








Environmental and Social Impact Assessment Study of 589.75 (net) MW on Gas (NG/RLNG)/ 541.22 (net) MW on Liquid Fuel (HSD) of Combined Cycle Power Station: *Meghnaghat Power Hub, Narayanganj District, Bangladesh*

Summit Meghnaghat II Power Company Limited (SMIIPCL)

Report

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CONTENTS

0	*EXECUTIVE SUMMARY*	*I*
0.1	*INTRODUCTION AND BACKGROUND*	*I*
0.2	*PROJECT ALTERNATIVES*	*V*
0.3	*PROJECT AREA OF INFLUENCE*	*VII*
0.4	*KEY IMPACTS FOR DECISION MAKING*	*XIII*
0.5	*PROJECT BENEFITS*	*XIX*
0.6	*ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN*	*XX*
0.7	*CONCLUSION*	*XXIII*
1	*INTRODUCTION*	*1*
1.1	*BACKGROUND*	*1*
1.2	*OVERVIEW OF THE PROJECT*	*3*
1.3	*PURPOSE AND OBJECTIVE OF THE STUDY*	*5*
1.4	*SCOPE OF ESIA STUDY*	*5*
1.5	*APPROACH AND METHODOLOGY*	*6*
1.6	*ESIA TEAM*	*10*
1.7	*REPORT STRUCTURE*	*11*
1.8	*LIMITATIONS*	*13*
2	*PROJECT DESCRIPTION*	*15*
2.1	*THE PROJECT*	*15*
2.2	*KEY PROJECT COMPONENTS*	*28*
2.3	*RESOURCES REQUIREMENT AND UTILITIES*	*33*
2.4	*PROJECT LIFE CYCLE OVERVIEW ALONG WITH KEY ACTIVITIES AND SCHEDULE*	*41*
2.5	*POLLUTION MONITORING SYSTEM*	*44*
2.6	*SAFETY PROVISIONS*	*45*
2.7	*PROJECT SCHEDULE*	*47*
2.8	*ANALYSIS OF ALTERNATIVES*	*48*
3	*ADMINISTRATIVE FRAMEWORK*	*52*
3.1	*INTRODUCTION*	*52*
3.2	*ENVIRONMENT-RELATED POLICIES IN BANGLADESH*	*52*
3.3	*ENVIRONMENT AND SOCIAL RELATED LEGISLATIONS IN BANGLADESH*	*55*
3.4	*ADMINISTRATIVE SETUP RELATED TO ENVIRONMENT IN BANGLADESH*	*63*
3.5	*PROJECT RELEVANT INTERNATIONAL TREATIES AND CONVENTIONS*	*67*
3.6	*INTERNATIONAL SAFEGUARD REQUIREMENTS*	*68*
3.7	*APPLICABLE EHS STANDARDS*	*82*
3.8	*APPLICABLE ENVIRONMENTAL STANDARDS*	*82*
4	*ENVIRONMENTAL AND SOCIAL BASELINE CONDITIONS*	*85*
4.1	*INTRODUCTION*	*85*
4.2	*PROJECT INFLUENCE AREA*	*85*

