



Bharat Heavy Electricals Limited

Monthly Monitoring Report - 11 (February, 2019)

Environment Compliance Monitoring During Construction Period of 2x660 MW Maitree Super Thermal Power Project Rampal, Bagerhat



Submitted in March, 2019

C_≈GIS

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of 2x660 MW Maitree Super Thermal Power Project
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Acknowledgements

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Abbreviations and Acronyms

BHEL	Bharat Heavy Electricals Limited
BIFPCL	Bangladesh-India Friendship Power Company Limited
BOD	Biochemical Oxygen Demand
BPDB	Bangladesh Power Development Board
CEGIS	Center for Environmental and Geographic Information Services
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
COD	Chemical Oxygen Demand
DO	Dissolved Oxygen
DoE	Department of Environment
EC	Electric Conductivity
EIA	Environmental Impact Assessment
EHS	Environmental Health Safety
EMP	Environmental Management Plan
EPC	Engineering, Procurement and Construction
HSE	Health Safety and Environment
MW	Mega Watt
NO _x	Oxides of Nitrogen
NTPC	National Thermal Power Corporation
PM	Particulate Matter
PP	Power Plant
PPE	Personal Protective Equipment
SO ₂	Sulfur Dioxide
SPM	Suspended Particulate Matter
TDS	Total Dissolved Solid
ToR	Terms of Reference
USEPA	United States Environmental Protection Agency

Glossary

Term	Definition
Compliance	When construction activities are being conducted in accordance with the Environmental Requirements (standards) of the Project.
Environmental Requirements	Environmental Specifications set out in the Environmental Management Plan (EMP) and relevant Environmental Protection Plan (EPP). Conditions included in the Environmental Assessment Approval for the Project.
Non-conformance	A construction activity conducted in a manner that deviates from a best management practice, compliance with which is required in the EPP for that construction activity.
Non-compliance	A construction activity conducted in a manner that deviates from a legal condition under a permit, an enactment, or a regulation, compliance with which is required in the EPP for that construction activity.
Reportable Environmental Incident	An incident of non-conformance or non-compliance which has caused or has the potential for causing an impact on the quality of air, land or water, human life, wildlife, aquatic species, species at risk or heritage resources, and is reportable under a permit, an enactment, or a regulation.

Unit Conversion

General Units

1 meter = 3.28 ft
1 kilometer = 0.621371192 mile
1 nautical mile = 1.852 kilometer
1 kilogram = 2.20 pound
1 metric ton = 1000 kg
1 barrel = 42 U.S. gallons = 159.0 liters
1 liter = 0.264172052 gallon (US)
1 square mile = 640 acres = 2.590 km²
1 hectare = 10⁻² km² = 2.471 acres
1 Pascal = 1 N/m² = 0.01 millibar
1 liter = 0.001 cubic meter
1°C = 274.15K = 33.8°F
1 mg/m³ = 1 µg /L
1 mg/L ≈ 1 g/m³ ≈ 1 ppm (w/w)
1 µg/L ≈ 1 mg/ m³ ≈ 1 ppb (w/w)
1 knot = 0.514444 m/s
1µg/m³ = 1 ppb*(12.187)*(M) / (273.15 + °C)

Energy Units

1 Cal = 4.19 J
1 Btu = 1055.87J
1 Btu = 251.9958 cal
1 joule = 0.239 cal
1 kWh = 3412 Btu.
1MW=1000KW=10⁶ W
1 kWh = 3.6 x 10⁶ J
1 kWh = 859.85 kcal
1 horsepower = 746 W
1 GWyr = 8.76 x 10⁹ kWh

1. Introduction

1.1 Background

The Maitree Super Thermal Power Plant is a joint venture Project of Bangladesh Power Development Board (BPDB), and National Thermal Power Corporation (NTPC) Ltd., India and isrun by Bangladesh-India Friendship Power Company Pvt. Ltd. (BIFPCL). Bharat Heavy Electricals Limited (BHEL) has awarded the contract of all Engineering, Procurement and Construction works of the Power Plant within the specified time schedule. BHEL has already initiated the construction works. In order to fulfil the environmental consequences, BHEL has decided to engage a third party for monthly monitoring of the environmental compliance within the Project area as per the requirement of Department of Environment (DoE), Bangladesh EIA approval Condition No-44 which is: “Environmental Monitoring Reports according to specific format specified in the EIA Report shall be made available simultaneously to DoE Bagerhat District Office, Khulna Divisional Office and Headquarters on a monthly basis during the construction period of the Project.”. In this regard, monitoring of environmental parameters as well as the status of Environmental Health and Safety (EHS) should be conducted in accordance with the EMP as stated in EIA Study Report.

Accordingly, CEGIS has been appointed by BHEL for conducting the monthly monitoring of the environmental compliance of Maitree Super Thermal Power Plant of BIFPCL. These monitoring activities need to be continued for the entire construction period and the reports need to be submitted to DoE on monthly basis. According to the contract, CEGIS has already conducted environmental compliance monitoring from April till January, 2019 and submitted the report to BHEL. As a continuous process, CEGIS conducted the 11th monthly monitoring activities during February, 2019 and this 11th monitoring Report has been prepared for submission to BHEL for their consideration. The aforementioned format of the report specified in the EIA study along with the monitoring results has been appended in the **Annex-I**.

1.2 Brief of the Project

The construction works of BIFPCL 2x660 MW Maitree STPP has been progressing well and the Project is now in the infrastructure development stage. The Project area includes 366.40 hectares (905 acres) of land (Block-A) which is just beside the BPDB Project area (Block-B). The MSTPP Project area is connected with a 6 km long two-lane access road from the Khulna-Mongla Highway to the MSTPP area. Expansion works are going on to convert this access road into a six-lane road. A number of construction companies are now working at the BIFPCL Project site to complete the civil works within the stipulated time schedule. The Project activities conducted at various stages include:

- Extension work for increasing the width of the access road within the Project area;
- Passage of road for traffic movement for construction purposes;
- Construction works of some roads and permanent drainage network in the Plant area;
- Construction materials are aggregated for major mechanical construction works;
- Pile driving, soil compaction, base and sub-base construction activities;
- Construction works in the Jetty area;

- Labor shed construction and also construction of new labour sheds;
- Service works;
- Power supply from the national grid and also from generator at Project site;
- Concrete Batching Plant and concrete pouring operations; and
- Development of various infrastructure works like store, material shed, labour shed, office complex, residential complex etc.

1.3 Selection of Sample Collection Site

Eleventh monthly environmental compliance monitoring has been conducted from 05th February, 2019 to 8th February, 2019. One Environmental Expert and one Engineer along with two Technicians of CEGIS visited and conducted the field investigation. They collected samples from the pre-selected site and monitored the sampling equipment continuously.

The Team communicated with Mr. Sartaj Husain, Dy. Engineer, BHEL for informing him about the routine monitoring activities. A discussion meeting was held with the proponent regarding the storm discharge water collection location, monitoring schedule and significant issues of ambient air quality and noise level. During this field visit of CEGIS monitoring team from 05-08th February, 2019, Mr. Sartaj Husain, Dy. Engineer, BHEL assisted the monitoring team in collecting data and information and facilitated the field monitoring activities. During this field trip, the monitoring team has successfully conducted the field activities and eventually, generated the monitoring results after laboratory analysis that has been presented in this Eleventh monthly monitoring Report.

1.4 Location of the Project

The MSTPP is located in between latitude 22° 37' 0"N to 22°34'30"N and longitude 89°32'0"E to 89°34'5"E and at about 23 km south of the Khulna City and 14 km north-eastward from the Sundarbans. The location of the MSTP Project area is presented in **Figure 1.1** and **Figure 1.2**, respectively.

