employees for the duration of their contracts. ▪ Provide insurance for accidents resulting in disabilities or death of employees for the duration of their contracts ▪ EPC Contractor should abide by the rules and regulations of BLA, 2006; ILO, 1998; EP-III and IFC PS-II.	EPC Contractor	EHSU/PIU-BCIC

VECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	Supervision
Cultural conflicts	B16. Immigrant workers will come from different parts of the country and abroad having cultural diversity, so there will be possible cultural conflicts among workers, and between communities and workers.	To avoid the conflict the EPC contractor will have to develop following things: ▪ Project-level Grievance Redressal Mechanism (GRM). ▪ Worker Code of Conduct in local language(s). ▪ Provision of cultural sensitization training for workers regarding engagement with local community. ▪ Arrangement of separate accommodation with proper security and amusement facilities should be created for the foreigners.	EPC Contractor	EHSU/PIU-BCIC
Increased burden on public service provision	B17. The presence of construction workers and service providers can generate additional demand for the provision of public services, such as water, electricity, medical services, education and social services.	▪ Workers' camps to include wastewater disposal and septic system for managing human excreta. ▪ Identification of authorized water supply source and prohibition of use from other community sources ▪ Separate service providers for community and workers' camp/construction site ▪ Worker Code of Conduct on water and electricity consumption ▪ Contingency plans for temporary rise in demand for utilities and public service provision ▪ Inclusion of relevant provisions in PESMP ▪ Monitoring and taking appropriate actions to ensure CESMP provisions are met ▪ Investment in and capacity building of local public service providers ▪ Implementation support to verify compliance with PESMP and CESMP	EPC Contractor	EHSU/PIU-BCIC

VECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	Supervision
Increased risk of communicable diseases	B18. Increased interactions between the incoming workforce and the local community may result in increasing rates of communicable diseases, including sexually transmitted diseases (STDs) and HIV/AIDS.	▪ Contracting of an HIV service provider to be available on-site; ▪ Implementation of HIV/AIDS education program; ▪ Information campaigns on STDs among the workers and local community; ▪ Education about the transmission of diseases; ▪ Provision of condoms ▪ Inclusion of requirements for education on STD/HIV prevention in the contract; ▪ Establishment or upgrade of health centers at camp and construction sites (unless designated as contractor responsibility); ▪ Free testing facilities; ▪ Monitoring of local population health data, in particular for transmissible diseases; ▪ Monitoring and taking appropriate actions to ensure CESMP provisions are met ▪ Community sensitization campaigns; ▪ Awareness raising about public health impacts from labor influx ▪ Inclusion of relevant provisions in PESMP and Legal Agreement ▪ Provision of advice on expected or likely issues based on Bank experience	EPC Contractor	EHSU/PIU-BCIC
Gender based violence	B19. Construction workers are predominantly younger males. Those who are away from home on the construction job are typically separated from their family and their normal sphere of social control. This can result in inappropriate behavior,	▪ Mandatory and regular training for workers on required lawful conduct in host community and legal consequences for failure to comply with laws; ▪ Commitment / policy to cooperate with law enforcement agencies investigating perpetrators of gender-based violence; ▪ Creation of partnership with local NGO to report workers' misconduct and complaints/reports on gender-based violence or harassment;	EPC Contractor	EHSU/PIU-BCIC

VECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	**Supervision**
	such as sexual harassment of local women and girls and illicit sexual relations with minors from the local community	▪ Provision of opportunities for workers to regularly return to their families; ▪ Provision of opportunities for workers to take advantage of legal entertainment opportunities away from rural host communities ▪ Instruction and equipping of local law enforcement to act on community complaints; ▪ Information and awareness-raising campaigns for community members, specifically women and girls ▪ Inclusion of relevant provisions in PESMP ▪ Monitoring and taking appropriate actions to ensure CESMP provisions are met ▪ Increased security presence in nearby communities; ▪ Reinforcement of police force where needed; ▪ Deployment of female police officers in project area; ▪ Application of long-term community-based approaches to address the issue ▪ Implementation support to verify compliance with PESMP and CESMP		
Public safety	B20. Increased Traffic on local roads will affect access to the trading center and, houses close to the road, deteriorate safety (especially the school children), spillage of fuels and chemicals, and damage to infrastructures and properties due to vibration.	▪ Contractor will implement traffic management plan to ensure uninterrupted traffic movement during construction. ▪ Restrict truck deliveries, where practicable, to day time working hours. ▪ Restrict the transport of oversize loads. ▪ Enforce on-site speed limit, especially close to the sensitive receptors, schools, health centres, etc. ▪ Implement ECP 10: Traffic Management ▪ Inspect structures within the close proximity of construction site for damages.	EPC Contractor	EHSU/PIU-BCIC

VECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	Supervision
Health safety	B21. Operation of heavy equipment and transport vehicles will cause noise and vibration affecting workers and the nearby population.	▪ Construction activities near settlements will be limited to day time only (8AM – 6PM). ▪ High noise producing equipment will be provided with mufflers or acoustic hood/enclosures. ▪ Install acoustic enclosures around generators and install temporary noise control barriers where appropriate to reduce noise levels. ▪ Fit high efficiency mufflers to appropriate construction equipment. ▪ Notify affected communities in advance regarding major noisy operation. ▪ Implement Noise Management Plan	EPC Contractor	EHSU/PIU-BCIC
Operation Phase (C)				
Ambient air quality	C1. Ambient air quality might be deteriorated due to emission of NH3, NOx, PM10, PM2.5 SO2 and CO.	▪ Regular monitoring of emission should be conducted. ▪ Online monitoring should be introduced.	BCIC	EHSU
Ambient Noise Level	C2. Noise generation from cooling tower, boiler, ST, GEG, NH3 Plant, Urea Plant and other utility services which may result disturbances and discomfort to the human helath.	▪ Regular monitoring of noise should be conducted. ▪ Noise hood should be installed where applicable. ▪ Plantation program should be implemented for attenuating noise.	BCIC	EHSU
Surface water availability	C3. Water intake for the operation of the Project	▪ System loss during plant operation should be minimized as much as possible. ▪ Regular O&M should be conducted; ▪ Regular monitoring of dry season water flow should be ensured. ▪ Cooling water should be reused with due treatment. ▪ Rainwater Harvesting System should be installed in the factory level.	BCIC	EHSU

VECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	Supervision
Ground Water Level	C4. Drawdown induced lowering of ground water level may cause crisis of household level availability of groundwater trhough hand tubewell.	▪ The proponent should encourage and facilitate introduction of Rainwater Harvesting System (RHS) as a substitute for other local users of GW as part of CSR. ▪ Monitoring should be considered as one of the important components during ground water extraction. ▪ Water supply system should be leakage proof. ▪ Aquifer recharge could be an effective option through groundwater injection well26 if groundwater drawdown effect is observed. ▪ Whole colony should be supplied with purified surface water for potable use.	BCIC	EHSU
Habitation of aquatic organisms	C7. Raw water abstraction through intake pumps with the designed velocity (0.51 m/s) may destabilize habitation of aquatic organisms including fish and causing the alterations to substrates and aquatic community structure and diversity.	▪ Water intake pipe diameter should be increased to reduce intake velocity to around 0.3 m/s for avoiding fish entrainment. ▪ Double layer strainer of adequate mesh size should be installed around the intake point for . Regular monitoring of dry season water flow should be ensured. ▪ Cooling water should be reused with due treatment. ▪ Rainwater Harvesting System should be installed in the factory level. ▪ System loss during plant operation should be minimized as much as possible.	BCIC	EHSU

26 The U.S. Environmental Protection Agency (EPA) regulates around 850,000 underground injection wells through its Underground Injection Control program under the Safe Drinking Water Act: https://www.americangeosciences.org/critical.../what-underground-injection-wells-use.

VECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	Supervision
Fish mortality	C8. Water intake at the rate of 0.567 m3/s would generate velocity of about 0.51 m/s at (considering 24 m diameter of pipeline) that point may cause entrainment of fish which cannot sustain the resultant velocity.	▪ Maintaining minimum water velocity of 0.3 m/s during pre-monsoon and monsoon period ▪ Strainer with 6 mm mesh size should be placed before the intake of water; ▪ An additional reservoir should be constructed with regulated canal for conserving fish when dry down of the basin required. ▪ Acoustic Air Bubble Curtain using perforated pipe should be installed as a deterrent system for fish in order to be avoiding from water intake point.	BCIC	EHSU
Fish and other aquatic resources	C9. Fishery resources and others aquatic organisms along with benthic habitats may degrade along with the Gangetic River Dolphin.	▪ Minimize NOx emission by using low NOx burner. ▪ Ensure proper operation of Effluent Treatment Plant (ETP) ▪ Reuse of treated water	BCIC	EHSU
Heavy metal accumulation in fish due to effluent discharge	C10. Detritus feeders, marginal small fishes, planktivores and even predator fish would become susceptible to accumulate trace heavy metal	▪ Keep functional ETP and do continuous monitoring for maintaining the accepted limit of heavy metal values in effluent	BCIC	EHSU
Occupational health and safety hazards	C16. Injuries to the workers, even casualty or life loss in case of accident osccur during operation of plants (Amonia & Urea) and dispatch of urea.	▪ Need contingency fund for affected people to address accidental issues during operational period. ▪ Ensure proper emergency response team and facilities in place. ▪ Proper awareness program about possible accidents should be ensured and regular evacuation training for the employees. ▪ PIU will establish a grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal.	BCIC	EHSU
Impact on Public Health and Safety	C17. In case of any serious accident, the Plant may become a risk factor for those	▪ Need contingency fund for affected neighboring people to address accidental issues during operational period ▪ Ensure proper emergency response team and facilities in place	BCIC	EHSU

VECs/Issues	Environmental Impacts	Mitigation Measures	Institutional Responsibilities	
			Implementation	Supervision
	people who are living/working adjacent to it. Particularly, it may cause safety risk to the nearby residential areas, school and offices. It is apprehended that fatalities may take place if any accident occurs.	▪ Proper awareness program about possible accidents should be ensured for the neighboring people ▪ PIU will establish a grievance mechanism and documenting its use for complaints about unfair treatment or unsafe living or working conditions without reprisal.		
Transportation of urea fertilizer	C21. Movement of various Cargoes and Lorries, carrying lube oils, chemicals and other volatile substances, may spill in to the road. Road accidents due to these spilled chemicals may cause injuries to passerby and workers. They may even cause damage to properties and structures. Besides, Vehicular traffic will increase for transporting the produced Urea around the country.	▪ Effective traffic management plan by EPC contractor ▪ Use of modern trucks with silencer for avoiding noise ▪ Regular maintenance of truck engine ▪ Schedule deliveries of material/ equipment during off-peak hours ▪ Depute flagman for traffic control ▪ Arrange for signal light at night ▪ Local routes will be kept free for use as much as possible. If unavoidable, alternative routes will be identified in consultation with the local community.	BCIC	EHSU

9.6 Corporate Social and Environmental Responsibility (CSER)

661. The Corporate Social Responsibility will be suitably planned as per general instructions of the Government of Bangladesh and practices of different corporate bodies. However, the government is set to formulate a common guideline to regulate how profitable companies spend money on Corporate Social and Environmental Responsibility (CSER). The guideline would focus on encouraging CSER processes at the company level and emphasize on how CSER should be integrated into business practices. The Planning Ministry came up with a draft CSR guidelines under the caption of "Developing the National CSR Guideline for Bangladesh" in 2016. The GPUFP will invest in construction of school premises, road networks to villages, conducting medical camps in nearby villages, construction of village ponds, plantation at road sides and other open places etc. The CSER activity for the coming years shall be added to the report after public hearing comments received by the GPUFP.