4.3	*PHYSICAL ENVIRONMENT*	*89*
4.4	*ECOLOGICAL ENVIRONMENT*	*147*
4.5	*SOCIAL ENVIRONMENT*	*158*
5	*ENVIRONMENTAL AND SOCIAL SCREENING AND SCOPING*	*180*
5.1	*SCREENING*	*180*
5.2	*SCOPING*	*183*
6	*IMPACT ASSESSMENT & MITIGATION/ ENHANCEMENT MEASURES*	*192*
6.1	*INTRODUCTION*	*192*
6.2	*IMPACT ASSESSMENT METHODOLOGY AND APPROACH*	*193*
6.3	*ASSESSMENT OF ENVIRONMENTAL IMPACTS - CONSTRUCTION PHASE*	*200*
6.4	*ASSESSMENT OF ECOLOGICAL IMPACTS – CONSTRUCTION PHASE*	*228*
6.5	*ASSESSMENT OF ENVIRONMENTAL IMPACTS - OPERATION AND MAINTENANCE PHASE*	*235*
6.6	*ASSESSMENT OF ECOLOGICAL IMPACTS – OPERATION AND MAINTENANCE PHASE*	*276*
6.7	*ASSESSMENT OF SOCIO-ECONOMIC IMPACTS*	*281*
6.8	*CUMULATIVE IMPACTS DUE TO OPERATION OF PROPOSED POWER PLANTS*	*288*
7	*ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN*	*301*
7.1	*MITIGATION MEASURES*	*301*
7.2	*ENVIRONMENTAL MONITORING*	*311*
7.3	*INSTITUTIONAL SETTING AND IMPLEMENTATION ARRANGEMENTS*	*319*
7.4	*TRAINING*	*322*
7.5	*PLANS FOR CONSTRUCTION AND OPERATION PHASE OF THE PROJECT*	*323*
7.6	*INSPECTION, MONITORING AND AUDIT*	*325*
7.7	*REPORTING AND DOCUMENTATION*	*325*
7.8	*ESMP REVIEW AND AMENDMENTS*	*326*
7.9	*BUDGET*	*326*
8	*RISK ASSESSMENT*	*327*
8.1	*RA STUDY OBJECTIVE*	*327*
8.2	*RA METHODOLOGY*	*328*
8.3	*HAZARD IDENTIFICATION*	*329*
8.4	*FREQUENCY ANALYSIS*	*332*
8.5	*CONSEQUENCE ANALYSIS*	*337*
8.6	*RISK REDUCTION MEASURES*	*361*
9	*STAKEHOLDER ENGAGEMENT*	*367*
9.1	*PURPOSE & OBJECTIVE OF STAKEHOLDER ENGAGEMENT*	*367*
9.2	*IDENTIFICATION OF STAKEHOLDERS*	*368*
9.3	*STAKEHOLDER CONSULTATION*	*369*
10	*CONCLUSION*	*374*
10.1	*PROJECT IMPACTS*	*375*

10.2 *OVERALL PROJECT CATEGORISATION* *376*
10.3 *ENVIRONMENTAL AND SOCIAL MANAGEMENT* *377*
10.4 *RESIDUAL IMPACTS* *377*
10.5 *CONCLUSION* *379*

TABLES

Table 1.1	Resources/Receptors and Impacts Considered in Scoping	8
Table 1.2	ESIA team and their roles	11
Table 1.3	Layout of the Report	11
Table 2.1	Salient features of the site and surroundings	19
Table 2.2	Industries in Meghnaghat (N) Industrial Cluster	22
Table 2.3	Power Plants in Meghnaghat North Industrial Cluster	23
Table 2.4	Meghna Group of Industries – Units in Meghnaghat	24
Table 2.5	Industries in Meghnaghat (S) Industrial Cluster	25
Table 2.6	Gas Specification	28
Table 2.7	HSD Specification	29
Table 2.8	Break-up of Land Requirement for the Project and Associated Utilities	33
Table 2.9	Chemicals and Storage Capacity	39
Table 2.10	Laydown and Camp Area Requirement	41
Table 2.11	Tentative Project Construction Schedule	47
Table 3.1	Policies relevant to Environment	54
Table 3.2	National Legal Instruments relevant to the Project	59
Table 3.3	Project Relevant International Treaties and Conventions	67
Table 3.4	IFC Performance Standards	73
Table 3.5	Equator Principles and their Applicability for the Project	80
Table 3.6	Stack Emission Limits	82
Table 3.7	Ambient Air Quality Standards	82
Table 3.8	Effluent Standards/ Guidelines	83
Table 3.9	Standards for Sewage Discharge	84
Table 3.10	Noise Level Standards/ Guidelines	84
Table 4.1	Details of Satellite Data used in the Study	90
Table 4.2	Landuse/Land cover statistics of the Project AOI	93
Table 4.3	Soil Quality Monitoring Locations Details	97
Table 4.4	Soil Quality Monitoring Results in the study area	100
Table 4.5	Sediment Monitoring Location	101
Table 4.6	Sediment Quality Monitoring Results in the Study Area	104
Table 4.7	Summary of Flood study (2007, 2004, 1998 and 1988) in Meghna Rover	109
Table 4.8	Surface Water Quality Monitoring Location Details	112
Table 4.9	Surface Water Quality Monitoring Results in the Study Area	114
Table 4.10	Comparative Analysis of Surface Water Data of Meghna River	115
Table 4.11	Comparative Analysis and Inferences – Meghnaghat	117
Table 4.12	Ground Water Monitoring Location	118
Table 4.13	Ground water monitoring results in the study area	120
Table 4.14	Climatic Data of the Dhaka Station (2016)	123
Table 4.15	Summary of Primary Meteorological Data Collected at Site	125
Table 4.16	Air Monitoring Locations	134
Table 4.17	Summary of Ambient Air Quality Monitoring Results	139
Table 4.18	Comparative Analysis of Air Quality in Meghnaghat Area	140
Table 4.19	Primary Noise Monitoring Locations	144
Table 4.20	Ambient Noise Quality in the Study Area	145
Table 4.21	Status of Road and River Traffic	146
Table 4.22	Herpetofaunal Species in the Study Area	150