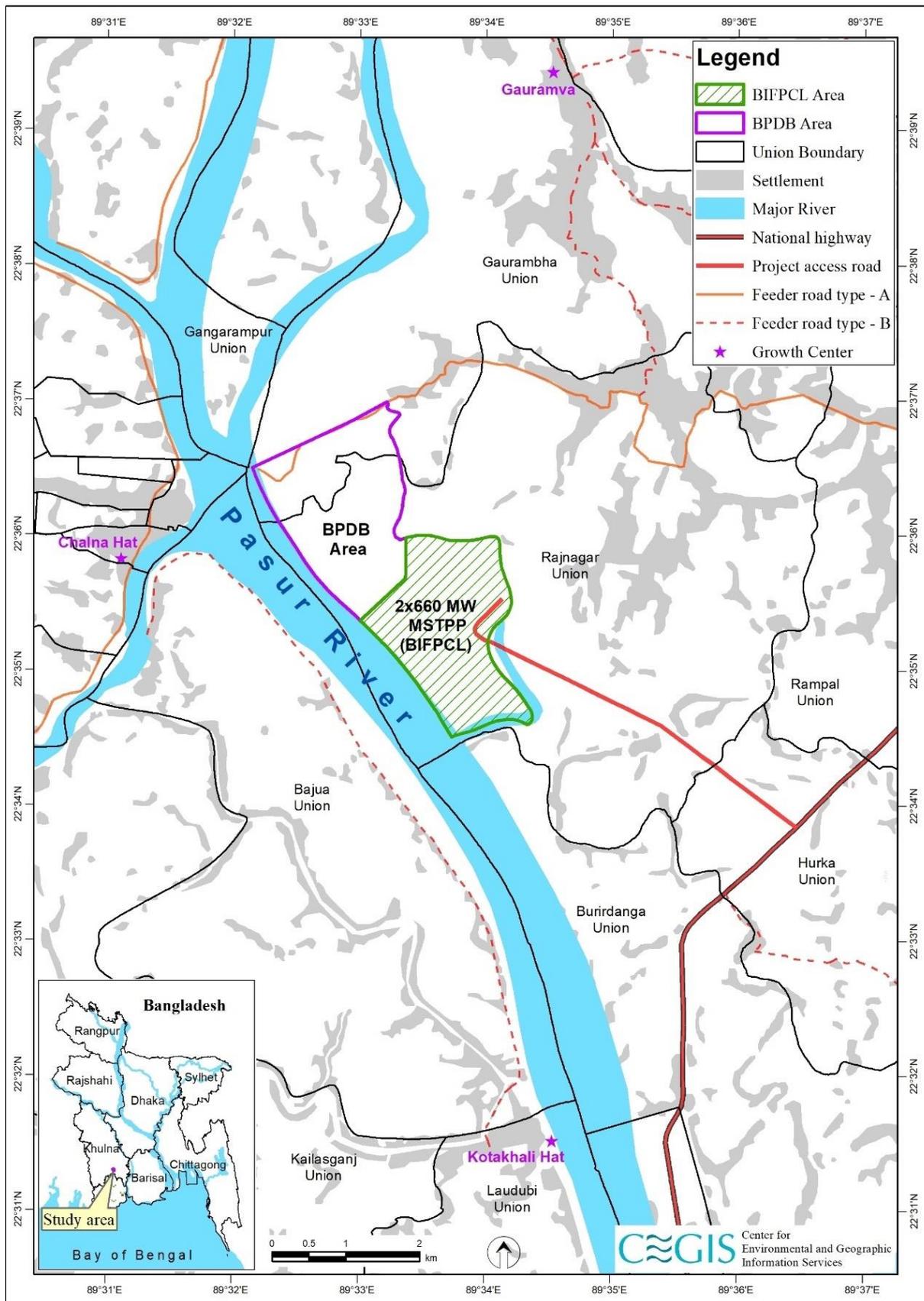


Figure 1.1: Location of 2x660 MW Maitree Super Thermal Power Plant

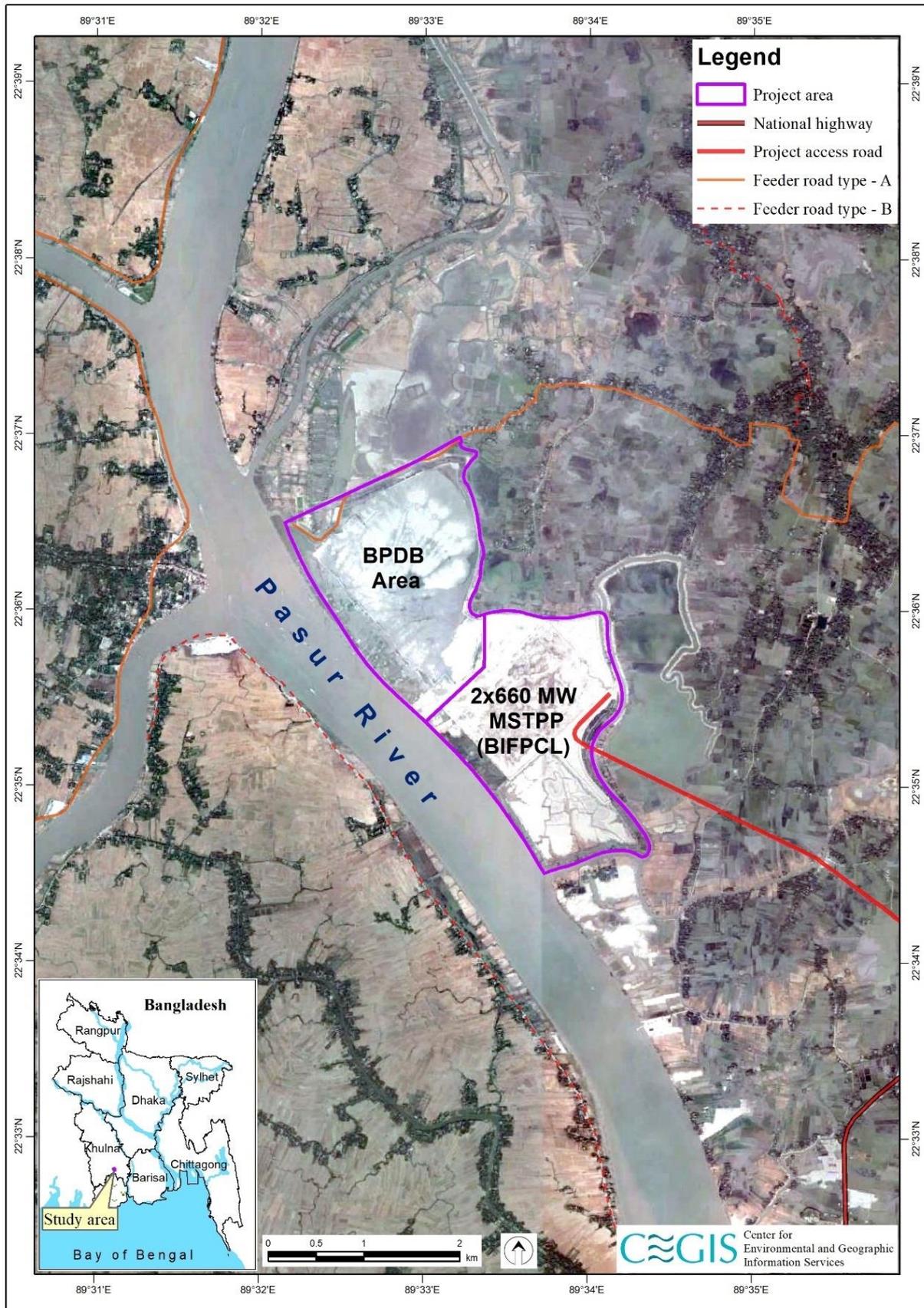


Figure 1.2: Location of Maitree Super Thermal Power Plant in Google Map

1.5 Study Objectives

The overall objective of this study is to monitor the environmental compliance of certain parameters during the construction phase of this Power Plant Project.

- Monitoring of the certain environmental parameters of air quality, water quality and noise level at the sensitive receptor (point) in and around the Project site;
- Comparing the monitoring results with national (ECR, 1997) and international standard (IFC, 2007); and
- Identifying the causes behind non-compliance and suggesting mitigation measures accordingly.

1.6 Scope of the Services

The scope of the study are as follows which are specified in **Table 1.1**

- Conducting monthly air quality monitoring continuously (24 hrs.) at the sensitive receptors within the project boundary. Air quality monitoring stations are to be set at least one in every location near the labour shed, one in major construction works area, and one at the Jetty area. Air quality monitoring parameters to be monitored include PM₁₀, PM_{2.5}, SPM, SO₂, NO_x, CO and O₃.
- Conducting monthly water quality monitoring in the project area, especially at the discharge points. At least three samples are to be collected from the project area, which include discharge outlet point and drinking water, etc. The monitoring parameters are pH, DO, Salinity, Temperature, BOD₅, COD, Hardness, Electric Conductivity (EC), TDS, NO₃, PO₄, SO₄, and CL⁻ after grab sampling.
- Conducting monthly monitoring of noise level as Leq, (dBA) values both for day and night time. Noise level will be monitored at ten locations through USEPA approved standard procedure. Monitoring locations will be determined because of site-specific work and location sensitivity.