9.7 Budget for EMP

662. The cost of implementing the EMP is USD 2.92 million. Details of EMP and associated costs are given in Table 9.3.

Table 9.3: Estimated cost of EMP

Sl. No.		Items	Unit	Quantity	Unit Rate (USD)	Amount (USD)
1		**Instrument and Lab facilities to be considered in EPC Contract**				
	1.1	Continuous Ambient Air Quality Monitoring Station (CAAQMS)	No.	2	250,000	500,000
	1.2	Continuous Effluent Quality Monitoring System (CEQMS)	LS	-	-	150,000
	1.3	Noise attenuation measures	LS	-	-	15,000
	1.4	Micro Weather Station	No.	1	40,000	40,000
	1.5	Environmental Laboratory	No.	1	400,000	400,000
	1.6	EHS Staff of Contractor (3)	MM	60	5,000	300,000
	1.7	Contractor's HIV/AIDs Management	LS	-	-	40,000
		Sub-Total=				***1,445,000***
2		**Environment Management Plan**				
	2.1	Air Quality Management Plan	LS	-	-	50,000
	2.2	Plantation Program (Greenbelt)	LS	-	-	22,398
	2.3	Emergency Preparedness and Response Plan	LS	-	-	1,000,000
		Sub-Total=				***1,072,398***
3		**Institutional Arrangements**				
	3.1	EHS Staff of EHSU (6 years)[1]				300,000
	3.2	Capacity Building and Training	LS	-	-	100,000
		Sub-Total=				***400,000***
					Grand Total=	**2,917,398**
Note:	[1]	3 years during construction and 3 years during operation				

Source: CEGIS estimation, 2019

10. Hazard and Risk Assessment

10.1 Introduction

663. Hazard is any substance, phenomenon or situation, which has the potential to cause disruption or damage to people, their property, their services and their environment. Whereas, risk is the probability that negative consequences may arise when hazards interact with vulnerable areas, people, property and environment. Thus a risk assessment is conducted, to carefully examine the potential hazards, how they occur and the measures to prevent such hazards. Mismanagement of one particular hazard can have consequences that simultaneously impact to a varying degree on several risk types.

664. In this chapter, an assessment of probable hazards and risks are done and necessary mitigation measures against the assessed impacts are given. In addition to that, necessary emergency response plans have also been given.

10.2 Consequence Analysis

665. To ensure food security, use of fertilizer for agricultural purposes has been increased over the time period in Bangladesh. This is due to expansion of irrigation facilities and depletion of soil fertility induced by higher cropping intensity and cultivation of high yielding crop varieties. Statistical data reveals that, the major chemical fertilizers used for agricultural purposes are: Urea, TSP, DAP, MP, SSP, Ammonium Sulfate, Zinc Sulfate, Gypsum, and NPKS, of which Urea alone shares 70-75% of the total fertilizer use.

666. The proposed Project is a Urea Fertilizer Factory would be constructed at the PUFFL premise to replacethe existing UFFL and PUFFL. Consequence analysis gives probable health hazards those could be occurred during demolition of the civil structures of the proposed site. Potential hazards have been identified in different stages of the Project, at various points and Project activities. Cause analysis has also been conducted for potential hazards for each of the Project activities. In addition to that, the damage for various release scenarios of toxic and flammable chemicals from ammonia plants during operation of the Project. The flammable substances that could pose hazardous situations are carbon monoxide and ammonia.

10.2.1 Potential Hazard and Risk during Pre-construction, Construction and Erection and Operation

667. Table 10.1 shows potential hazards and risk with their consequences during various period of activities of the proposed Project.

Table 10.1: Potential hazard and risk during pre-construction, construction and erection and operation

Location of hazard	Project Activities	Potential hazard	Root Causes	Consequences
Demolition and Site Preparation Phase (A)				
• GT area and other civil structures	• Demolishing components of the existing fertilizer Plant including power plant, movement of the machinery, equipment and vehicles and other associated activities	• Cuts and bruises • Noise generation	• Lack of safety training • Fatigue or prior sickness of the workers • Not abiding by general health and safety and traffic rules	• Health injury • Disability • Life loss
• Project site	• Vehicle and Bulldozer movement for site preparation	• Noise generation • Air quality deterioration due to dust emission • Exhaust emission	• Running engine, hydraulic horns, sirens etc. • Mechanical failure • Old engine or engine parts/ lack of maintenance • Generating noise from bulldozer due to leveling the land	• Health problems (e.g. respiratory, hearing and/or cardiac problems) • Disabilities
Construction Phase (B)				
• Construction site	• Construction of building, steel structure and its foundation, cutting, welding, painting works, drilling work, etc. • Work at heights	• Accidents (burns, electric shocks etc.) • Injuries from falls and slips • Inhalation of dust • Cuts and bruises • Injuries from falls and slips (e.g. broken bones, fractures, traumas, etc.)	• Fatigue or prior sickness • Electric failure • Equipment failure • Lack of safety protocols (e.g. not putting up warning signs or enclosing the area to prevent entry of outside people) • Not maintaining a designated place for backfilling storage • Not maintaining enough lighting during the night (for those working overtime)	• Physical injury • Disability • Life loss

Location of hazard	Project Activities	Potential hazard	Root Causes	Consequences
	• Vehicle movement	• Noise generation • Accidents • Emission from vehicles • Spread of dust and minute particles due to vehicle movement	• Running engine, hydraulic horns, sirens etc. • Mechanical failure • Old engine or engine parts/ lack of maintenance	• Injuries • Health problems (e.g. respiratory, hearing and/or cardiac problems) • Fatalities • Disabilities
	• Occupational Hazard	• Cuts, bruises and burns • Falls and slips • Health injuries • Sickness and illness	• Lack of safety awareness • Carelessness in maintaining safety protocols • Use of faulty machineries and equipment • Improper hygiene • Prior sickness or illness • Heavy workload	• Health injuries (burns, anxiety, depression etc.) • Disabilities • Fatalities
	• Natural hazard	• Accidents • Injuries from falls and slips • Fire/ explosion due to short circuit	• Earthquake	• Health injury • Disabilities • Casualty
Operation Phase (C)				
• Proposed Project site and surroundings	• Vehicle movement, transportation of chemical, like Sulphuric Acid for the Fertilizer factory	• Accidents • Accidental release of chemicals • Fire/explosion from inflammable chemicals	• Lack of safety protocols (e.g. not putting up warning signs or enclosing the area to prevent entry of outside people) • Lack of safety training • Chemical spillage • Mishandling	• Health injury and casualty due to heavy traffic and carelessness • Health injuries • Property damage • Environmental damage
• Chemical storage area	• Handling of hazardous chemical	• Accidental release of chemicals • Acute/chronic toxicity from exposures to chemicals • Fire/explosion from inflammable chemicals	• Chemical spillage • Chemical fires • Mishandling and misuse • Lack of safety protocols • Carelessness (e.g. smoking near chemical storage area)	• Health injuries (burns, anxiety, depression etc.) • Disabilities • Fatalities • Loss of properties • Degradation of air, water and soil quality

Location of hazard	Project Activities	Potential hazard	Root Causes	Consequences
			• No proper bounding of chemical storage area • Improper chemical storage (e.g. faulty/ leaky containers, improper containers, improper sealing of containers etc.)	
• Hazardous Elements from the Plant	• Hazardous substances used in the ammonia plant • Effluents from ammonia and Urea Plants	• The flammable substances used in ammonia manufacture e.g. nitrogen, water, methane, hydrogen and other toxic substances that could pose hazardous situations • Air emission • Waste water • Wastes • Noise	• Failure of ammonia storage tank • Toxic release from ammonia plant • Unplanned drainage of waste water and wastes from urea plant • Leakage of sulfuric acid and caustic soda along with other chemicals •	• Health injuries • Degradation of air, water and soil quality • Property damage • Environmental damage
	• Producing hazardous elements in the plant	• Nearby waterbodies, paddy field and other vegetation might be affected • Excessive gaseous event may occur • Humans as well as crop field fauna might be affected due to soil contamination	• Excessive ammonia release from the plant • Toxic release from the plant	• Nearby paddy and other vegetation might be burnt • Health hazard • Environmental damage
• Turbine, generator and its ancillary components	• Electricity generation through natural gas based Power Plant	• Mechanical hazard • Fire hazard/ explosion • Electrical hazard • Noise generation	▪ Mechanical failure • Lack of sound buffers	• Health injury • Fatalities • Property damage • Environmental damage
• Non-functional lightning arrestor	• Keeping the equipment safe from lightning.	• Fire hazard	• Malfunction or faulty equipment	• Equipment damage • Fire due to arc flash/arc blast
• Fertilizer factory and in the Power Plants	• Natural hazard	• Accidents • Injuries from falls and slips • Fire/ explosion due to short	• Earthquake	• Health injury • Disabilities • Casualty

Location of hazard	Project Activities	Potential hazard	Root Causes	Consequences
		circuit		• Equipment damage
• Chemical storage area, godown and the Plant location	• Handling of necessary equipment and hazardous chemicals	• Equipment and chemical missing	• Lack of proper maintanence of equipment • Lack of proposer inspection of stogae chemicals, machineries and other important equipment • Lack of safety protocol • Lack of proper safety training	• Fire hazard • Equipment and property damage • Important and costly equipment and chemical like acid might be stolen

10.2.2 Prediction of Hazards through Modeling

668. ALOHA (Areal Locations of Hazardous Atmospheres) software has been used to simulate the consequences of Ammonia storage tank failure. ALOHA is a tool to estimate threat zones associated with hazardous chemical releases, including toxic gas clouds, fires, and explosions. ALOHA has been applied to simulate the following sequential hazards:

- Flammable Area of Vapor Cloud Formation
- Thermal radiation from jet fire
- Thermal radiation from fireball

669. The basic assumptions on climatic condition, site condition and release conditions are provided in the corresponding simulations of the probable hazards. One of the key assumptions is wind direction, which has been considered from 'South' as year round maximum average wind flow. Average Wind speed has been considered as 2.8 m/s at 5 m height. The storage tank will be surrounded by main plant structure and vegetation that may obstruct free flow of wind in the proposed area.

Simulation of Flammable Area of Vapour Cloud Formation

670. The vapour cloud formed from a leakage of storage tank. ALOHA has been applied to estimate the possible flammable area of the vapour cloud. The explosion limit of ammonia is 5% (LEL) - 15% (UEL). The local area of flame can occur even though the concentration is below the lowest explosion limit (LEL). ALOHA considers 60% of the LEL to cause a flame.

671. 60% of the LEL level i.e., 90,000 ppm concentration has been considered as high threat zone (red) of occurring vapor cloud (flammable) and 10% of LEL i.e., 15,000 ppm is considered low threat zone (yellow). The model estimated the threat zone might spread up to 298 m. The details of the simulation results are shown in Figure 10.1 and Table 10.2.