Table 4.23	Avifaunal Species in the Study Area	151
Table 4.24	Mammalian Species within Study Area	153
Table 4.25	Surface Water Quality Monitoring Location Details	155
Table 4.26	Species Diversity Indices of Meghna River	156
Table 4.27	Study Area Break-up	159
Table 4.28	Population Trends of Narayanganj and Munshigunj Districts	160
Table.4.29	Population trends of Sonargaon, Gazaria & Meghna Upazillas	160
Table 4.30	Demography Profile of the Core Study Area	164
Table 4.31	Literacy Profile in Study Area	168
Table 4.32	Education Infrastructure in Upazilas and Districts	170
Table 4.33	Distribution of Type of Residential Structures in Core and Buffer Study Areas	171
Table 4.34	Distribution of Sanitation Units in Core and Buffer Study area	172
Table 4.35	Healthcare Infrastructure Statistics for Upazilas & Districts in Study Area	172
Table 4.36	Financial Institutions in Upazilas & Districts in Study Area	173
Table 5.1	Project Categorisation as per ADB Safeguards	180
Table 5.2	Scoping Matrix of Potential Interactions	185
Table 6.1	Magnitude Prediction Criteria	194
Table 6.2	Magnitude Definitions for Physical, Biological & Human Resources/Receptors	194
Table 6.3	Assessing Magnitude of Impact	195
Table 6.4	Sensitivity/Importance/ Vulnerability Criteria	196
Table 6.5	Definitions of Sensitivity/Importance /Vulnerability Biophysical and Human	196
Table 6.6	Categorise of Impact Significance	198
Table 6.7	Sensitivity Assessment Criteria for Soil and Sediment quality (compaction, erosion and contamination) and Landuse	201
Table 6.8	Criteria for Impact Magnitude for Assessment of Impact to Soil and Sediment Quality and Landuse	202
Table 6.9:	Sensitivity Assessment Criteria for Water Resources (Surface water and Ground water)	209
Table 6.10	Criteria for Impact Magnitude for Assessment of Impact to Surface and Ground water Resources	211
Table 6.11	Sensitivity Criteria for Air quality	216
Table 6.12	Criteria for Impact Magnitude for Assessment of Impact to Air Quality (Construction Phase)	216
Table 6.13	Sensitivity Assessment Criteria for Ambient Noise Impacts	221
Table 6.14	Magnitude Assessment Criteria for Ambient Noise Impacts	221
Table 6.15	Assumed Construction Equipment Sound Pressure Level Inventory	222
Table 6.16	Predicted Noise Levels at Noise Receptors during Construction Phase	226
Table 6.17	Habitat-Impact Assessment Criteria	229
Table 6.18	Species-Impact Assessment Criteria	230
Table 6.19	Modelling Scenarios for Air Quality Impact Assessment	241
Table 6.20	Emission Parameters for the Power Plant with Natural Gas as Fuel	243
Table 6.21	Emission Parameters for the Power Plant with HSD as Fuel	243
Table 6.22	Sensitivity Criteria for Air quality	244
Table 6.23	Criteria for Impact Magnitude for Assessment of Impact to Air Quality (Operation Phase)	244
Table 6.24	Monitoring Locations with respect to the Project	246
Table 6.25	Predicted Concentrations at Receptors due to Operation of Summit M2 with Gas and HSD as Fuel	251
Table 6.26	Maximum Predicted Concentrations due to Operation various industries in the neighbourhood with Summit M1 and M2 using Natural Gas	258