Table 1.1: Environmental Parameters Measurement during Monthly Monitoring Visit

Parameters		Number of Location	Frequency of Sampling	Quantity of Samples	Guidance and Acceptance of the tests
Air Quality	PM ₁₀ , PM _{2.5} , SPM, SO ₂ , NO _x , CO and O ₃	<ul style="list-style-type: none"> • North west corner of the Power Plant/Jetty Location • Labor Shed area. • Major Construction area 	1	3	As per the guidelines provided in approved EIA reports for 2x660 MW, Coal based Thermal Power Construction Project at Rampal Upazila, under Bagerhat District of Bangladesh and in line with the relevant Environmental Acts and Rules of Govt. of Bangladesh.
Water Quality	BOD ₅	<ul style="list-style-type: none"> • Outlet point-1 • Outlet point-2 • Outlet point-3 	1	3	
	COD		1	3	
	Total Hardness		1	3	
	Chlorine		1	3	
	pH		1	3	
	DO		1	3	
	Salinity		1	3	
	Temperature		1	3	
	EC		1	3	
Nitrate	1	3			

Parameters		Number of Location	Frequency of Sampling	Quantity of Samples	Guidance and Acceptance of the tests
	Sulphate		1	3	
	Phosphate		1	3	
	TDS		1	3	
Noise Level	Noise level	10 sites (considering the major sensitive area/construction activities)	1	10	

1.7 Purpose of the Study

Environmental Compliance Monitoring is immensely necessary for a project to assess the environmental status, non-compliance and non-conformance issues as per national environmental standards and good international practices. Additionally, with the aim of complying the EIA approval condition (Condition no.: 44) of Department of Environment, Bharat Heavy Electricals Limited (BHEL) has engaged Center for Environmental and Geographic Information Services (CEGIS) for carrying out the Monthly Environmental Compliance Monitoring study of the Maitree Super Thermal Power Plant. The Environmental Monitoring report presents the results of physical environment, particularly ambient air quality, ambient noise level and water quality, during the construction phase of the proposed Power Project. These monitoring activities will be conducted monthly, which has already started from the month of April 2018 and will be continued for one year. Moreover, quarterly monitoring of environmental parameters is already being conducted by BIFPCL since February 2014. The results of the monitoring are being presented on a monthly basis to BHEL reflecting the compliance status of the environmental parameters along with the follow-up actions.

1.8 Team Mobilization

An Environmental Compliance Monitoring Team consisting of one Environmental Expert, one Junior Environmental Engineer and two technicians conducted the monitoring study in the field (**Table 1.2**). The monitoring Team worked at the BIFPCL 2x660 MW MSTPP site for 4 days i.e., from 05th to 08th February, 2019. The monitoring activities have been performed independently as per standard practices.

Table 1.2: Composition of Environmental Compliance Monitoring Team

Position Assigned	Number	Responsibilities
Environmental Expert	1	Preparation of the Monitoring Plan, maintaining effective communication with BHEL and preparation of the Report.
Junior Environmental Engineer	1	Implementation of the compliance monitoring and preparation of the Report
Technician	2	Operation of the machineries and equipment, sampling etc.,

Samples collected from the field have been submitted to laboratory for analysis and testing. The results were checked meticulously. The root cause of changing environmental parameters over period has been assessed after analysis of the results and field observation. Additionally, a compliance monitoring Report for the month of February, 2019 has been prepared, which is reviewed by the internal and external experts. A number of internal professional man power inputs have been used within the Consultant's Team for the efficient functioning and completion of the services.

2. Approach and Methodology

2.1 Overall Approach

The Study approach is prepared based on the scope of services. According to the ToR, this monitoring report has been prepared for the month of February 2019. The environmental parameters for air quality, water quality and noise level have been selected based on the monitoring framework of the EIA study of 2x660 MW Coal based Thermal Power Plant Project at Rampal, Bagerhat which is also recommended in the scope of the services.

The location of air, water and noise monitoring sites (stations) were selected depending on the recommendation of the EIA study, location sensitivity and impact potentiality of that particular area in a specific time period. The **Figure 2.1** below provides an understanding of the different activities, which were carried out during the monthly monitoring of Environmental Compliance of Maitree Super Thermal Power Plant.

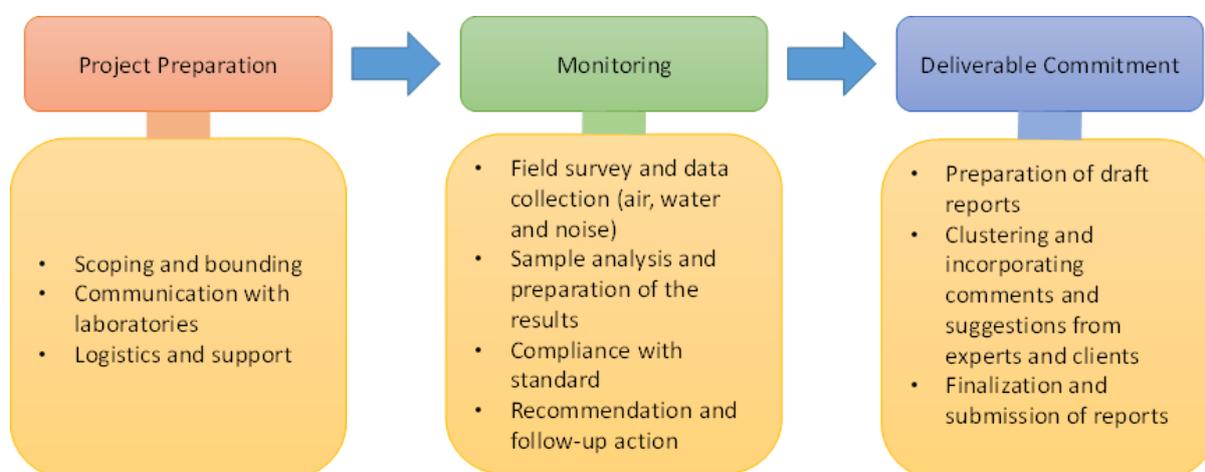


Figure 2.1: Monitoring Framework

Monitoring of environmental parameters like air quality, water quality and noise level have been investigated through different monitoring equipment and tools. For air quality monitoring volumetric sampler has been used, water quality parameters have been tested in-situ in the field and grab sample has been collected for laboratory analysis and finally the sound pressure level meter has been used to estimate the present noise level equivalent in the surrounding areas. The monitoring activities have been conducted continuously at specified locations by skilled technicians and professionals.

2.2 Methodology of Environmental Compliance Monitoring

The monitoring activities have been performed through a methodological framework. QA/QC procedure have been maintained during the field investigation and sampling of all the environmental parameters. The locations of air quality, water quality and noise level monitoring are shown in **Figure 2.9** and **Figure 2.10**. The locations are subjected to change in future depending on the potentiality of the impacts and its magnitude, sensitivity of the receptors and capturing the worst-case scenarios. The procedures associated with the monitoring of each of the environmental parameters are described in the following sub-articles.

2.2.1 Ambient Air Quality

The ambient air quality has been monitored in three locations as specified in **Figure 2.2**. Air quality monitoring has been performed at locations adjacent to the labour shed, jetty areas and construction site where construction and installation works as well as transportation of materials for working might affect the ambient air quality. The air samples have been collected at the construction areas to test the environmental parameters to ensure that the EPC contractor BHEL complies with the terms and conditions of environmental protection.

Emission of particulate matters and gaseous pollutants from the construction site have been monitored for 24 hours continuously. All of the criteria pollutants (PM_{10} , $PM_{2.5}$, SPM, SO_2 , NO_x , CO and O_3) have been monitored at specified places. Respirable Dust Sampler (Model-Envirotech India APM-460BL) and Fine Particulate Sampler (Model-Envirotech India APM-550) have been used to collect the air samples. The $PM_{2.5}$, PM_{10} , and SPM have been tested by gravimetric method. The SO_2 has been absorbed in a specified chemical and tested by West-Gaeke method. The NO_2 has also been absorbed in specified chemicals and tested by Jacob and Hochheiser method. Finally, CO and O_3 have been measured using a Metravi CO-10 meter and Tongdy O_3 monitor, respectively.



Figure 2.2: Ambient Air Quality Monitoring

2.2.2 Water Quality

Reverse osmosis technology is being used for producing fresh water by treatment of saline water of the Passur River as per suggestion of the EMP of EIA study. In this process, high concentrated saline water called brine is produced which is ultimately discharged to the Passur River. At present there are two RO based Water Treatment Plants supplying water to the officials of BIFPCL, BHEL and the laborers. The laborers usually collect their drinking water from Jetty Side RO drinking water point during two times in a day. Large quantity of water barrel, jars are used to reserve water at the worksite after filling them from the RO drinking water supply point. At the time of field investigation, the RO based Water Treatment Plant near the Jetty area was in operation.

During this 11th monthly compliance monitoring program three water samples were collected, one from RO technology (near jetty area) based Water Treatment Plant discharge outlet, one from storm water discharge outlet near BIFPCL office which is located in latitude $22^{\circ} 35' 36.5''N$ and longitude $89^{\circ}33' 58.89''E$ and one from drinking water outlets from RO Plant near the Plant jetty site for analysis. The locations of samples collected for water quality monitoring

are shown in **Figure 2.3**, **Figure 2.4**, **Figure 2.5** and **Figure 2.6**. A sample of water discharge from the Project site to Passur River was collected to determine the status of discharge water quality.