Table 10.2: Threat Zone of Vapor Cloud Formation (Flammable)

Items	Red Threat Zone (meter)	Yellow Threat Zone (meter)
Definition	LOC: = 90,000 PPM Which is equal to the 60% of the Lowest Explosion Limit (LEL) of Ammonia.	LOC: = 15000 PPM Which is equal to the 10% of the Lowest Explosion Limit (LEL) of Ammonia.
Flammable area of vapor cloud formation	92 m	268 m

Source: Findings of ALOHA model done by CEGIS, 2019

Note: LOC: Level of Concern

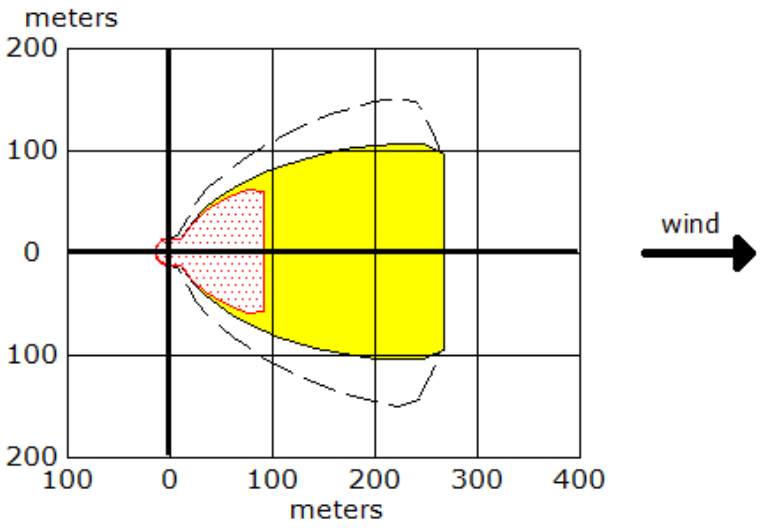


Figure 10.1: Flammable area of vapour cloud formation

SITE DATA:	Location: GHORASAL, NARSINGDI, BANGLADESH
	Building Air Exchanges Per Hour: 0.50 (sheltered single storied)
	Time: December 10, 2018 1226 hours ST (using computer's clock)
CHEMICAL DATA:	Chemical Name: AMMONIA
	Molecular Weight: 17.03 g/mol
	AEGL-1 (60 min): 30 ppm
	AEGL-2 (60 min): 160 ppm
	AEGL-3 (60 min): 1100 ppm
	IDLH: 300 ppm LEL: 150000 ppm UEL: 280000 ppm
	Ambient Boiling Point: -33.4° C
	Vapor Pressure at Ambient Temperature: greater than 1 atm
	Ambient Saturation Concentration: 1,000,000 ppm or 100.0%
ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)	Wind: 2.8 meters/second from S at 3 meters
	Ground Roughness: urban or forest
	Cloud Cover: 5 tenths
	Air Temperature: 28° C
	Stability Class: E (user override)
	No Inversion Height
	Relative Humidity: 50%
SOURCE STRENGTH:	Leak from hole in vertical cylindrical tank
	Flammable chemical escaping from tank (not burning)
	Tank Diameter: 30 meters Tank Length: 21.1 meters
	Tank Volume: 14880 cubic meters
	Tank contains liquid Internal Temperature: 28° C

	Chemical Mass in Tank: 9,315 tons Tank is 95% full
	Circular Opening Diameter: 2 inches
	Opening is 11.6 meters from tank bottom
	Release Duration: ALOHA limited the duration to 1 hour
	Max Average Sustained Release Rate: 2,620 kilograms/min (averaged over a minute or more)
	Total Amount Released: 157,043 kilograms
	Note: The chemical escaped as a mixture of gas and aerosol (two phase flow).
THREAT ZONE:	Threat Modeled: Flammable Area of Vapor Cloud
	Model Run: Heavy Gas
	Red : 92 meters --- (90000 ppm = 60% LEL = Flame Pockets)
	Yellow: 268 meters --- (15000 ppm = 10% LEL)

672. Liquid ammonia leakage from the tank may cause a jet fire if it ignites with fire; come to close proximity of thermal radiation, heat and toxic by-products. ALOHA software has been applied to estimate the threat zone of thermal radiation of the possible jet fire. The Figure 10.2shows the predicted areas of different threat zone and Table 10.3 gives a narrative summary of the prediction.

Table 10.3: Threat Zone of Thermal Heat Radiation of a Jet Fire from gas leak

	Red Threat Zone (meter)	**Orange Threat Zone (meter)**	**Yellow Threat Zone (meter)**
Definition	LOC: 10 kw/m^2 Potentially lethal within 60 sec exposure if ignites	LOC: 5 /m^2 2^{nd} degree burn within 60 sec exposure if ignites	LOC: 2 kw/m^2 Pain within 60 sec exposure if ignites
Heat radiation from jet fire	20 m	34 m	56 m

Note: LOC: Level of Concern

Thermal radiation from jet fire

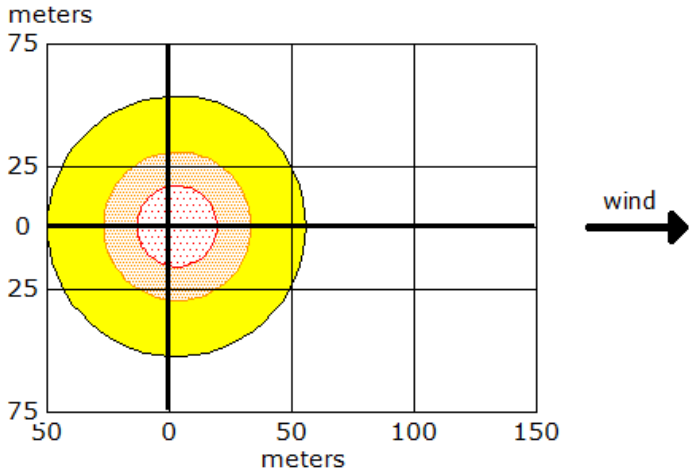


Figure 10.2: Thermal rediation from jet fire

SITE DATA:	Location: GHORASAL, NARSINGDI, BANGLADESH
	Building Air Exchanges Per Hour: 0.50 (sheltered single storied)
	Time: December 10, 2018 1226 hours ST (using computer's clock)
CHEMICAL DATA:	Chemical Name: AMMONIA
	Molecular Weight: 17.03 g/mol
	AEGL-1 (60 min): 30 ppm
	AEGL-2 (60 min): 160 ppm
	AEGL-3 (60 min): 1100 ppm
	IDLH: 300 ppm LEL: 150000 ppm UEL: 280000 ppm
	Ambient Boiling Point: -33.4° C
	Vapor Pressure at Ambient Temperature: greater than 1 atm
	Ambient Saturation Concentration: 1,000,000 ppm or 100.0%
ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)	Wind: 2.8 meters/second from S at 3 meters
	Ground Roughness: urban or forest
	Cloud Cover: 5 tenths
	Air Temperature: 28° C
	Stability Class: E (user override)
	No Inversion Height
	Relative Humidity: 50%
SOURCE STRENGTH:	Leak from hole in vertical cylindrical tank
	Flammable chemical is burning as it escapes from tank
	Tank Diameter: 30 meters Tank Length: 21.1 meters
	Tank Volume: 14880 cubic meters
	Tank contains liquid Internal Temperature: 28° C
	Chemical Mass in Tank: 9,315 tons Tank is 95% full
	Circular Opening Diameter: 2 inches
	Opening is 11.6 meters from tank bottom
	Max Flame Length: 27 meters
	Burn Duration: ALOHA limited the duration to 1 hour
	Max Burn Rate: 2,620 kilograms/min
	Total Amount Burned: 157,043 kilograms
	Note: Ammonia escaped from the tank and burned as a jet fire.
THREAT ZONE:	Threat Modeled: Thermal radiation from jet fire

Red : 20 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)

Orange: 34 meters --- (5.0 kW/(sq m) = 2nd degree burns within 60 sec)

Yellow: 56 meters --- (2.0 kW/(sq m) = pain within 60 sec).

10.3 Ecological/Habitat Risk Assessment

10.3.1 General

673. Habitats and species provide essential benefits for people, including regulating, material, and non-material services. For example, wetland ecosystem provides valuable ecosystem services including breeding and rearing habitat for fish and shellfish, control pollution by absorbing excess nutrients and sediment, habitat for rare and endangered species and protection from flood by storing excess rain water. However, these valuable habitats are degrading due to increased human activities. Therefore, an understanding of the intensity of human impacts on valuable habitat ecosystems is an essential component of informed and successful terrestrial and aquatic resources management. Hence, the overall aim of this section of the report is to assess preliminary habitat/ecological risk due to fertilizer industry construction in Ghorasal area of Bangladesh.

10.3.2 Ecosystem Risk Assessment (ERA) Process

674. A quantitative ecological risk assessment matrix was applied for assessing the combined risk to habitats from fertilizer industry activities. Based on field observation, ecosystem risk was estimated.This was developed based on the cumulative impact and risk assessment literature for ecosystem components. These include different criteria for quantifying exposure and consequence. To estimate exposure of habitats to development activities, it requires information on (1) spatial and (2) temporal overlap between habitats and activities, (3) intensity of the activity and (4) effectiveness of management strategies for reducing exposure (Appendix10.1). To estimate the consequence of exposure to human activities, the ERA process requires information about habitat-specific sensitivity to different activities and life history characteristics of the different taxa. So, the consequences criterion encompasses (1) change in area, (2) change in structure, (3) frequency of natural disturbance, and (4) resilience. For biotic habitats the resilience criterion encompasses the mortality, recruitment (e.g. artificial/natural) rate and recovery time of the habitat forming species. For non-living habitats, whose resilience cannot be captured through demographic rates, resilience is evaluated through estimates of recovery time to pre-disturbed conditions. The ERA produces exposure and consequence scores on a scale of 1 (lowest) to 3 (greatest) risks. Total of five sensitive habitat/ecosystems (i.e. Pond, Agricultural land, Homestead, Terrestrial Vegetation, River, and Beels) were identified during field visit.

10.3.3 Ecological Risk Assessment Findings

675. Ecological risk assessment matrix shows that waterbodies, terrestrial vegetation and agricultural crop area will be at moderate to high risk due to tree felling, emission of toxic elements and water withdrawal from river (Table 10.4). High risk of terrestrial vegetation destruction can be minimized through green belt development and bush regeneration. Water bodies will also be at high risk due to emission of toxic elements and water withdrawal from

the river. The river water is mainly used for operating different industries like power plants, existing fertilizer factories, food processing, etc. along with irrigation in the surrounding agricultural field. The net intake of surface water from the Shitalakhya River for the proposed Project will beabout1,020 t/h (0.283m^3/s), whereas the gross intake will be about 2,040 t/h (0.567m^3/s). This net amount is much lower than the existing intake of the fertilizer factories (2,100 t/h (0.583 m^3/s) and it is only 0.34% of the discharge (83 m^3/s) of the river.Recently, the local people are using a combination of ground water and surface water for irrigation. According to the locals, they need to extract ground water from 300 feet deep (91.4 m), the depth is increasing day by day. All these issues creating risk to the river fishery and other aquatic resources (e.g. river dolphin) as well as surrounding agricultural ecosystem. Effective management approach such as effluent treatment plant, low NOx burner and open recirculation cooling machine will minimize the risk.