Table 6.27	Maximum Predicted Concentrations due to Operation various industries in the neighbourhood with Summit M1 and M2 using HSD as fuel	258
Table 6.28	Percentage Contribution of Summit M2 Project in Overall GLC and applicable standards	265
Table 6.29	Estimated GHG Emissions from the Plant	267
Table 6.30	Noise Emission Criteria	269
Table 6.31	Predicted Noise Levels at Noise Receptors during Operation Phase of Summit M2 Project	273
Table 6.32	Critical Levels for NO_2	277
Table 6.33	River water temperature monitoring results (Summit M1 project)	279
Table 6.34	Summary of Emissions for the Proposed Power Plants for Separate stacks in the study area	289
Table 6.35	Predicted Concentrations at Receptors due to Operation of Proposed Power Plants and Overall Cumulative Impacts	291
Table 6.36	Predicted Noise Levels at Noise Receptors during Operation Phase of Summit M2 and Reliance Power Projects	298
Table 7.1	Environmental, Ecological and Social Management Plan of the Project	303
Table 7.2	Environmental Monitoring Programme (Construction and Operation Phase)	313
Table 7.3	Roles and Responsibilities of Project Developer and EPC Contractor	319
Table 8.1	EPRG Guideline for Sulphuric Acid Exposure	332
Table 8.2	Frequency Categories and Criteria	333
Table 8.3	Primary Gas Pipeline Failure Frequency	333
Table 8.4	Primary Failure Frequency based on Diameter Class (1970-2013)	334
Table 8.5	Natural Gas Pipeline - Failure Frequency	335
Table 8.6	Hydrogen Storage - Failure Frequency Based on Release Type	336
Table 8.7	Failure Frequencies for Sulphuric Acid Piping	337
Table 8.8	Severity Categories and Criteria	337
Table 8.9	Risk Matrix	338
Table 8.10	Risk Criteria and Action Requirements	338
Table 8.11	Hydrogen Storage Tank – Risk Modelling Scenarios	340
Table 8.12	Pipeline Risk Modelling Scenarios	347
Table 8.13	Sulphuric Acid Storage Tank – Risk Modelling Scenarios	354
Table 9.1	List of Stakeholders Identified	368
Table 9.2	Summary of Stakeholder Consultations during Site Reconnaissance	369
Table 10.1	Summary of Impact Assessment and Residual Impacts	378

FIGURES

Figure 0.1	Project Location	II
Figure 0.2	Raw Material, Land and Natural Resource Footprint	IV
Figure 0.3	Impact Assessment Process	XIV
Figure 0.4	Overview of E&S Impacts and Significance of Residual Impacts	XXII
Figure 1.1	Regional setting of the proposed project	2
Figure 1.2	Impact Assessment Process	7
Figure 1.3	Sustainable Livelihoods Framework	9
Figure 1.4	Impact Assessment Approach	10
Figure 2.1	Project Location	17
Figure 2.2	Site Photographs	18
Figure 2.3	Master Layout Plan of Meghnaghat Power Hub	20
Figure 2.4	Aerial View of Meghnaghat Power Hub	21
Figure 2.5	Map showing Industries in Meghnaghat-North and Meghnaghat-South Industrial Areas	27
Figure 2.6	Tentative Plant Layout	31
Figure 2.7	HSD Supply Arrangement of Summit M-1 Project	32
Figure 2.8	Water Balance Diagram	37
Figure 2.9	Proposed wastewater treatment system	38
Figure 2.10	Map Showing Temporary Jetty Location	41
Figure 2.11	Map showing Areas Available for Laydown and Camps within Meghnaghat Power Hub	43
Figure 3.1	DOE Environmental Clearance Applicability and Procedure	65
Figure 3.2	Flow Chart of EIA Process Applicable to the Proposed Project	66
Figure 4.1	Study Area Map (10 Km Radius)	88
Figure 4.2	Land use / Land cover Map of Study Area	94
Figure 4.3	Physiographic Map of Bangladesh	95
Figure 4.4	Topography Map of the Bangladesh	96
Figure 4.5	Soil Quality Monitoring Location (Primary & Secondary) Map	99
Figure 4.6	Photographs of Soil Sample Collection	100
Figure 4.7	Sediment Sampling Locations in the Study Area	103
Figure 4.8	Geological Map of Bangladesh	106
Figure 4.9	Drainage Map of the Study Area	107
Figure 4.10	Flood Affected Areas of Bangladesh	108
Figure 4.11	***Surface Water, Ground Water & Sediment Quality Monitoring Location Map***	111
Figure 4.12	Water Table Variations in Sonargaon Upazila Monitoring Wells	116
Figure 4.13	Water Table Variations in Monitoring Wells of DPHE in Meghnaghat Area	117
Figure 4.14	Climatic Sub-regions of Bangladesh	122
Figure 4.15	Graphical Representation - Temperature, Humidity & Rainfall at Dhaka	123
Figure 4.16	Monthly Humidity	124
Figure 4.17	Monthly Rainfall	124
Figure 4.18	Wind Rose of Dhaka Station	125
Figure 4.19	Windrose Diagram - Primary Baseline Monitoring Period	126
Figure 4.20	Earthquake Zone Map of Bangladesh	127
Figure 4.21	Cyclonic Storm Tracks in Bangladesh	128
Figure 4.22	Cyclone Affected Area Map of Bangladesh	129
Figure 4.23	Ambient Air Quality Monitoring Locations of Reliance Power Project	131