Water quality field investigation was conducted in February 2019. Storm water discharge outlet has been observed at different places around the project site. Therefore, one sample from storm water discharge outlet, one from RO discharge water outlet and one from RO Drinking water outlet has also been collected.



Figure 2.3: In-situ parameters Testing



Figure 2.4: RO Discharge Water Sample Collection



Figure 2.5: RO Discharge Water outlet



Figure 2.6: Storm Discharge Water sample collection and Discharge outlet

Standard practices have been followed for monitoring the water quality. In-situ testing was done at field and collected samples were brought and submitted to the laboratory for various analysis. The parameters that were analysed include pH, DO, Salinity, Temperature, BOD₅, COD, EC, TDS, NO₃, PO₄, SO₄, and Chloride as recommended in the EIA study done for the BIFPCL Project. Detail methodology for testing the water quality parameters are shown in **Table 2.1**.

Table 2.1: Methods Followed in Analyzing Water Samples

Sl. No	Parameters	Unit	Methods	Reference
01	Temp	°C	Electrode	HORIBA, U-50 Multi-parameter Water Quality Meter
02	pH	pH	Electrode	HORIBA, U-50 Multi-parameter Water Quality Meter
03	EC	µS/cm	Electrode	Multi-parameter meter (Instrument Catalog)
04	TDS	mg/L	Electrode	Multi-parameter meter (Instrument Catalog)
05	Dissolved Oxygen (DO)	mg/L	DO Meter	Lutron DO 5519 (Instrument Catalog)
06	Biological Oxygen Demand (BOD ₅)	mg/L	DO Meter	Lutron DO 5519 (Instrument Catalog)
07	Chemical Oxygen Demand (COD)	mg/L	Colorimetric Method (COD Reactor: Et 125 SC and Spectrophotometer: UNICO 4802)	APHA, (1992)
08	Total Hardness (TH)	mg/L	Titrimetric Method	APHA, (1992)
09	Chloride (Cl ⁻)	mg/L	Moh's Titration	APHA, (1992)
10	Sulfate (SO ₄ ²⁻)	mg/L	Turbidity metric Method	APHA, (1992)
11	Phosphate (PO ₄ ³⁻)	mg/L	Ascorbic Acid Method	APHA, (1992)
12	Nitrate (NO ₃ ⁻)	mg/L	Ultraviolet Spectrophotometric Screening Method	APHA, (1992)
13	Salinity	ppt	Electrode	HORIBA, U-50 Multi-parameter Water Quality Meter
14	Turbidity	NTU	Electrode	HORIBA, U-50 Multi-parameter Water Quality Meter

2.2.3 Ambient Noise Level

During the construction stage, the major source of noise is expected to stem from the construction site, movement of vehicles, electricity producing, generator etc. For the sake of this study, ambient noise levels have been monitored at ten locations. Noise levels have been measured during day (**Figure 2.7**) and night time (**Figure 2.8**) at each of the 10 locations based on the location sensitivity, importance and impact potentiality. Each time the noise level was recorded for fifteen minutes continually by using portable noise level meter. The sites are subject to change in future monitoring schedule based on the changing of working areas, types of work and importance of the location.



Figure 2.7: Ambient Noise Level Monitoring during Day Time

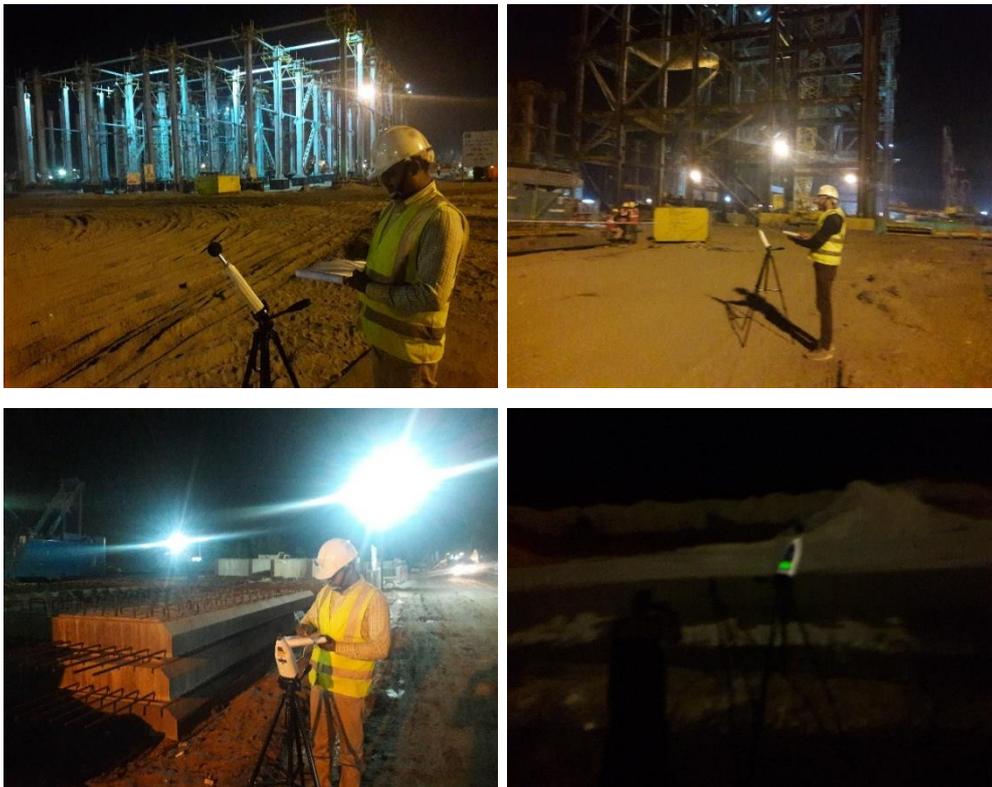


Figure 2.8: Ambient Noise Level Monitoring during Night time

Noise is described by a weighted sound intensity (or level) and is measured in units called decibels (dBA). However, in this circumstance the noise level has been measured in terms of A- weighted equivalent continuous sound pressure level (L_{eq}) and recorded by Sound Level Meter (kanomax-4431). Depending on the site condition and acoustic environment, the noise meter was set up and calibrated each time following the manufacturer's instruction manual.