Table 10.4: Potential cumulative ecosystem risk due to Fertilizer Industry construction in the Project Site

		Exposure criteria			Consequence criteria sensitivity			Consequence criteria—resilience		
Habitat/Ecosystem Name	Stressor Name	Spatial overlap	Intensity	Management effectiveness	Area Change	Structure Change	Disturbance Frequency	Mortality	Recruitment	Recovery time
Pond	Tree harvesting	0	0	0	0	0	0	0	0	0
Pond	Noise emission	0	0	0	0	0	0	0	0	0
Pond	Emission of toxic elements	2	2	1	0	0	3	3	1	1
Pond	Water withdrawal from river	0	0	0	0	0	0	0	0	0
Agricultural land	Tree harvesting	0	0	0	0	0	0	0	0	0
Agricultural land	Noise emission	0	0	0	0	0	0	0	0	0
Agricultural land	Emission of toxic elements	2	3	1	0	0	2	3	0	1
Agricultural land	Water Withdrawal from river	3	3	1	0	0	3	1	0	1
Terrestrial vegetation	Tree harvesting	2	3	1	3	3	0	3	1	2
Terrestrial vegetation	Noise emission	0	2	1	0	0	3	0	1	0
Terrestrial vegetation	Emission of toxic elements	2	3	1	0	0	2	2	1	1
Terrestrial vegetation	Water withdrawal from river	0	0	0	0	0	0	0	0	0
River	Tree harvesting	0	0	0	0	0	0	0	0	0
River	Noise emission	0	0	0	0	0	0	0	0	0
River	Emission of toxic elements	3	3	1	0	0	2	3	1	1
Rivers	Water withdrawal from river	3	3	1	0	0	3	2	0	2
Homestead	Tree harvesting	0	0	0	0	0	0	0	0	0
Homestead	Noise emission	1	1	1	0	1	1	0	1	0
Homestead	Emission of toxic elements	2	1	1	0	0	2	1	1	1
Homestead	Water withdrawal from river	0	0	0	0	0	0	0	0	0
Beels/haors	Tree harvesting	0	0	0	0	0	0	0	0	0
Beels/haors	Noise emission	0	0	0	0	0	0	0	0	0

		Exposure criteria			Consequence criteria sensitivity			Consequence criteria—resilience		
Habitat/Ecosystem Name	Stressor Name	Spatial overlap	Intensity	Management effectiveness	Area Change	Structure Change	Disturbance Frequency	Mortality	Recruitment	Recovery time
Beels/haors	Emission of toxic elements	1	1	1	0	0	0	1	1	1
Beels/haors	Water withdrawal from river	0	1	1	0	0	2	1	1	0

Note: Low Risk-1, Medium Risk-2, High Risk-3, 0-No Risk/Not Applicable

10.3.4 Hazard Consequence & Frequency Scales

676. The potential impacts of the Project have been scaled and prioritized based on the magnitude of those potential impacts (consequence) and the likelihood of them occurring (frequency). The consequence of the said impacts have been classified and illustrated in Table 10.5.

Table 10.5: Hazard Consequence Scale

Parameter	1(Insignificant)	2(Minor)	3(Moderate)	4(Major)	5(Catastrophic)
Duration of potential impact	Temporary with no detectable potential impact	Limited to construction period	Medium Term (1 to 2 years)	Long term (more than 2 years)	Permanent Damage
Spatial extent of the potential impact	Specific location within Project component or site boundaries with no detectable potential impact	Within Project boundary	Beyond immediate Project components, site boundaries or local area	Widespread far beyond Project boundaries with some community and wildlife habitat coverage	Beyond Project boundaries extending to widespread communities and wildlife habitat
Reversibility of potential impacts	Baseline remains almost constant	Baseline returns naturally or with limited intervention and within a few months	Potential impact requires a year or so for recovering with some interventions to return to baseline	Potential impact is long-term, requiring considerable intervention to return to baseline	Potential impact is effectively permanent, with little to no chance of returning to baseline
Compliance to Legal Standards before Mitigation Measures	Complies with all minimum requirements only some improvement opportunities to strengthen good practices	Meets minimum national standard limits or international guidelines	Complies with limits given in national standards but breaches international lender guidelines in one or more parameters	Complies partially with limits given in national standards but breaches international lender guidelines	Completely breaches national standards and or international guidelines/ obligations
Extent of health injuries	Minor pain, scratch, discomfort requiring no medical attention	Health injuries can be cured with first aid and/or some medical attention	Health injury requires hospitalization; may require long term recuperation; may lead to long term absence from work	Health injury may lead to permanent disability; few fatalities of workers and/or community people	Fatalities of workers more than 5 and or community people more than 2

Parameter	1(Insignificant)	2(Minor)	3(Moderate)	4(Major)	5(Catastrophic)
Impact on wildlife	Minimal disturbance within compliance	Disturbing habitat of wildlife causing discomfort	Disturbing habitat of wildlife causing decrease of prey animals and forcing them to relocate	Impact leading to deaths of any endangered species and decrease of their food source	Impact may lead to deaths of 2 or more endangered marine mammals and/or 5 of other endangered species

677. Criteria for determining the frequency of occurrence of the potential hazard being occurred are outlined in Table 10.6.

Table 10.6: Criteria for Determining Frequency of the Potential Hazard

Frequency Scale Determination	Definition
1 (Rare)	Rare chance of occurrence, if not at all
2 (Low)	Very minimal chance of occurring
3 (Medium)	May occur considering if the conditions are abnormal or exceptional
4 (High)	Occurs more frequently and without any prior warnings
5 (Almost Certain)	Occurs under typical conditions

10.3.5 Developing Risk Matrix

678. Following the consequence and frequency scales, a risk matrix can be developed after analyzing the potential hazards for the Project. Table 10.7 shows the risk matrix for the potential hazards and how frequently they may occur. In Table 10.8, the risk evaluation based on the type of activities and potential hazards are shown.

Table 10.7: Risk Matrix of Potential Hazards/Impacts

Frequency (F) of Hazards ↓	Hazard Consequence (C) →				
	1 (Insignificant)	**2 (Minor)**	**3 (Moderate)**	**4 (Major)**	**5 (Severe)**
1 (Rare)	1	2	3	4	5
2 (Low)	2	4	6	8	10
3 (Medium)	3	6	9	12	15
4 (High)	4	8	12	16	20
5 (Almost Certain)	5	10	15	20	25

Color Legend:

Red (15-25)	≡ Top Priority	:	Action with follow-up verification & validation by authority needed before allowing work
Orange (10-14)	≡ High Priority	:	Action needed under follow-up supervision before allowing work
Yellow (5-9)	≡ Medium Priority	:	Require maintaining with routine monitoring & reporting
Green (1-4)	≡ Low Priority	:	Only for awareness; no intervention action needed to start work

679. Based on the National Health Service (NHS) 2008, the risk for the potential hazard/impact is evaluated considering the combination of the hazard consequence and their frequency. In order to calculate the potential risk, the frequency of impact is multiplied with consequences; e.g. Level 1 of frequency of an hazard (Rare) is multiplied with Level 1 of hazard consequence (insignificant) to give a total score of 1 (1X1=1) and so on. In that regards, a score from 1 to 4 is considered low priority; a score from 5 to 9 is considered medium priority and; a score from 10 to 14 is considered high priority; and a score from 15 to 25 is considered top priority.

10.4 Risk Mitigation Measures

680. Based on the hazard consequence and frequency scales in Table 10.6 and Table 10.7 potential risk of a particular hazard/ impact is estimated and given a score. The score is given in terms of the presence and absence of safeguards. The final evaluation of the potential risks is determined based on the combined score of hazard magnitude and its frequency. Table 10.8 shows the risk evaluation (risk ranking) according to the Project activities and its subsequent hazards (both before and after implementing necessary mitigation measures).

Table 10.8: Hazard consequence and frequency scales

Location of hazard	Project Activities	Potential hazard	Cause Analysis	Hazard Consequence (Before Safety Measures)	Hazard Frequency (Before Safety Measures)	Risk Ranking (Evaluation) (Before Safety Measures)	Suggested Safety measures (Risk Management Plan)	Hazard Consequence (After Safety Measures)	Hazard Frequency (After Safety Measures)	Risk Ranking (Evaluation) (After Safety Measures)
Demolition and Site Preparation Phase (A)										
• Machinery, necessary equipment and existing factory are to be shut down	•Demolishing components of the existing fertilizer Plant including power plant, movement of the machinery, equipment and vehicles and other associated activities	• Trips and falls • Cuts and bruises • Noise generation	• Mechanical failure • Lack of safety training • Fatigue or prior sickness of the workers • Not abiding to general health and safety and traffic rules	3	3	**9**	• Proper safety training should be provided to all construction workers and lorry drivers, including the proper use of PPEs, before demolishing and associate other activities • Arranging toolbox meeting before going out for work • Regular inspection and maintenance of equipment • A thorough lorry driver selection process via interviews, checking whether they have the proper licenses and from past experiences • Training of traffic rules and regulation, including maintaining vehicle speed limit for different categories of road after the selection process is complete • Limiting movement of vehicles after sunset and before sunrise	2	1	2
• Land development	• Vehicle and Bulldogger movement	• Noise generation • Air quality deterioration due to dust emission	• Running engine, hydraulic horns, sirens etc. • Mechanical failure • Old engine or engine parts/ lack of maintenance • Generating noise from bulldogger due to leveling the land	2	3	**6**	• Spraying water on dust at the plant site to minimize the moving particles in air due to vehicle movement and leveling the soil. • Switch off engines/ equipment when not in use. • Workers should use ear plugs and mask while working	1	1	1
Construction Phase (B)										
• Construction Site	• Construction of building, steel structure and its foundation, placement generators, cutting, welding, painting works, drilling work, etc.	• Accidents (burns, electric shocks etc.) • Injuries from falls and slips (e.g. broken bones, fractures, traumas, etc.) • Injuries from falling of heavy objects/ machineries • Inhalation of dust • Cuts and bruises	• Fatigue or prior sickness • Electric failure • Equipment failure • Lack of safety protocols (e.g. not putting up warning signs or enclosing the area to prevent entry of outside people) • Not maintaining a designated place for backfilling storage • Not maintaining enough lighting during the night (for those working overtime)	3	2	**6**	• Arranging toolbox meeting before going out for work (during each construction activity.). • A safety checklist with safety permit should be provided to each worker based on their works, before starting any activities. • Regular inspection and maintenance of equipment, machineries are must. • A registry file should be maintained for all equipment so that if there is any fault, necessary action can be taken instantly; • No work should be done until the faulty machineries are replaced and	2	2	4