Figure 4.24 Map showing AQ Monitoring Locations - CEIA Study of Meghnaghat Region131
Figure 4.25 AQ Monitoring Network - ESIA Study of Summit M1 Project 132
Figure 4.26 Station wise PM $_{2.5}$ and PM_{10} Concentrations in Meghnaghat Industrial Area132
Figure 4.27 Location wise NOx Concentrations in the Meghnaghat Industrial Area 133
Figure 4.28 Air, Noise Quality, Traffic Monitoring Location Map (Primary) 135
Figure 4.29 Concentration of SPM in Study Area 136
Figure 4.30 Concentration of PM_{10} in Study Area 137
Figure 4.31 Concentration of $PM_{2.5}$ in Study Area 137
Figure 4.32 Concentration of SO_2 in Study Area 138
Figure 4.33 Concentration of NOx in Study Area 138
Figure 4.34 PM Emission Monitoring Data of Summit M-1 Project (with HSD as fuel) 141
Figure 4.35 Noise Quality Monitoring Location during CEIA Study 143
Figure 4.36 Bio-ecological Zones of Bangladesh 148
Figure 4.37 Diversity index (H′) value of phytoplankton of different sampling sites of Meghna River 157
Figure 4.38 Diversity index (H′) value of zooplankton of different sampling sites of Meghna River 158
Figure 4.39 Study Area Map showing Upazillas and Unions 162
Figure 4.40 Core Study Area Map with Union Boundaries 163
Figure 4.41 Sex wise Population Distribution within Core Study Area 165
Figure 4.42 Sex wise Population Distribution within Buffer Study Area 165
Figure 4.43 Comparison of Age-wise Population Distribution within Core Area, Upazila and District 166
Figure 4.44 Comparison of Age-wise Population Distribution within Buffer Area Unions166
Figure 4.45 Percentage of different type of road network with the study area 174
Figure 4.46 Employment Pattern of Core Area 175
Figure 4.47 Employment Pattern of Buffer Area 176
Figure 4.48 Sector Wise Employment in Core Area 176
Figure 4.49 Sector Wise Employment in Core Area 177
Figure 6.1 Assessing Significance of Impact due to Proposed Project 197
Figure 6.2 Predicted Construction Noise Levels during Daytime (Leq $_{day}$) 224
Figure 6.3 Predicted Construction Noise Levels during Night time (Leq $_{night}$) 225
Figure 6.4 Annual Windrose of the Project Site 247
Figure 6.5 Wind Class Frequency Distribution 248
Figure 6.6 Ambient Air Quality monitoring Locations with respect to Project Site 249
Figure 6.7 NOx Isopleths - 1 Hourly Maximum Ground Level Concentrations (Summit M2 Operation with Natural Gas as Fuel) 252
Figure 6.8 NOx Isopleths - 1 Hourly Maximum Ground Level Concentrations (Summit M2 Operation with HSD as Fuel) 253
Figure 6.9 SO_2 Isopleths - 24 Hourly Maximum Ground Level Concentrations (Summit M2 Operation with HSD as Fuel) 254
Figure 6.10 PM_{10} Isopleths – 24 hourly Maximum Ground Level Concentrations (Summit M2 Operation with Natural Gas as Fuel) 255
Figure 6.11 PM_{10} Isopleths – 24 Hourly Maximum Ground Level Concentrations (Summit M2 Operation with HSD as Fuel) 256
Figure 6.12 NOx - 1 Hourly Maximum Ground Level Concentrations with CCPPs using Natural Gas as Fuel 260
Figure 6.13 PM10 - 24 Hourly Maximum Ground Level Concentrations with CCPPs using Natural Gas as Fuel 261