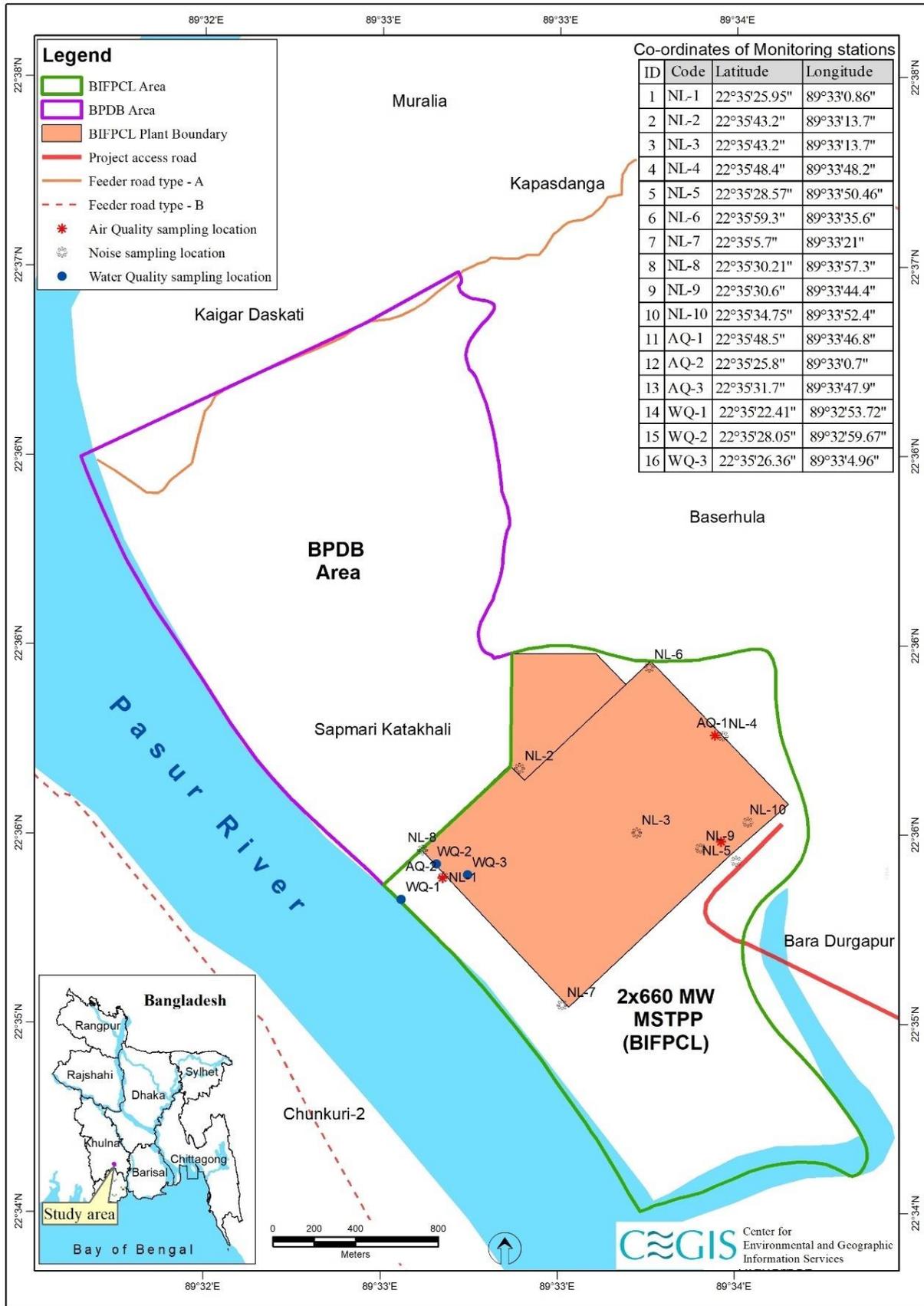


Figure 2.9: Sampling Locations Map

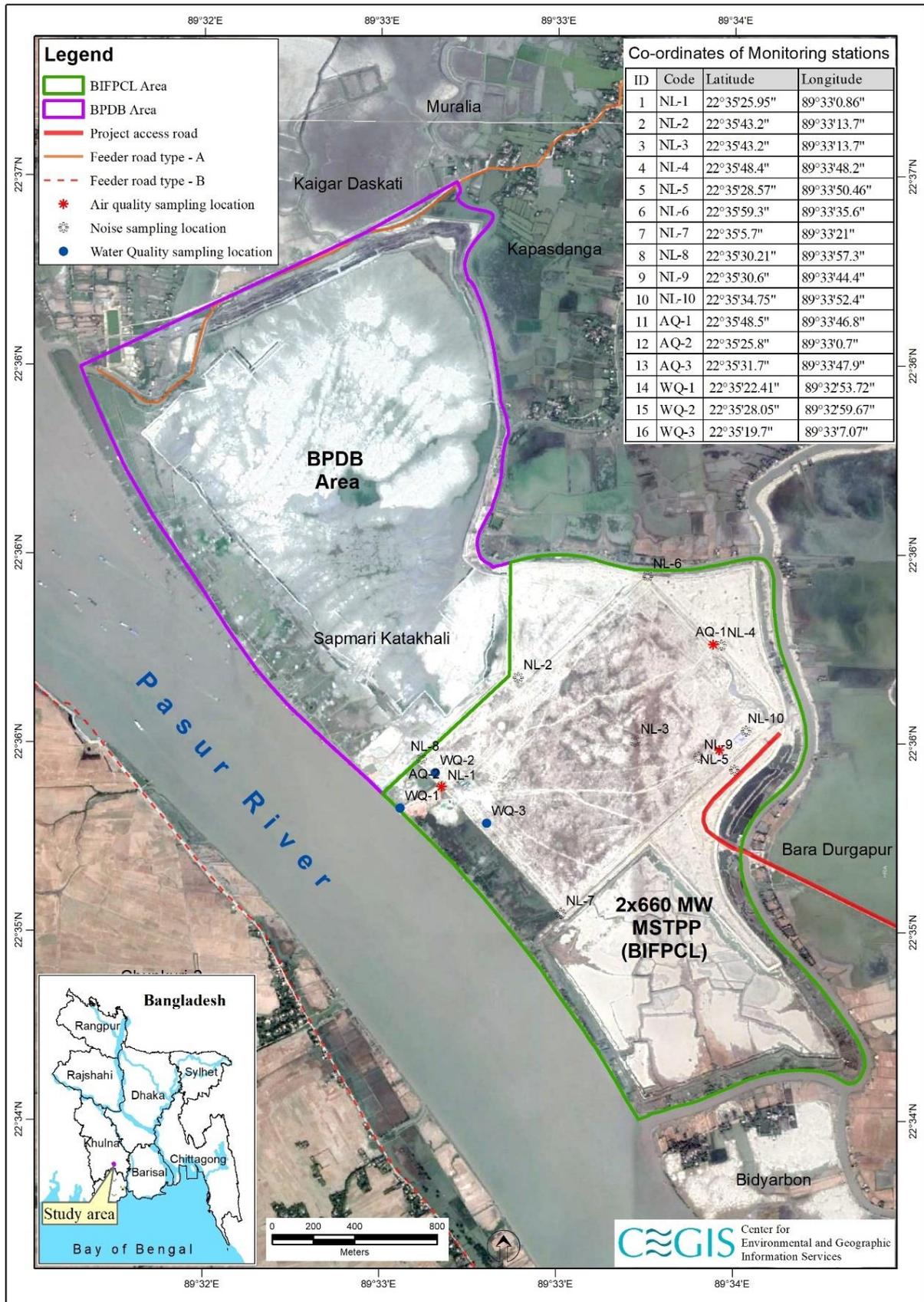


Figure 2.10: Sampling Locations in Google Map

3. Results and Discussion

Environmental compliance monitoring has been implemented by an independent organization, CEGIS under a contract signed between BHEL and CEGIS. In line with the directives of the ToR of the contract, the environmental compliance monitoring has been performed. The monthly environmental monitoring results have been generated through in-situ testing and analysis of samples at the laboratory. This report also compares the sample results with the standard limits and provides commentary on environmental issues during the month of February, 2019. Results of the previous investigations (1st to 10th month) have also been incorporated in this Report so as to compare the overall trend of the concerned environmental compliances.

3.1 Ambient Air Quality

Air quality has been sampled through volumetric sampling procedure. Samples have been collected for 24 Hours continually at three places namely labor shed, Jetty area and major construction areas inside the project site. All of the criteria pollutants have been checked in the Project site in order to assess the baseline situation as well as for the compliance standard. **Table 3.1** shows the monitoring results of the criteria pollutants.

Ambient air quality for all the pollutant gases (except PM₁₀ at Jetty location) have been recorded as well below the standard limit during this month of February, 2019. Presence of PM_{2.5}, NO_x, CO and O₃ have been recorded relatively higher than the previous months at Labour Shed and Jetty Location but these pollutant concentration are lower at major construction area. PM_{2.5}, O₃, PM₁₀ and SO_x have been found lower than the previous month at the major construction area. Increasing activities at the project site and lack of rain during the dry season were responsible for increasing pollutants' concentration in the ambient air. However, the potential sources of air pollutants during the 24 hrs. sampling are presented below:

- Increased construction activities;
- Exposed/uncovered soil of the Project site;
- Construction works such as piling, excavation, surface levelling, building construction and other civil works etc.;
- Extensive vehicular movement over the unpaved roads inside the Project area;
- Stockpile of sand, stone, debris etc.;

Since maximum project works are limited during the daytime, the pollutants' concentrations increases during the daytime and reduces during the night time. Therefore, the collective pollution concentration for each of the criteria pollutants represents the average values for 24 hrs. However, the ambient air pollutants were found within the standard limit as set by the ECR'97 and subsequent amendments. The Project authority should take further necessary actions, such as, use of covered van, regular water spraying over the exposed / uncovered top soil of the Project site, avoiding unpaved road for vehicular movement. Furthermore, the project authority should ensure the use of dust mask for the labourers etc. during working hours at the construction site for their occupational health and safety.

3.2 Water Quality

As per the Environmental Management Plan (EMP) of the EIA Report and EIA approval condition, "the Project Authority will not use ground water during construction as well as operation purposes of the Power Plant." Therefore, BHEL has to use desalinated Passur River water during this construction stage of the Power Plant. Accordingly, a small scale Reverse Osmosis (RO) desalinization Plant near the BHEL office has been operating to supply the required drinking water. Additionally, a large scale desalinization Plant based on Reverse Osmosis (RO) technology has been established near the proposed Jetty of the Project and is under operation for supplying the required water for construction at site. Moreover, this desalinization RO technology based Plant is also used for supplying drinking water for the labourers as well as officials working at the Project site.

During this monitoring period it was observed that the permanent drainage network construction is ongoing which will be used for discharging storm water of the Project area to the adjacent river. During this dry period, the available water are re-used for sprinkling for controlling dust or for curing purpose. As mentioned earlier, during this 11th monitoring program, three samples were collected, one from RO technology based Water Treatment Plant discharge outlet, one from storm water discharge outlet and one from drinking water outlets from Plant jetty site for analysis.