Location of hazard	Project Activities	Potential hazard	Cause Analysis	Hazard Consequence (Before Safety Measures)	Hazard Frequency (Before Safety Measures)	Risk Ranking (Evaluation) (Before Safety Measures)	Suggested Safety measures (Risk Management Plan)	Hazard Consequence (After Safety Measures)	Hazard Frequency (After Safety Measures)	Risk Ranking (Evaluation) (After Safety Measures)
							tested properly. • Proper safety training should be provided to all workers as well as the employees those work in the construction site including the proper use of PPEs during work • The construction area should be enclosed with yellow barricade tape to restrict local people in the site during the whole construction process. • Spraying water on dust at the plant site to minimize the moving particles in air due to vehicle movement and leveling the soil. • Put stockpile at a designated place and cover them with GI sheet; put up GI sheet fencing around the construction site. • Equipment, machineries and electric wires should be checked for current and voltage ratings. • Recording of any unusual activities and issuance of fines or suspensions if any rules are broken			
	• Work at heights • Lifting of machineries and equipment from tall heights	• Accidents • Injuries from falls and slips (e.g. broken bones, fractures, traumas, etc.) • Fatalities	• Fatigue or prior sickness • Lack of safety protocols (e.g. not putting up warning signs or enclosing the area to prevent entry of outside people) • Lack of awareness for abiding health and safety rules • Use of limited light during the night	4	2	**8**	• Proper safety training should be provided to all workers including the proper use of PPEs during Lifting of machineries and equipment from tall heights • Recording of any unusual activities and issuance of fines or suspensions if any rules are broken • Maintenance of an accident registry book. • Not allowing workers working in dimly lit areas. Appropriate warning signs must be placed in hazard prone working areas with the hazard signs being fluorescent and perfectly readable from 3-4 meter distance. • Restricting workers from working without appropriate safety measures in place during night times (e.g. wearing appropriate PPEs and safety harness etc.). • Maintaining a registry on who is working night shifts and where. • Overtime hours should be restricted	3	2	**6**

Location of hazard	Project Activities	Potential hazard	Cause Analysis	Hazard Consequence (Before Safety Measures)	Hazard Frequency (Before Safety Measures)	Risk Ranking (Evaluation) (Before Safety Measures)	Suggested Safety measures (Risk Management Plan)	Hazard Consequence (After Safety Measures)	Hazard Frequency (After Safety Measures)	Risk Ranking (Evaluation) (After Safety Measures)
							to no more than two hours per day as per Bangladesh Labour Rules, 2015 (Chapter 9, article 99).			
	• Vehicle movement	• Noise generation • Accident • Emission from vehicles • Spread of dust and minute particles due to vehicle movement.	• Running engine, hydraulic horns, sirens etc. • Mechanical failure • Old engine or engine parts/ lack of maintenance	3	2	**6**	• Regular inspection and maintenance of equipment, machineries and vehicles. • Training of traffic rules, including maintaining vehicle speed limit for different categories of roads. • Spraying water on dust at the plant site to minimize the moving particles in air due to vehicle movement and leveling the soil. • Regulate the use of hydraulic horns during construction. Set a limit on the amount of noise generated as stipulated in schedule III of ECR, 1997. • Switch off engines/ generators/ equipment when not in use.	2	1	**2**
	• Occupational Hazard	• Fire caused by mechanical/ electrical failure of generators • Fire caused by mechanical/ electrical failure of vehicle oil and storage tanks • Cuts, bruises and burns • Falls, slips and trips • Health injuries • Sickness and illness • Suffocation • Falling of debris • Release of toxic fumes	• Lack of proper maintenance of machineries, equipment, storage tanks and vehicles • Lack of safety awareness • Carelessness in maintaining safety protocols • Use of faulty machineries and equipment • Improper hygiene • Prior sickness or illness • Heavy workload	4	2	**8**	• Regular inspection and maintenance of equipment, machineries, vehicles and acetylene cylinders. • Training on how to use/ handle acetylene welding machines. • Ensure proper usage of PPEs (gloves, safety mask etc.) before commencement of welding works. • Ensure firefighting equipment such as fire extinguishers are at hands reach in case of a minor fire breakout. • In case of severe fire break out, raise alarm and notify appropriate authorities and nearby firefighting departments. • Raising awareness on occupational hazards. Arrange monthly health and safety training, electrical safety training and firefighting drills to all construction workers • Maintenance of hygiene at construction site and providing appropriate training to workers in hygiene maintenance • Supplying workers with safe drinking water • Monthly health checkup of workers for any sickness or illness. Provide	3	1	**3**

Location of hazard	Project Activities	Potential hazard	Cause Analysis	Hazard Consequence (Before Safety Measures)	Hazard Frequency (Before Safety Measures)	Risk Ranking (Evaluation) (Before Safety Measures)	Suggested Safety measures (Risk Management Plan)	Hazard Consequence (After Safety Measures)	Hazard Frequency (After Safety Measures)	Risk Ranking (Evaluation) (After Safety Measures)
							treatment/consultation accordingly. In serious cases of injuries or sickness, an ambulance should be on standby for transporting them to nearby hospital. • Work load should be managed effectively. Workers working every 2 hours should be given a mandatory 30 minutes break as stipulated in chapter 9 of Bangladesh Labour Rules, 2015[27]. • Employment of child labour (children below the age of 18), pregnant women and elder citizens in hard labour and dangerous activities must be prohibited. • All other facilities (toilet, canteen, overtime hours, leaves etc.) should be followed as stipulated in Labour Rules, 2015			
	• Natural hazard	• Accidents • Injuries from falls and slips • Fire/ explosion due to short circuit	• Earthquake	3	2	**6**	• Awareness should be raised • Necessary training should be provided on handling the hazardous situations	1	2	**2**
Operation Phase (C)										
• Proposed Project site and surroundings	• Vehicle movement, transportation of chemical, like Sulphuric Acid for the Fertilizer factory	• Road accidents due to huge vehicle movement • Accidental release of chemicals • Fire/ explosion from inflammable chemicals	• Chemical spillage and fires • Mishandling and misuse • Lack of safety protocols • Mishandling chemicals for storage • Carelessness	4	2	**8**	• Awareness should be raised • Necessary training should be provided on handling the hazardous situations • Employment of child labour (children below the age of 18), women and elder citizens for carrying chemicals to the storage areas must be prohibited • Putting up “chemical hazard” warning sign in the entry of chemical storage areas. • Speed of vehivles should be in limit at the proposed Project site and surroundings	2	2	**4**
• Chemical storage area	• Handling of hazardous chemical	• Accidental release of chemicals • Acute/chronic toxicity from exposures to chemicals	• Chemical spillage • Chemical fires • Mishandling and misuse • Lack of safety protocols • Carelessness (e.g. smoking	4	3	**12**	• Avoid siting ammonia storage tanks close to installations where there is a risk of fire or explosion; • Install automated fire alarms and fire hydrant system in the Chemical	3	2	**6**

[27] Bangladesh Labour Rules (2015). *Ministry of Labour and Employment*. Retrieved from http://www.dpp.gov.bd/upload_file/gazettes/14079_83432.pdf.

Location of hazard	Project Activities	Potential hazard	Cause Analysis	Hazard Consequence (Before Safety Measures)	Hazard Frequency (Before Safety Measures)	Risk Ranking (Evaluation) (Before Safety Measures)	Suggested Safety measures (Risk Management Plan)	Hazard Consequence (After Safety Measures)	Hazard Frequency (After Safety Measures)	Risk Ranking (Evaluation) (After Safety Measures)
		• Fire/explosion from inflammable chemicals Fire hazard/ explosion • Electrical hazard • Noise generation	near chemical storage area) • No proper bounding of chemical storage area • Improper chemical storage (e.g. faulty/leaky containers, improper containers, improper sealing of containers etc.)				storage room, where is the storage of flammable and/or combustible chemicals. • Use refrigerated storage for large quantities of liquid ammonia since the initial release of ammonia in the case of line or tank failure is slower than in pressurized ammonia storage systems; • Putting up “chemical hazard” warning sign in the entry of chemical storage areas. • Set up awareness programs on how to handle/store chemicals. • Leaked and faulty containers are to be changed immediately if found • Labeling chemical storage containers for easy recognition. Chemical containers should be labeled with appropriate warning labels (e.g. corrosive, toxic, flammable etc.) • All flammable or corrosive chemicals should be stored separately and should have proper bounding • A fire extinguisher/ fire hydrant should be installed nearby in case of any fire breakout. • Implement and maintain a specific Emergency Management Plan providing guidance on emergency measures to protect both operators and local communities in the event of toxic ammonia releases. • Emergency contact details for fire fighters and ambulance service should also be placed there. • In case of a spillage, keep flammable substance away from the spillage area and inform on site EPC contractor immediately. • Recording of any unusual activities and issuance of fines or suspensions if any rules are broken.			
• Hazardous Elements from the Plant	• Hazardous substances used in the ammonia plant • Effluents from Urea Plants	• The flammable substances used in ammonia manufacture e.g.	• Failure of ammonia storage tank • Toxic release from ammonia plant	4	3	**12**	• Implement maintenance programs, particularly in stuffing boxes on valve stems and seals on relief valves, to reduce NH_3 releases.	3	2	**6**

Location of hazard	Project Activities	Potential hazard	Cause Analysis	Hazard Consequence (Before Safety Measures)	Hazard Frequency (Before Safety Measures)	Risk Ranking (Evaluation) (Before Safety Measures)	Suggested Safety measures (Risk Management Plan)	Hazard Consequence (After Safety Measures)	Hazard Frequency (After Safety Measures)	Risk Ranking (Evaluation) (After Safety Measures)
		methane, hydrogen and other toxic substances that could pose hazardous situations • Air emission • Waste water • Wastes • Noise	• Unplanned drainage of waste water and wastes from urea plant				• Improve evaporation heater/ separator design to minimize urea entrainment; • Remove NH_3, CO_2, and urea from the process water in a process water treatment unit, and recycle the gases to the synthesis to optimize raw material utilization and reduce effluents; • Provideadequate storage capacity for plant inventory to preparefor plant upsetand shutdown conditions; • Install submerged tanks to collect plant washings and other contaminated streams from drains for recycling to process or conveying to the process water treatment unit. • Segregate process areas, storage areas, utility areas, and safe areas, and adopting of safety distances.			
	• Producing hazardous elements in the factory	• Nearby paddy field and other vegetation might be affected • Excessive gaseous event may occur • Humans as well as crop field fauna might be affected due to soil contamination	• Excessive ammonia release from the plant • Toxic release from the plant	4	3	**12**	• Implement maintenance programs, particularly in stuffing boxes on valve stems and seals on relief valves, to reduce NH_3 releases. • Arresting ammonia in the plant and bottling ammonia for other effective uses could be an effective measure. • Effluent should pass through the ETP and oily water should pass through the oil separator.	3	2	**6**
• Turbine, generator and its ancillary components	• Electricity generation through natural gas based Power Plant	• Mechanical hazard • Leakage of fuel • Fire hazard/explosion (if in contact with an ignition source) • Electrical hazard • Noise generation	• Mechanical hazard • Fire hazard/ explosion • Electrical hazard like short circuit • Noise generation • Engineering design fault	4	2	**8**	• Regular inspection and maintenance of equipment, machineries and especially, safety harness. Maintain a registry for any faulty equipment found; inform site contractors and have those replaced immediately. No work should be done until the faulty machineries are replaced and tested. • Using circuit breakers to prevent any damages caused by sudden electrical surges	2	2	**4**
• Non-functional lightning arrestor	• Keeping the equipment safe from lightning.	• Fire hazard	• Malfunction or faulty equipment	3	2	**6**	• Regular inspection and maintenance of equipment, machineries and especially, safety harness.	2	2	**4**
• Fertilizer factory and in	• Natural hazard	• Accidents	• Earthquake	3	2	**6**	• The Fertilizer Factory including	2	2	**4**