Figure 6.14	NOx - 1 Hourly Maximum Ground Level Concentrations with Summit M1 and M2 using HSD as Fuel	262
Figure 6.15	SO2 – 24 Hourly Maximum Ground Level Concentrations with Summit M1 and M2 using HSD as Fuel	263
Figure 6.16	PM10- 24 Hourly Maximum Ground Level Concentrations with Summit M1 and M2 using HSD as Fuel	264
Figure 6.17	Noise Sources and Receptors Locations	271
Figure 6.18	Predicted Operation Phase Noise Levels of Summit M2 Project during Daytime (Leq_{day})	272
Figure 6.19	River water temperature profile (December 2017)	280
Figure 6.20	NOx Isopleths – Cumulative 1 Hourly Maximum Ground Level Concentrations from Proposed Power Plants (with Summit M2 using Natural Gas)	293
Figure 6.21	NOx Isopleths – Cumulative 1 Hourly Maximum Ground Level Concentrations from Proposed Power Plants (with Summit M2 using Liquid Fuel)	293
Figure 6.22	SO_2 Isopleths – Cumulative 24 Hourly Maximum Ground Level Concentrations from Proposed Power Plants (with Summit M2 using Liquid Fuel)	294
Figure 6.23	PM_{10} Isopleths – Cumulative 24 hourly Maximum Ground Level Concentrations from Proposed Power Plants (with Summit M2 using Liquid Fuel)	294
Figure 6.24	Predicted Operation Phase Noise Levels of Summit M2 and Reliance Power Projects during Night-time (Leq_{day})	297
Figure 7.1	Organization Chart for Environmental and Social Management and Reporting Responsibilities during Construction and Operation Phase of the Project	321
Figure 8.1	Risk Assessment Methodology	329
Figure 8.2	Gas Pipeline Failure – Distribution of Incident & Causes	334
Figure 8.3	Hydrogen Release – Consequence Probabilities	336
Figure 8.4	Hydrogen Release – Potential Consequences	339
Figure 8.5	Threat Zone Plot –Hydrogen Tank Failure (10mm dia)	341
Figure 8.6	Threat Zone Plot –Hydrogen Tank Failure (25mm dia)	342
Figure 8.7	Threat Zone Plot –Hydrogen Tank Failure (50mm dia)	343
Figure 8.8	Threat Zone Plot –Hydrogen Tank Failure (50% release and ignition)	345
Figure 8.9	Natural Gas Release – Potential Consequences	347
Figure 8.10	Threat Zone Plot – Natural Gas Pipeline Leak (25mm dia)	349
Figure 8.11	Threat Zone Plot – Natural Gas Pipeline Leak (50mm dia)	350
Figure 8.12	Threat Zone Plot – Natural Gas Pipeline Rupture	352
Figure 8.13	Threat Zone Plot– 5% release of total sulfuric acid storage	355
Figure 8.14	Threat Zone Plot– 15% release of total sulfuric acid storage	357
Figure 8.15	Threat Zone Plot– 50% release of total sulfuric acid storage	359
Figure 9.1	***Consultations with Community***	373