The analysis results have been presented in **Table 3.2, Table 3.3 and Table 3.4.**

Table 3.2: Discharge Water Quality Monitoring Result (RO Discharge Point)

Parameters	1 st MM Result (April, 2018)	2 nd MM Result (May, 2018)	3 rd MM Result (June, 2018)	4 th MM Result (July, 2018)	5 th MM Result (August, 2018)	6 th MM Result (September, 2018)	7 th MM Result (October, 2018)	8 th MM Result (November 2018)	9 th MM Result (December, 2018)	10 th MM Result (January, 2019)	11 th MM Result (February, 2019)	ECR, 1997 for Inland SW	IFC 2007, Effluent Guidelines
Temp (°C)	30.80	32.10	34.32	32.04	31.81	31.50	31.22	30.5	26.50	21.42	22.14	45 ⁰ (Winter)	3degC the edge of the mixing zone
pH	7.70	7.90	7.86	8.71	8.43	7.73	8.09	7.85	7.78	7.20	7.88	6-9	6-9
EC (µS/cm)	28,000	48,800	30,700	1180	577.00	498.00	822	1000	9480	23,300	26,600	1200	-
TDS (mg/L)	14,000	24,600	18,040	757	369.00	319.00	419.0	520	4740	14,500	16,500	2100	-
DO (mg/L)	4.50	4.90	4.34	7.86	7.32	6.84	6.64	6.15	7.84	6.35	7.88	4.8-8	-
BOD ₅ (mg/L)	2.30	2.41	2.00	1.00	1.00	1.00	1.00	12.00	11.00	50.0	60.00	50	30*
COD(mg/L)	417.25	520	480	4.00	4.00	4.00	4.00	44.00	40.00	204.00	244.00	200	125*
TH(mg/L)	4,900	5,220	4520	300	240	240	295	865	1255	2740	5300	-	-
Cl ⁻ (mg/L)	514	14,500	11800	225	105	140	76.00	2120	2910	7850	9200	600	-
SO ₄ ²⁻ (mg/L)	1209	1520	1360	43.00	16.00	53.00	26.00	650	740	760	237.30	-	-
PO ₄ ³⁻ (mg/L)	0.299	0.450	2.06	0.35	0.53	0.22	0.27	0.31	2.30	1.17	1.17	-	2*
NO ₃ ⁻ (mg/L)	5.07	5.40	3.20	2.10	3.00	2.90	1.50	3.70	6.50	7.7	7.95	10	10*
Salinity (ppt)	15.80	25.80	19	0.60	0.30	2.70	1.80	1.76	5.44	14.10	16.2	-	-
Turbidity (NTU)	13.00	10.60	10.7	41.9	28.90	12.6	7.56	9.15	16.50	10.00	2.73	-	-

Source: CEGIS field visit and laboratory analysis, 2019

Note: WQ – Water Quality; SW – Surface Water; MM: Monthly monitoring

*Sanitary Sewage Discharges of IFC, 2007

It has been observed that all of the water quality parameters in the discharge from RO Plant (near the jetty site) contains high concentration of the selected parameters than the previous month due to seasonal shifting towards driest period when upstream sweet water flow reduces significantly. It may be mentioned here that, the intake river water chemical composition (parameters) were in the higher concentration trend during the post-monsoon period. However, maximum parameters have been found within the standard limit of ECR, 1997 except EC, TDS, BOD, COD and Cl⁻). Water quality of Passur River changes with the seasonal variation from post-monsoon to dry season which is the main cause of changing the intake water parameters. Reduction of upstream flow during the dry season implies to increase salinity intrusion into the Passur River from the Bay-of Bengal. Since the RO intake water is already concentrated with high salinity and other physio-chemical parameters, which is further concentrated during RO process. However, some of the parameter like EC, TDS, BOD, COD and Cl⁻ has been breached the national standard limit. But the total daily maximum load is so minute with respect to Passur river tidal flow that the effects would be insignificant.

Table 3.3: Storm Water Discharge Quality Monitoring Result

Parameters	3 rd MM Result (June 2018)	4 th MM Result (July 2018)	5 th MM Result (August 2018)	6 th MM Result (September 2018)	7 th MM Result (October 2018)	8 th MM Result (November 2018)	9 th MM Result (December 2018)	10 th MM Result (January 2019)	11 th MM Result (February 2019)	ECR , 1997 for Inland SW	IFC 2007, Effluent Guidelines	Remarks
Temp (°C)	31.98	35.80	32.67	31.02	32.2	30.00	27.00	21.95	25.64	45 (Winter)	3°C at the edge of the mixing zone	
pH	8.16	7.94	7.56	7.80	7.53	7.15	7.04	7.96	8.10	6-9	6-9	
EC (µS/cm)	1190	12,500	3830	823	7510	5500	2108	5,710	5,140	1200	-	
TDS (mg/L)	593	7,780	2450	519	3650	2715	1052	3,600	3,240	2100	-	
DO(mg/L)	4.63	6.84	6.89	6.92	7.31	6.95	6.89	8.51	6.84	4.8-8	-	
BOD ₅ (mg/L)	2.00	3.00	12.00	4.00	5.00	7.00	26.00	14.00	12.00		30*	
COD(mg/L)	8.00	16.00	50.00	1.00	16.00	24.00	80.00	52.00	48.00		125*	
TH(mg/L)	300	3900	655	765	770	325	495	715	2500		-	
Cl(mg/L)	290	3850	880	1360	1660	305	505	1540	1410		-	
SO ₄ ²⁻ (mg/L)	69	750	190	480	250	57.00	120	360	153.86		-	
PO ₄ ³⁻ (mg/L)	1.91	0.37	0.43	0.36	0.18	0.31	0.42	0.67	0.80		2*	
NO ₃ ⁻ (mg/L)	5.60	4.20	3.30	0.40	3.20	2.00	1.726	10.00	2.694		10*	
Salinity (ppt)	0.6	7.10	2.00	0.40	1.60	1.10	1.12	3.10	2.80		-	
Turbidity (NTU)	334	89.3	15.30	11.60	2.15	3.30	5.24	25.00	12.20		-	

Source: CEGIS 2019

Note: WQ – Water Quality; SW – Surface Water; MM: Monthly monitoring

*Sanitary Sewage Discharges of IFC, 2007

Storm water discharge consists of the rainfall runoff, washout from the project site and other sources within the project area. No national or international standards have been fixed for storm water discharge quality. Since the storm water was released from the Project Site, the standard for effluent has been used for compliance.

Table 3.3 shows the measured storm water discharge quality. Most of the measured water quality parameters were recorded higher than the previous month which implies that for the Project Authority should look for better waste management of the project. The EC and TDS value is still higher than the standard limit. Solid and liquid waste disposal from the construction yard, labor shed and other sources might be responsible for EC and TDS increase. Moreover, the discharge from construction waste water, batching Plant water, washing water, curing water, subsurface water increases the EC and TDS of the storm water discharge.

Drinking water is supplied to the workers continuously. The labourers usually take their required drinking water from the RO supply line established near the Jetty location. **Table 3.4** shows the quality of drinking water supplied to the labourers living near the Jetty Area.

Table 3.4: Drinking Water Quality Monitoring Result (Near Jetty Area)

Parameters	1 st MM Result (April 2018)	2 nd MM Result (May 2018)	3 rd MM Result (June 2018)	4 th MM Result (July 2018) Near BHEL Office	5 th MM Result (August 2018)	6 th MM Result (September 2018)	7 th MM Result (October 2018)	8 th MM Result (November 2018)	9 th MM Result (December 2018)	10 th MM Result (January 2019)	11 th MM Result (February 2019)	ECR , 1997 standard for Drinking Water
Temp (°C)	31.8	31.70	31.86	33.93	31.63	30.2	31.81	30.3	27.15	25.86	22.60	20-30
pH	8.70	8.97	8.80	6.08	8.09	8.70	8.32	8.10	8.19	6.64	9.04	6.5-8.5
EC (µS/cm)	70.50	176.00	272	1.00	13.00	54.25	112.0	105.0	52.40	222	733.0	-
TDS (mg.L-1)	34.80	87.00	135	0.00	9.00	26.14	53.0	50.00	26.20	140	470.0	1000
DO (mg.L-1)	4.10	5.14	4.5	7.63	7.56	7.10	7.35	7.20	7.34	7.50	8.15	6.0
BOD ₅ (mg.L-1)	2.10	2.08	1.00	1.00	1.00	8.00	1.00	1.00	2.00	1.00	1.00	2.00
COD (mg.L-1)	bdl	4.00	4.00	4.00	4.00	3.00	4.00	4.00	8.00	4.00	4.00	4.00
TH (mg.L ⁻¹)	bdl	105.00	220	105	115	120.00	135	125.0	145.0	70.00	105.00	200-500
Cl ⁻ (mg.L ⁻¹)	102.80	36.00	70.00	10.00	10.00	11.00	10.00	24.00	18.00	52.00	120.00	150-600
SO ₄ ²⁻ (mg.L ⁻¹)	11.65	4.00	2.00	1.00	1.00	1.00	1.00	2.00	1.00	1.00	6.98	400
PO ₄ ³⁻ (mg.L ⁻¹)	0.0795	0.18	0.66	0.25	0.50	0.23	0.10	0.24	0.25	0.12	0.36	6.00
NO ₃ ⁻ (mg.L ⁻¹)	1.83	0.10	0.4	4.6	2.1	1.70	0.70	1.60	0.128	5.2	1.70	10.00
Salinity (ppt.)	1.00	0.20	0.10	0.00	0.00	0.21	0.0	0.15	0.026	0.10	0.40	-
Turbidity (NTU)	5.08	8.81	9.60	0.001	10.00	4.02	0.50	1.50	1.24	0.92	0.29	10.00