Location of hazard	Project Activities	Potential hazard	Cause Analysis	Hazard Consequence (Before Safety Measures)	Hazard Frequency (Before Safety Measures)	Risk Ranking (Evaluation) (Before Safety Measures)	Suggested Safety measures (Risk Management Plan)	Hazard Consequence (After Safety Measures)	Hazard Frequency (After Safety Measures)	Risk Ranking (Evaluation) (After Safety Measures)
the Power Plants		• Injuries from falls and slips • Fire/ explosion due to short circuit					Ammonia Plant will be constructed considering the BNBC Code. • Awareness should be build up • Necessary training should be provided on handling the hazardous situations.			
• Chemical storage area, godown and the Plant location	• Handling of necessary equipment and hazardous chemicals	• Fire hazard • Equipment and property damage • Important and costly equipment and chemical like acid might be stolen	• Lack of proper maintanence of equipment • Lack of proposer inspection of stogae chemicals, machineries and other important equipment • Lack of safety protocol • Lack of proper safety training	3	2	**6**	• Regular inspection and maintenance of equipment, machineries and especially, safety harness. • Recording of any unusual activities and issuance of fines or suspensions if any rules are broken. • Emergency contact details for fire fighters or any human made hazard i.e any missing case is identified should also be placed there • CC TV camera footage may be used for monitoring the important places including the store house and inside the plant • Responsible persons as guard may be hired for safety issues. • The plant site must be kept as restricted and proper documents must be shown to the guard if it is necessary to enter the plant site.	2	1	**2**

10.5 Disaster Management Plan

681. The process that helps us to combat disasters efficiently, timely and effectively is commonly known as disaster preparedness. The disaster management plan is formulated with broad objective of safeguarding human life and minimizing human sufferings and property losses by localizing the emergency and to eliminate it as far as possible. History shows that where communities get prepared adequately to confront disasters, losses to life and property have been less and environment could be protected. There are three key stages of activities in disaster management:

a) Before a Disaster (Pre Disaster): To develop the capacity and create resilience in the community (nearby villagers and municipality people along with colony people) and responders to minimize human, material or environmental losses caused by hazards.

b) During a Disaster: To ensure that the needs and provisions of victims are met to alleviate their sufferings. Therefore, treatment, transport, firefighting facilities should be kept arranged.

c) After a Disaster (Post Disaster): To achieve rapid and durable recovery which does not reproduce the original vulnerable conditions.

682. BCIC is currently running many fertilizer plants in Bangladesh. The Emergency Preparedness Plan as being followed by BCIC in its other operating plants will be followed in principle for GPUFP with further modernization of the system.

10.6 Emergency Response Plan

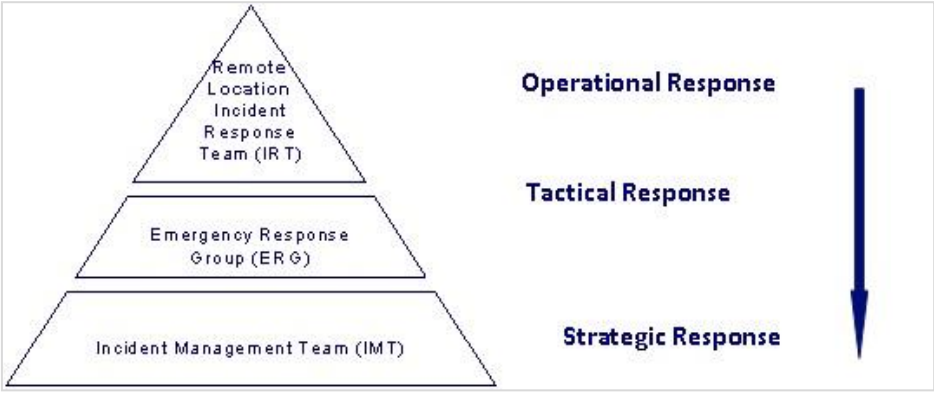
683. Possible emergency events during operational phase could be immediate evacuation due to personnel injury, kidnap and/or extortion (ransom), bomb threat, pandemic, significant business loss, pollution incident, fire and explosion, gas leak and structure collapse.

Emergency Management Strategy

684. This ERP during operation is intended to provide information, strategies and procedures relating to all aspects of emergency management which comprise:

a. Prevention of emergencies,
b. Preparation for emergencies.
c. Response to an emergency. and
d. Recovery following an emergency.

Emergency Management Organization



The Incident Response Team (IRT)

685. The Incident Response Team (IRT), based on the Project location, is trained and responsible for dealing with all envisaged incidents and emergency situations which may occur at the location. Where additional support in the way of resources and advice may be required by the IRT at a remote location this will be requested through and provided by the Emergency Response Group (ERG) of Dhaka Office. On all occasions when an IRT is mobilized due to an incident or emergency situation, the ERG Manager must be notified immediately.

686. The IRT is chaired by the Plant Manager and includes senior staff from the Human Resources (HR), Health Safety Environment (HSE) and Logistics department within the plant.

687. The IRT is responsible for monitoring the safety of the repowering of existing plant and coordinating and responding to all emergency events during the demolition and construction of fertilizer plant and directly report to the ERG Manager.

The Emergency Response Group (ERG)

688. The Emergency Response Group (ERG) is based in the BCIC Head Office in Dhaka, and is responsible for providing tactical response, support, assistance and advice to all incident and emergency situations at site/location and for providing operational response to any emergency situation which may occur. This plan describes how the ERG should handle both the "technical" crises e.g. fire, explosion, oil spill, and "social" crisis e.g. illness, injury, kidnap, civil unrest. On all occasions,the Incident Response Chair must be notified immediately so that the ERG is mobilized if any incident or emergency situation arises.

689. The function of the ERG is to coordinate and oversee arrangements to ensure that the IRT meets its emergency management obligations. The Managing Director of GPUFP will be the Chair of the ERG and will nominate an Emergency Response Coordinator to coordinate with representatives from various agencies and also senior staff from HR, Finance, HSE, Logistic, Security, IT, and public affairs department within the BCIC.

The Incident Management Team (IMT)

690. The Incident Management Team (IMT) is the corporate body located in the BCIC headquarters in Dhaka, with the responsibility to define and control strategy for major incidents. A strategic response is defined as a situation arising from a single or multiple incident/s or emergencies that escalate to a point beyond which significant damage to the

Company's business could result, including commercial and reputation damage, significant financial loss, shareholders' loss of confidence and damages resulting from litigation. When a potential strategic situation appears the IMT will be mobilized to manage issues pertaining to the reputation and the continued commercial wellbeing of the Company. The IMT may however also be called upon to address some of the tactical roles that would normally be the responsibility of the ERG, for example, if the Dhaka Office were out of action or in the event of an evacuation from the Project site, which may equally limit the ERG's capability.

691. The IMT is chaired by the Director-Production of BCIC and includes high level representation from the Ministry of Industries (MoI), Army, Police Department, Fire Department, District Commissioner's Office and the Disaster Management Bureau (DMB) of the Bangladesh Government.

692. The detailed Emergency Response Plan is prepared separately and included in Vol. 2 of this EIA.

11. Environmental Monitoring Plan

11.1 Monitoring Plan

693. A three tier monitoring program has been proposed comprising compliance monitoring, impact monitoring, and external or independent monitoring, as the key elements of the EIA. The main purpose of this monitoring program is to ensure that the various tasks detailed in the environmental management plan, particularly the mitigation measures are implemented effectively and also to evaluate Project's impacts on the key environment and social parameters. Different types of monitoring are presented in the following sections and monitoring locations during Demolition, Site Preparation and Construction Phases and Operation Phase are presented in Figure 11.1 and Figure 11.2 respectively. The monitoring points, its elaborative form with coordinates and attributes are presented in Table 11.1 for Operation Phase. Monitoring point notations are also same for the Demolition, Site Preparation and Construction Phases, for this reason is not shown separately.

Table 11.1: Monitoring points, coordintes and attributes in the Operation Phase

Monitoring Points	Elaboration	Coordinates	Attributes
AQ-1	Air Quality	23°59'30.66"N 90°38'58.61"E	Northeast Side of the Project Area at Khanepur
AQ-2		23°58'55.36"N 90°38'46.15"E	South side of the Project Area at Ghorasal Municipality
AQ-3		23°59'7.05"N 90°38'51.47"E	Office Area of the GPUFP
NL-1	Noise Level	23°58'57.93"N 90°38'46.62"E	Community close to Project Site
NL-2		23°59'8.52"N 90°39'2.34"E	Colony School at Township Area
NL-3		23°59'24.20"N 90°38'58.88"E	Khanepur Village close to Lagoon
NL-4		23°59'9.65"N 90°38'48.81"E	Administrative Buildings at Project Site
NL-5		23°59'33.55"N 90°38'6.59"E	90°38'6.59"E
GW-1	Ground Water Quality	23°59'30.90"N 90°38'37.42"E	North Side of the Lagoon at Khanepur
SW-1	Surface Water Quality	23°59'49.26"N 90°38'16.81"E	500m U/S of Effluent Discharge Point
SW-2		23°59'30.84"N 90°38'13.87"E	Effluent Discharge Point at the Shitalakhya River
SW-3		23°59'17.99"N 90°38'8.68"E	500m D/S of Effluent Discharge Point
FS-1	Fisheries Resources	23°59'50.10"N 90°38'15.39"E	Fish Biodiversity Survey at 500m U/S of Effluent Discharge Point at the Shitalakhya
FS-2		23°59'34.07"N 90°38'13.83"E	Fish Biodiversity Survey at Effluent Discharge Point at the Shitalakhya
FS-3		23°59'30.98"N 90°38'12.85"E	Fish Biodiversity Survey at Intake Point at the Shitalakhya
FS-4		23°59'18.98"N 90°38'6.14"E	Fish Biodiversity Survey at 500m D/S of Effluent Discharge Point at the Shitalakhya
FS-5		23°59'27.97"N 90°39'2.40"E	Aquaculture at Khanepur

Monitoring Points	Elaboration	Coordinates	Attributes
EC-1	Ecological Resources	23°59'31.94"N 90°38'5.45"E	Terrestrial Habitat at Nargana
EC-2		23°59'31.63"N 90°38'47.86"E	Terrestrial Habitat (Plant and Wildlife) at Khanepur
EC-3		23°59'11.04"N 90°39'5.41"E	Terrestrial Habitat (Plant and Wildlife) at GPUFP Colony
EC-4		23°58'59.37"N 90°38'24.46"E	Terrestrial Habitat (Plant and Wildlife) at UFFL
EC-5		23°59'28.99"N 90°38'10.70"E	Dolphin Abundance in the Shitalakhya River
AG-1	Agricultural Resources	23°59'29.70"N 90°38'4.56"E	Crop Land at Nargana
AG-2		23°59'35.68"N 90°38'58.73"E	Crop Land at Khanepur
SE-1	Socio-economic Resources	23°59'30.25"N 90°38'44.42"E	Community Health at North Khanepur
SE-2		23°59'24.11"N 90°39'0.26"E	Community Health at East Khanepur
SE-3		23°59'0.99"N 90°38'49.83"E	Community Health at Ghorasal Municipality
SE-4		23°59'32.72"N 90°38'5.69"E	Community Health at Nargana

Source: Field study

11.1.1 Compliance Monitoring

694. Compliance monitoring is a very important aspect of environmental management for safeguarding the environment. The compliance monitoring plan is presented in Table 11.2. The monitoring will comprise surveillance to check whether the contractor is meeting the provisions of the contract during construction and commissioning phase of the Project including the responsible agencies for implementation and supervision.