ANNEX

Annex A	Letter of Intent from Bangladesh Power Development Board
Annex B	Rapid Environment Assessment Checklist
Annex C	Involuntary Resettlement Assessment Checklist
Annex D	Indigenous People Assessment Checklist
Annex E	Screening Checklist for Greenfield Projects – Summit Corporation Limited
Annex F	Flora recorded at Project Site and Study Area
Annex G	Environment, Social and Health & Safety Policies of Summit Corporation Limited
Annex H	Framework Environmental and Social Management Plans for Construction Phase
Annex I	Risk Assessment Study of Liquid Fuel Storage at Summit M1 Project Site
Annex J	Procedure for Liquid Fuel Transfer – Summit M1 Project
Annex K	Emergency Response Plan – Summit M1 Project

ABBREVIATIONS

ADB	Asian Development Bank
ALARP	As Low As Reasonably Practicable
ASME	American Society of Mechanical Engineers
BFIDC	Bangladesh Forest Industries Development Corporation
BFRI	Bangladesh Forest Research Institute
BMD	Bangladesh Meteorological Department
BNH	Bangladesh National Herbarium
BPC	Bangladesh Petroleum Corporation
BPDB	Bangladesh Power Development Board
BWDB	Bangladesh Water Development Board
CCO	Chief Compliance Officer
CCPP	Combine Cycle Power Plant
CEIA	Cumulative Environmental Impact Assessment
DC	Deputy Commissioner
DG	Diesel Generator
DoE	Department of Environment
DPHE	Department of Public Health Engineering
ECA	Environmental Conservation Act
ECC	Environmental Clearance Certificate
ECR	Environmental Conservation Rules
EGIG	European Gas Pipeline Incident Data Group
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPFI	Equator Principles Financial Institution
EQS	Environmental Quality Standard
ERM	ERM India Private Limited
ERP	Emergency Response Plan
ERPG	Emergency Response Planning Guidelines
ESIA	Environmental and Social Impact Assessment
ETA	Event Tree Analysis
ETP	Effluent Treatment Plant
FD	Forest Department
FI	Financial Intermediaries
FNTP	First Notice to Proceed
FPIC	Free, Prior, and Informed Consent
FSA	Fuel Supply Agreement
GHG	Green House Gases
GIIP	Good International Industry Practice
GoB	Government of Bangladesh
GSA	Gas Supply Agreement
GSS	Grid Sub-station
GT	Gas Turbine
GT	Gas Turbine
GTCL	Gas Transmission Company Limited
HFL	High Flood Level
HRSG	Heat Recovery Steam Generator

HSD	High Speed Diesel
IA	Implementation Agreement
ICP	Informed Consultation Process
IEC	Important Environmental Components
IEE	Initial Environmental Examination
IFC	International Finance Corporation
ILO	International Labour Organisation
IP	Indigenous People
IPP	Indigenous Peoples Plan
IR	Involuntary Resettlement
LAC	Land Allocation Committee
LEL	Lower Explosive Limit
LFL	Lower Flammability Limit
LGED	Local Government Engineering Department
LILO	Line-in Line-out
LLA	Land Lease Agreement
LNG	Liquefied Natural Gas
LOC	Level of Concern
LOI	Letter of Intent
MCR	Maximum Continuous Rating
MSL	Mean Sea Level
NEC	National Electrical Code
NEMAP	National Environment Management Action Plan
NFPA	National Fire Protection Association, USA
O&M	Operation and Maintenance
PGCB	Power Grid Company of Bangladesh
PPA	Power Purchase Agreement
PS	Performance Standards
PWD	Public Works Datum
RA	Risk Assessment
REA	Rapid Environmental Assessment
RFI	Request for Information
RHD	Roads and Highways Department
RLNG	Regasified LNG
RP	Resettlement Plan
SCC	Site Clearance Certificate
SCL	Summit Corporation Limited
SIA	Social Impact Assessment
SMIIPCL	Summit Meghnaghat II Power Company Limited
SMPCL	Summit Meghnaghat Power Company Limited
SPS	Safeguard Policy Statement
ST	Steam Turbine
STP	Sewage Treatment Plant
T/L	Transmission Line
ToR	Terms of Reference
UEL	Upper Explosive Limit
VCE	Vapour Cloud Explosion
WB	World Bank