Source: CEGIS 2019

Note: WQ – Water Quality; SW – Surface Water; MM: Monthly monitoring

*Sanitary Sewage Discharges of IFC, 2007, bdl- beyond detectable limit; MM: Monthly monitoring

The drinking water quality is considered acceptable as most of the parameters were well within the standard limit. However, EC, TDS, SO_4^{2-} , Cl^- and Salinity were recorded higher than that of previous month. However, all of the parameters were recorded within the standard limit except pH. RO Plant discharge quality might be readjusted to reduce the pH level.

3.3 Ambient Noise Level

The ambient noise level has been monitored at 10 locations inside the Project area, which has been presented in **Figure 2.9 and Figure 2.10**. The locations were selected based on the sensitivity of the areas and potentiality of the impact magnitude. Monitoring results of the ambient noise is shown in **Table 3.5**. Results were recorded from 10 sampling locations during both day and night time as the equivalent noise level (Leq) in dBA scale.

Table 3.5: Ambient Noise Level from In and Around the Project Site

Location Name	Types of Area	Time	Noise Level dB(A)	Noise Level dB(A)	Bangladesh Noise Pollution Control Rule, 2006dB(A) Leq	IFC 2007 dB(A) Leq	Remark									
			Leq (1 st MM)	Leq (2 nd MM)	Leq (3 rd MM)	Leq (4 th MM)	Leq (5 th MM)	Leq (6 th MM)	Leq (7 th MM)	Leq (8 th MM)	Leq (9 th MM)	Leq (10 th MM)	Leq (11 th MM)			
Jetty Site NL-1	Industrial	D	59.3	59.0	66.6	62.5	61.0	52.9	58.6	65.9	68.1	66.8	61.9	75	70	Movement of heavy vehicles, Soil leveling, crane activities and human chattering etc.,
		N	55.0	66.9	47.3	58.6	59.2	53.3	63.8	55.1	63.0	61.5	65.0	70	70	Movement of vehicles, noise from water treatment plant and air quality machine running etc.
Township Construction Area NL -2	Industrial	D	59.5	55.5	56.6	62.9	59.3	62.9	59.8	64.4	65.8	52.8	59.1	75	70	Noise generated due to construction activities, Movement of heavy vehicles
		N	55.3	63.3	66.6	69.3	63.1	59.1	59.1	51.5	55.0	58.4	60.2	70	70	Noise generated due to vehicle movement Hornking and human soil compaction etc.
Construction Area NL-3	Industrial	D	58.7	68.8	70	73.6	67.0	60.7	55.2	60.0	65.6	60.1	59.6	75	70	Noise generated due to construction activities and vehicle movement etc.
		N	63.2	70.3	51.3	61.4	62.8	56.4	60.1	66.7	67.0	62.4	61.8	70	70	Noise generated due to construction activities, vehicle movement and human chattering etc.
Labor Shed (Area) NL-4	Residential	D	58.2	65.6	49.6	57.5	54.1	50.0	58.9	55.0	54.9	52.8	59.4	55	55	Noise generated from pump motor, Pilling activities, Vehicle movement, and Human chattering etc.

Location Name	Types of Area	Time	Noise Level dB(A)	Noise Level dB(A)	Bangladesh Noise Pollution Control Rule, 2006dB(A) Leq	IFC 2007 dB(A) Leq	Remark									
			Leq (1 st MM)	Leq (2 nd MM)	Leq (3 rd MM)	Leq (4 th MM)	Leq (5 th MM)	Leq (6 th MM)	Leq (7 th MM)	Leq (8 th MM)	Leq (9 th MM)	Leq (10 th MM)	Leq (11 th MM)			
		N	44.4	59.9	60.6	61.1	61.9	69.0	51.0	62.2	56.7	59.8	60.0	45	45	Generator running, Pile driving, Human chattering, Engine noise and vehicle movement etc.
Near Entrance Gate in front of Health Care Center NL-5	Commercial Area	D	59.6	60.6	62.5	63.6	51.5	60.6	62.0	65.0	64.2	60.9	60.3	70	70	Noise generated from Vehicle movement, running of construction machine and human chattering etc.
		N	49.2	52.8	57.3	64.7	65.2	60.9	63.5	63.3	62.5	61.8	60.9	60	70	Noise generated from Vehicle movement, running of construction machine and human chattering etc.
North-East corner of the PB NL-6	Industrial	D	53.8	51.6	45.3	46.6	44.5	52.4	58.6	58.0	54.6	47.5	48.5	75	70	Noise generated due to sound of birds.
		N	45.9	49.7	48.3	54.8	46.0	46.8	47	44.8	49.1	49.5	49.1	70	70	Construction works noise
South –West Corner NL-7	Industrial	D	60.6	55.8	44.5	53.2	53.0	52.3	52.0	74.3	68.4	50.9	65.5	75	70	Construction activities, rod cutting, crane activities, hammering and vehicular movements etc.
		N	53.5	52.4	49.7	55.9	51.5	57.7	52.6	70.0	64.7	66.9	66.0	70	70	Pile driving activities, Construction activities, pump motor running, hammering, welding and vehicular movements etc.
	Industrial	D	49.8	54.4	57.4	59.5	62.5	49.2	47.5	47.2	47.1	48.2	51.9	75	70	Noise generated due to soil compaction

Location Name	Types of Area	Time	Noise Level dB(A)	Noise Level dB(A)	Bangladesh Noise Pollution Control Rule, 2006dB(A) Leq	IFC 2007 dB(A) Leq	Remark									
			Leq (1 st MM)	Leq (2 nd MM)	Leq (3 rd MM)	Leq (4 th MM)	Leq (5 th MM)	Leq (6 th MM)	Leq (7 th MM)	Leq (8 th MM)	Leq (9 th MM)	Leq (10 th MM)	Leq (11 th MM)			
North west corner of the Project boundary NL-8		N	63.4	50.5	42.3	62.0	49.4	46.8	49	64.5	62.3	57.9	49.0	70	70	Noise generated due to vehicular movement, sound of insect, soil compaction and Honking etc.
Major construction Area NL-9	Industrial	D	58.5	71.1	66.8	72.1	70.0	72.5	65.5	72.8	71.4	65.2	72.0	75	70	Noise generated from construction activities, crane operation, bulldozing activities, grounding and running of generators etc.
		N	55.1	73.3	61.5	70.3	66.2	65.2	70.7	62.8	69.5	70.7	63.1	70	70	. Noise generated from construction activities and Vehicular movement etc.
Near BIFPCL Area NL-10	Commercial	D	62.8	62.8	59.9	51.3	62.4	45.6	53.3	52.8	57.1	56.2	62.3	70	70	Vehicular movement Nearby construction works, Human passing by, Sound of birds etc.
		N	49.4	51.1	45.9	55.7	56.4	54.0	56	63.8	66.8	70.2	62.9	70	70	Vehicular movement, Honking, Construction Activities and noise of nocturnal animals (such as, insects and frogs)

Source: CEGIS, 2019

Massive civil construction activities and mechanical construction are being carried out at the project site by BHEL as per design and stipulated time schedule. The sources of noise have been identified and presented in **Table 3.5**. The construction activities, vehicular movement, running of generator, Crane activities, soil compaction machineries, excavators' activity, Soil levelling activity and wind blowing are the major sources of noise generation. As seen from the above Table, the night-time and day-time noise level at labor shed areas (NL-4), night-time at near the entrance gate in front of healthcare centre (NL-5) and day-time noise level at Major Construction Area (NL-9) has exceeded the national standard limit. Operation of generator, construction works, human passing by, crane operation, bulldozing activities, pile driving and vehicular movement are responsible for increased noise level at labor shed and entrance gate. Heavy construction works during the daytime might be responsible for exceeding the standard noise limit at construction yard. Proponent was informed about this situation and suggestions provided for necessary improvement of this situation.