695. For monitoring of physico-chemical parameters, any location near the baseline sampling points is suggested. Actual monitoring time and location will be decided by BCIC with the assistance of the Owner's Engineer (OE). The Contractor will be responsible for carrying out, or contracting to an approved third party, the monitoring of all the parameters as required frequency as shown in the table by his own cost during the construction phase. The measurement values are to be compared with the WBG's General EHS Guidelines and the national standards (Environmental Conservation Rules, 1997 and amended in 2005) for compliance. An Environmental Compliance Monitoring Form form for conducting Compliance Monitoring is appended in Appendix 11.1. This will give idea to the Proponent as well as the EPC Contactor for preparing Environmental and Social Management Action Plan (ESAP).

11.1.2 Impact Monitoring during Construction

696. The purpose of the impact monitoring is to ensure that the contractor implements the mitigation measures given in the EMP and implements timely. This monitoring will generally be carried out by BCIC with the assistance of OE using checklists prepared on the basis of the impact monitoring Plan (Table 11.3).

11.1.3 Independent/External Monitoring

697. The BCIC will engage an independent organization for monitoring the EMP implementation. The main purpose of the Independent monitoring will be to ensure that all key entities including Environmental Health and Safety Unit (EHSU), Owner's Engineer, and contractors are fulfilling their designated role for EMP implementation, and that all the EMP requirements are being implemented timely and effectively. The ToR of the Independent monitor is presented in Appendix 11.2.

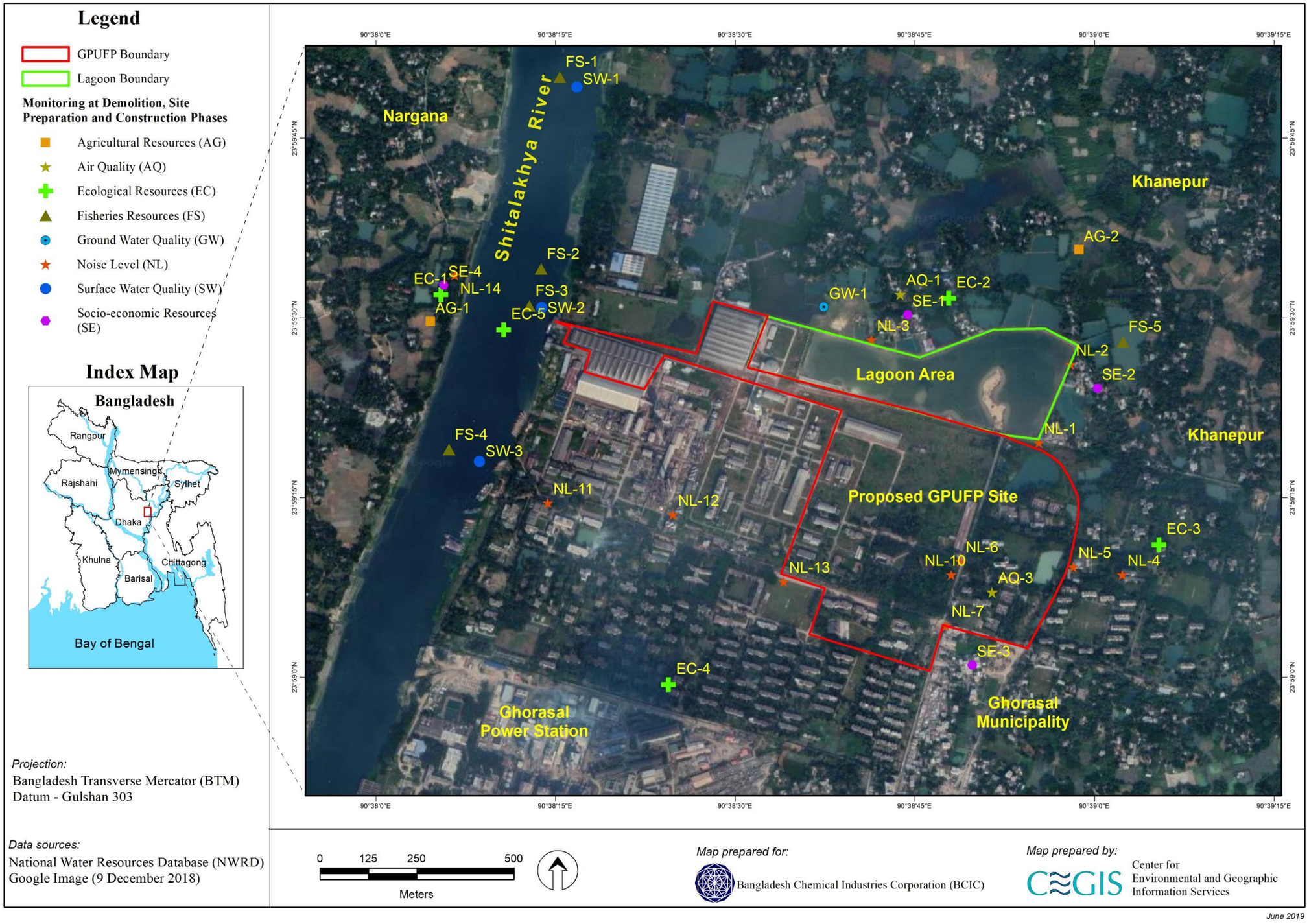


Figure 11.1: Monitoring locations during Demolition, Site Preparation and Construction Phases

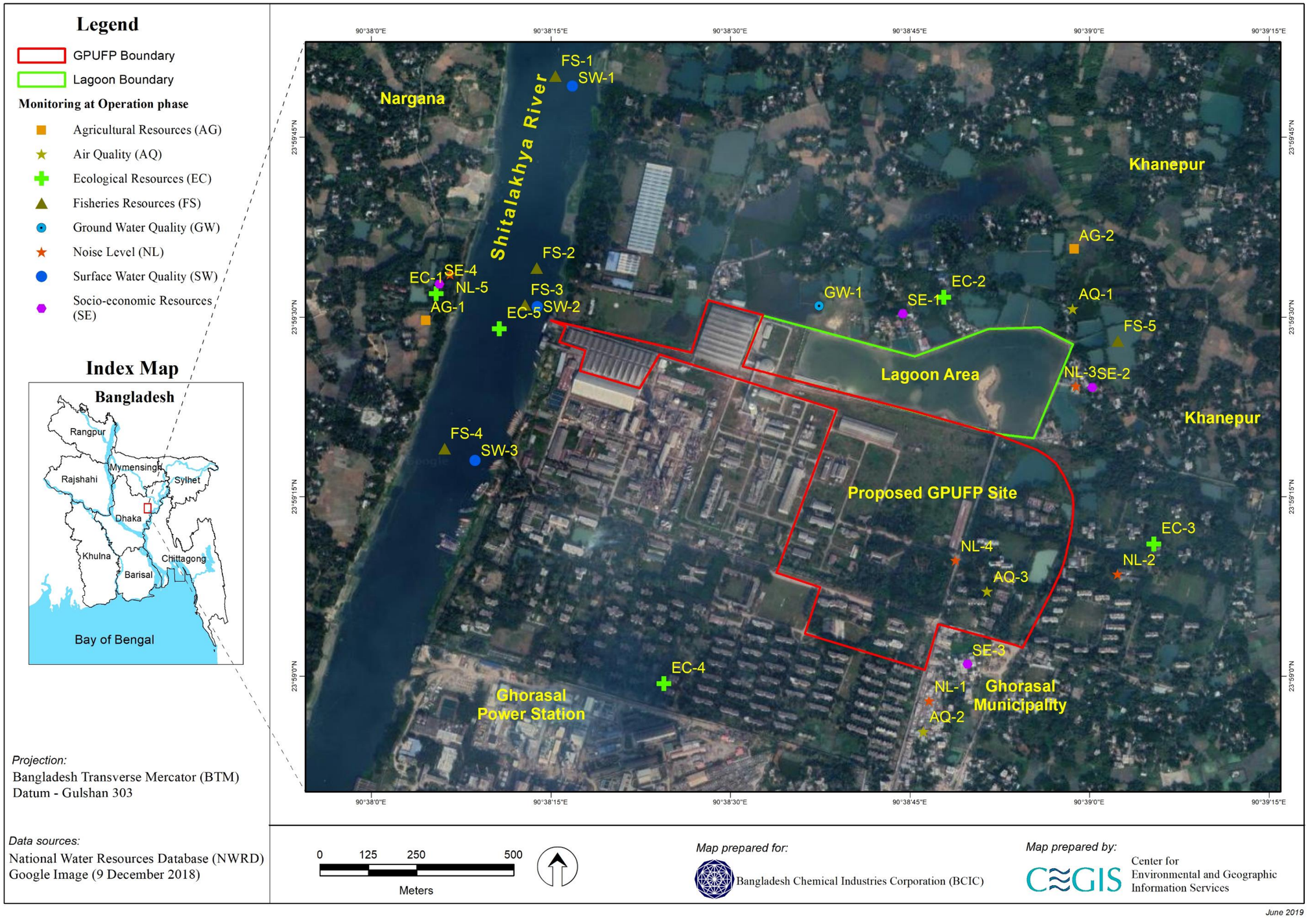


Figure 11.2: Monitoring locations during Operation Phase

Table 11.2: Environmental Compliance Monitoring Plan

Sl no	Components Monitoring	Monitoring Indicators	Locations	Frequency	Type/Duration of Sampling	Implemented by	
						Monitoring	Supervision
1.	**Demolition and Site Preparation Phase**						
1.1	Ambient Air Quality	Dust (SPM, PM10 and PM2.5)	Three Locations (AQ- 1 to 3): downwind and upwind of the Project site as shown in map (Figure 11.1).	Fortnightly	24hr	Contractor	IMA, OE, BCIC
1.2	Soil Quality	General soil properties	Two Locations (AG-1 to 2): Two samples in agriculture field as shown in map (Figure-11.1.	Quarterly	Composite Sampling	Contractor	IMA, OE, BCIC
1.3	Water Quality	Oil and Grease, Total Residual Cl, alkalinity, Nitrogen, Free Ammonia, Total Cr, Fe, Ca, Zn, Cu, etc.	Surface Water Three Locations (SW-1 to 3) Ground Water One Location (GW-1)as shown in map (Figure-11.1).	Quarterly	Grab Sampling	Contractor	IMA, OE, BCIC
1.4	Ambient Noise Level	LAeq	14 Locations (NL- 1 to 14) in and around the Project Site as shown in map (Figure 11.1).	Weekly	Three Samples during day time and one sample during night, 15 min sampling each time.	Contractor	IMA, OE, BCIC
1.5	Occupational health and Safety	Noise (LAeq)	Two Locations: ▪ Construction site ▪ Labor Shed	Weekly	Three Sample during day time and one sample during night, 15 min sampling each time.	Contractor	IMA, OE, BCIC