4. Follow-up Action

The monitoring activities have been performed independently in order to capture the worst-case scenarios of the vital environmental parameters. The result of the environmental parameters shows that most of the monitored environmental parameters are within the permissible limit of Bangladesh standard. A few water quality parameters e.g. EC, TDS and Cl⁻ from RO Plant discharge water and EC value of storm water discharge and COD value of drinking water have been recorded to be higher than the standard limit. The night time noise level at the labor shed area, entrance gate in front of Healthcare Centre and day time noise level at the major construction yard exceeds the national standard.

In order to reduce the water pollution and noise level and to keep the parameters within the Bangladesh standard the following measures should be adopted in the coming months.

- RO discharge water quality is directly influenced by intake river (Passur) water quality. Therefore, the EC, TDS, Cl⁻, BOD and COD were increased. However, the proponent may intake the river water during low tide period (if possible) in order to avoid sea water as much as possible. Chemical process of RO Plant should be adopted in such a way that will reduce the COD discharge and drinking water pH..
- The captive generators should be shut down or moved at a distance from the labor shed area after 9:00 pm for reducing the noise level.
- Ensure use of the PPEs by the labourers working at construction yard.

A	Monitoring	Description of equipment/ Indicators	Standard/Situation	Observed Situation($\mu\text{g}/\text{m}^3$)	Deviation / Change (\pm %)	Performance / Comments	Remarks
			7. Oxides of Sulfur (SO _x)-365 $\mu\text{g}/\text{m}^3$	f. CO = 22.0 g. O ₃ = 06 AQ-3(Major Construction area): a. SO ₂ = 11.3 b. NO _x = 12.1 c. SPM = 129.4 d. PM ₁₀ = 88.7 e. PM _{2.5} = 21.2 f. CO = 18.0 g. O ₃ = 01		AQ 3- Within the standard limit	
2	Water quality measuring instrument	HORIBA U-50 Multi-meter and Lab Analysis	Standard (Effluent Guidelines) a. Temperature.=3 ^o C at the age of the mixing zone, IFC2007; 40 ^o C (ECR, 1997) b. pH=6-9 (ECR, 1997;IFC,2007) c. EC=1200 ($\mu\text{S}/\text{cm}$) (ECR, 1997) d. TDS=2100 mg/L(ECR,1997) e. DO=4.8-8 (mg/L) (ECR,1997) f. BOD ₅ =50 (mg/L) (ECR,1997)/30 (mg/L) (IFC, 2007) g. COD=200 mg/L (ECR, 1997)/125 (mg/L) (IFC, 2007). h. TH=N/A Cl ⁻ =600 mg/L (ECR, 1997) i. SO ₄ ²⁻ =N/A	WQ-1: RO Discharge Water a. Temp = 22.14 (^o C), b. pH = 7.88 c. EC = 26,600($\mu\text{S}/\text{cm}$) d. TDS = 16,500(mg/L) e. DO = 7.88(mg/L) f. BOD ₅ = 60.00 (mg/L) g. COD = 244(mg/L) (std. 125, IFC-2007) h. TH = 5300(mg/L) i. Cl ⁻ = 9200(mg/L) j. SO ₄ ²⁻ = 237.30(mg/L) k. PO ₄ ³⁻ = 1.17(mg/L) l. NO ₃ ⁻ = 7.95(mg/L) m. Salinity = 16.20 (ppt.) n. Turbidity = 2.73 (NTU) WQ-2: Drinking Water	N/A	WQ -1 All of the parameter within the standard limit except EC, TDS, COD and Cl ⁻	The intake water of Passur river was higher EC and TDS due to dry season

A	Monitoring	Description of equipment/ Indicators	Standard/Situation	Observed Situation($\mu\text{g}/\text{m}^3$)	Deviation / Change (\pm %)	Performance / Comments	Remarks
				n. Turbidity= 12.20 (NTU)			
3	Noise quality measuring instrument	Kanomax Sound level meter- MODEL 4431	<ol style="list-style-type: none"> 1. std. ECR 2006, day= 75dB(A),Night=70 dB(A) IFC2007, day=70 dB(A), night=70 dB(A) 2. std. ECR 2006, day= 75 dB(A),Night=70 dB(A) IFC2007, day=70 dB(A), night=70 dB(A) 3. std. ECR 2006, day= 75 dB(A),Night=70 dB(A); IFC2007, day=70 dB(A), night=70 dB(A) 4. std. ECR 2006, day= 55 dB(A),Night=45 dB(A);IFC2007, day=55 dB(A), night=45 dB(A) 5. std. ECR 2006, day= 70 dB(A),Night=60 dB(A);IFC2007, day=70 dB(A), night=70 dB(A) 6. std. ECR 2006, day= 75 dB(A),Night=70 dB(A);IFC2007, day=70 dB(A), night=70 dB(A) 7. std. ECR 2006, day= 75 dB(A),Night=70 dB(A); IFC2007, day=70 dB(A), night=70 dB(A) 	<ol style="list-style-type: none"> 1. <u>Jetty Site NL-1,</u> Day = 61.9 dB(A), Night = 65.0 dB(A) 2. <u>Township Construction Area NL -2,</u> Day = 59.1 dB(A), Night = 60.2 dB(A) 3. <u>Construction Area NL-3,</u> Day = 59.6 dB(A), Night = 61.8 dB(A) 4. <u>Labor Shed (Area) NL-4,</u> Day = 59.4 dB(A), Night = 60.0 dB(A) 5. <u>Near Entrance Gate in front of Health Care Center-NL-5,</u> Day = 60.3 dB(A), Night = 60.9 dB(A) 6. <u>North-East corner of the PB NL-6,</u> Day = 48.5 dB(A), Night = 49.1 dB(A) 7. <u>South -West Corner NL-7,</u> Day = 65.5 dB(A), Night = 66.0 dB(A) 8. <u>North west corner of the Project boundary NL-8,</u> Day = 51.9 dB(A), 	N/A	All values were within standard limit except at NL-4 (Night time and Day time), NL-5 (Night), NL -9 (Day time), where it exceeded the standard limit	Construction works, vehicular movement and operation of diesel generator and heavy construction works at night were responsible for slightly higher of noise level.

A	Monitoring	Description of equipment/ Indicators	Standard/Situation	Observed Situation($\mu\text{g}/\text{m}^3$)	Deviation / Change (\pm %)	Performance / Comments	Remarks
			8.. std. ECR 2006, day= 75 dB(A),Night=70 dB(A); IFC2007, day=70 dB(A), night=70 dB(A) 9. std. ECR 2006, day= 75 dB(A),Night=70 dB(A); IFC2007, day=70 dB(A), night=70 dB(A) 10. std. ECR 2006, day= 70 dB(A),Night=60 dB(A); IFC2007, day=70 dB(A), night=70 dB(A)	Night = 49.0 dB(A) <u>9. Major construction Area NL-9,</u> Day = 72.0 dB(A), Night = 63.1 dB(A) <u>10. Near BIFPCL Area NL-10,</u> Day = 62.3 dB(A), Night = 62.9 dB(A)			
Activities of monitoring							
4	Digital process and online system						
5	Documentation/ archiving the monitoring data						
6	Number of accidental events						
7	Sampling of biota to the susceptible zone						
8	LCA of bio indicators						
9	Toxicity magnitude						
10	Behavioral/ attitude in all changes of fauna						

A	Monitoring	Description of equipment/ Indicators	Standard/Situation	Observed Situation($\mu\text{g}/\text{m}^3$)	Deviation / Change (\pm %)	Performance / Comments	Remarks
11	Performance of the Ecosystem management plan						
Interrogating to the investigator							
12	Regularity and authenticity check						
13	Continuation of training and capacity building and awareness, motivational program						
14	Ensure PEPs, ISO standards and ILL during operation of the projects						
15	Ensure the social development program and CSR during the operation of the project						
Interviews of the stakeholders							
16	Socio-economic Progress investigation						
17	Assessing Environmental pollution related problems						

A	Monitoring	Description of equipment/ Indicators	Standard/Situation	Observed Situation($\mu\text{g}/\text{m}^3$)	Deviation / Change (\pm %)	Performance / Comments	Remarks
18	Assess the changes of bio-diversity and ecosystem fragility						
19	Achievement of the social development program						
20	Checking of the Proper implementation of the EMP						

B. EVALUATION (of any of above points)

C. STEPS To Be TAKEN:

Non Compliance	Action	Tine Frame
1. Minor:		
2. Moderate:		
3. Major:		
4. Critical:		