Sl no	Components Monitoring	Monitoring Indicators	Locations	Frequency	Type/Duration of Sampling	Implemented by	
						Monitoring	Supervision
		Use of PPEs and practice of Safety Procedure	Employers involved in Demolition activities	Daily	Purposive Sampling from Employers involved in Demolition activities	Contractor	IMA, OE, BCIC
		Health Checkup	Project Site	Monthly		Contractor	IMA, OE, BCIC
1.6	Ecosystem and Biodiversity	Tree felling Biodiversity	Project Site	Monthly	Direct Counting Public Consultation	Contractor	IMA, OE, BCIC
2.	**Construction Phase**						
2.1	Ambient Air Quality	SPM, PM_{10} and $PM_{2.5}$	Three Locations (AQ- 1 to 3): downwind and upwind of the Project site as shown in map (Figure 11.1).	Quarterly	24 hour	Contractor	IMA, OE, BCIC
2.2	Ambient Noise Level	Day time (6:00 – 21:00) and Night time (21:00 – 6:00) L10, L90	14 Locations (NL- 1 to 14): In and around the Project Site as shown in map (Figure 11.1).	Quarterly	Three Sample during day time and one sample during night, 15 min sampling each time.	Contractor	IMA, OE, BCIC
2.3	Water Quality	pH, TSS, TDS, Oil and Grease, Total Residual Cl, Total Cr, Fe, Ca, Zn, Pb, Cd, Hg, As, total alkalinity, Free Ammonia, BOD_5, COD, EC, Temp etc.	<u>Surface Water</u> Three Locations (SW-1 to 3) <u>Ground Water</u> a. One Location (GW-1)as shown in map (Figure- 11.1).	Bi-monthly	Grab Sampling	Contractor	IMA, OE, BCIC
2.4	Ecosystem and Biodiversity	Plant Growth, Canopy Coverage, Disease, wildlife etc.	Five Locations (EC- 1 to 5): as shown in map (Figure 11.1).	Yearly	Plot Survey	Contractor	IMA, OE, BCIC

Sl no	Components Monitoring	Monitoring Indicators	Locations	Frequency	Type/Duration of Sampling	Implemented by	
						Monitoring	Supervision
2.5	Fish Diversity and Composition	Diversity Index, Richness, Composition, Habitat Suitability Index, etc.	Capture Fishery Four Locations (FS- 1 to 4) Culture Fishery One Location (FS-1) as shown in map (Figure 11.1).	Quarterly	Fish Catch Assessment, Fishers' interview	Contractor	IMA, OE, BCIC
2.6	Agricultural Production	Crop Production Loss	Two Locations (AG- 1 to 2) as shown in map (Figure 11.1).	Six monthly following cropping patterns	Agricultural Survey	Contractor	IMA, OE, BCIC
2.7	Occupational Noise	LAeq	Two Locations: ▪ Construction site ▪ Labor shed	Quarterly	Three Sample during day time and one sample during night, for noise 15 min sampling each time. by using: ANSI Type II Noise Meter	Contractor	IMA, OE, BCIC
2.8	Health and Sanitation	Availability of Potable Water, Drinking water quality, Availability of Hygienic Toilet	Project site	Quarterly	Inspection and interview of labor, project personnel	Contractor	IMA, OE, BCIC
2.9	Community Health, Safety and Security	Implementation of EMP	Four Locations (SE- 1 to 4) as shown in map (Figure 11.1).	Quarterly	Inspection and interview of local people followed by a checklist	Contractor	IMA, OE, BCIC
3.	**Operation Phase**						
3.1	Stack Emission (Boiler, Reformer & Granulation Tower)	NOx, NH3, PM2.5, PM10	Stack Points	Continuous	Continuous	EHSU /GPUFP	IMA/ BCIC
3.2	Ambient Air Quality	NOx, NH3, PM2.5, PM10	Three Locations (AQ- 1 to 3): (Subject to	Quarterly	24 hour	EHSU/ GPUFP	IMA / BCIC

Sl no	Components Monitoring	Monitoring Indicators	Locations	Frequency	Type/Duration of Sampling	Implemented by	
						Monitoring	Supervision
			seasonal changes of wind direction) as shown in map (Figure-11.1) and in Table 11.2.				
3.3	Ambient Noise Level	Day time (6:00 – 21:00) and Night time (21:00 – 6:00) LAeq, L10, L90	14 Locations (NL- 1 to 14) in and around the Project Site as shown in map (Figure 11.1) and in Table 11.2.	Monthly	Three Sample during day time and one sample during night, 15 min sampling each time.	EHSU/ GPUFP	IMA / BCIC
3.4	Leak detection	Along corridors to locate secondary indicators and walking the corridor with a “sniffer”	RMS and pipeline corridor	Every 3-5 years	Visual Observation for stressed vegetation and with a “sniffer”	EHSU/ GPUFP	IMA / BCIC
3.5	Effluent (Waste Water)	pH, TSS, TDS, Temperature, EC	Effluent Discharge Point	Quarterly	Continuous	EHSU/ GPUFP	IMA / BCIC
		Oil and grease, Total Residual Cl, Cu, Fe, Zn, Pb, Cd, Hg, As, COD, BOD	Effluent Discharge Point	Quarterly	Grab Sampling	EHSU/ GPUFP	IMA / BCIC
3.6	Water Quality: Surface Water	pH, TSS, TDS, Oil and Grease, Total Residual Cl, Total Cr, Fe, Ca, Zn, Pb, Cd, Hg, As, total alkalinity, Nitrogen, Free Ammonia,	<u>Surface Water</u> Three Locations (SW- 1 to 3) As shown in map in Figure 11.1 and in Table 11.2.	Quarterly	Grab Sampling	EHSU/ GPUFP	IMA / BCIC

Sl no	Components Monitoring	Monitoring Indicators	Locations	Frequency	Type/Duration of Sampling	Implemented by	
						Monitoring	Supervision
		BOD_5, COD, EC , Temp., etc.[28]					
3.7	Water Quality: Ground Water	pH, Total Hardness, Color, Cl, Total Coliform, F, Fe, Mn, As, PO_4, SO_4, etc.	Ground Water One Location (GW-1) as shown in map (Figure 11.1)	Monthly	Grab Sampling	EHSU/ GPUFP	IMA / BCIC
3.8	Generation of Non Hazardous Solid Waste (Domestic waste, Office Waste,)	Types and Quantity, Characteristics	Waste Disposal Point	Quarterly	Visual Inspection, waste classification	EHSU/ GPUFP	IMA / BCIC
3.9	Generation of Hazardous Solid Waste	Types and Quantity, Characteristics	Waste Disposal Point, Waste Generation Sources	Quarterly	Visual Inspection, waste classification	EHSU/ GPUFP	IMA / BCIC
3.10	Generation of Hazardous Liquid Waste, Sludge (return from Water Treatment Plant, Sludge from clarifier, neutralization pond)	Quality of Water in effluent pit e.g., corrosivity, reactivity.	Hazardous Liquid Waste and Sludge Disposal site (i.e. effluent pit)	Quarterly	Visual Inspection, waste classification	EHSU/ GPUFP	IMA / BCIC
3.11	Waste Management	Condition of waste bins, waste transportation vans	N/A	Quarterly	Visual inspection and document checking	EHSU/ GPUFP	IMA / BCIC
3.12		Capacity of Waste Disposal Site	Waste Disposal Point	Quarterly	Visual inspection and document checking	EHSU/ GPUFP	IMA / BCIC

[28] These monitoring parameters will be revised after monitoring the effluent water quality from the discharge channel. Some parameters might become redundant if the effluent water does not contain them.

Sl no	Components Monitoring	Monitoring Indicators	Locations	Frequency	Type/Duration of Sampling	Implemented by	
						Monitoring	Supervision
3.13	Hazardous Waste Management	Labeling of Hazardous Materials, hazardous waste, documentation of hazardous chemical use, etc.	Chemical Storage, Hazardous Material Storage area, Hazardous Waste Disposal Area.	Quarterly	Visual inspection, and document checking	EHSU/ GPUFP	IMA / BCIC
3.14	Plant Health	Plant Growth, Mortality, Canopy Coverage, Disease, etc.	1. Greenbelt area in GPUFP Complex 2. Five Locations (EC-1 to 4) as shown map in Figure 11.1 and in Table 11.2	Yearly	Proposed Greenbelt area in GPUFP: Four Plots of 25m X 25m (one plot at each corner of GPUFP Complex) Plot Survey	EHSU/ GPUFP	IMA / BCIC
3.15	Occurrence of Wildlife	Species Composition and Status	Same as above	Six monthly	Same as above	EHSU/ GPUFP	IMA / BCIC
3.16	Dolphin Abundance	Presence-absence of Dolphin	One Location (EC-5) in the Shitalakhya River nearby Project site as shown in map (Figure 11.1 and in Table 11.2.	Six monthly	Visual Sighting	EHSU/ GPUFP	IMA / BCIC
3.17	Fish Diversity and Composition	Diversity Index, Richness, Composition, Habitat Suitability Index, etc.	Capture Fishery Four Locations (FS-1 to 4) as shown in map (Figure 11.1) and in Table 11.2.	Quarterly	Fish Catch Assessment, Fishers' interview	EHSU/ GPUFP	IMA / BCIC
3.18	Aquaculture habitat	Fish mortality	Culture Fishery One Location (FS-5) as shown in map (Figure 11.1) and in Table 11.2.	Quarterly	Fish farmer interview	EHSU/ GPUFP	IMA / BCIC

Sl no	Components Monitoring	Monitoring Indicators	Locations	Frequency	Type/Duration of Sampling	Implemented by	
						Monitoring	Supervision
3.19	Land use and Land Cover change	Land cover and Land use	5km radius area of the plant	Once in three years	Satellite Image (5km radius area of GPUFP) Analysis	EHSU/ GPUFP	IMA / BCIC
3.20	Agricultural Production	Crop Production Loss	Two Locations (AG-1 to 2) as shown in map in Figure 11.1 and in Table 11.2.	Yearly	Farmers' Interview, Secondary Data from DAE	EHSU/ GPUFP	IMA / BCIC
3.21	Occupational Noise and vibration	LAeq, L10, L90, Noise Exposure	a. Inside GPUFP Area (Turbine hall, RMS, etc.) b. Control room c. Administrative building	Quarterly	Three Samples during day time and one sample during night, for noise 15 min sampling each time. by using: ANSI Type II Noise Meter Inspection of record of shifting hour, workers' roster	EHSU/ GPUFP	IMA / BCIC
3.22	Worker Health	General Health Condition, Hearing health, skin disease, etc.	Workers involved in the Plant operation and maintenance	Quarterly	Health Check up	EHSU/ GPUFP	IMA / BCIC
3.23	Health and Sanitation	Availability of Potable Water	GPUFP Complex	Six monthly	Visual Inspection and Record Checking	EHSU/ GPUFP	IMA / BCIC
3.24		Drinking water quality (As per ECR, 1997)	Water Supply System	Six monthly	Three samples from Drinking water supply system	EHSU/ GPUFP	IMA / BCIC
3.25		Availability of Hygienic Toilet	Office Building, Township Area, Common Places, etc.	Monthly	Visual Inspection	EHSU/ GPUFP	IMA / BCIC
3.26	Community Health	Status of Communicable Diseases	Four Locations (SE- 1 to 4) as shown in map in	Six monthly	Inspection of Disease Profile/Records in Health Camps/Clinic	EHSU/ GPUFP	IMA / BCIC