0 EXECUTIVE SUMMARY

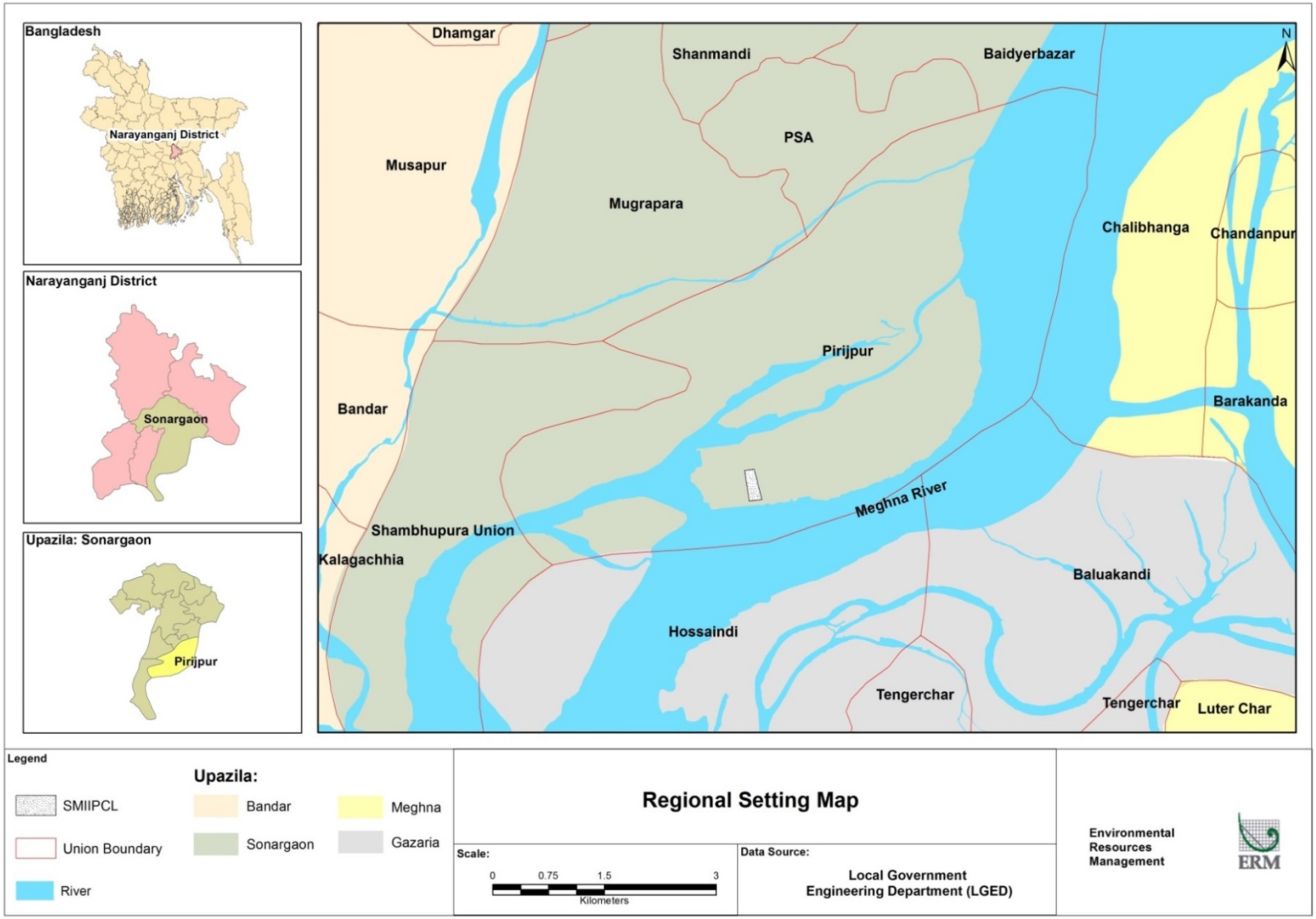
0.1 INTRODUCTION AND BACKGROUND

Summit Meghnaghat II Power Company Limited (SMIIPCL), a wholly owned subsidiary of Summit Corporation Limited ("SCL"), is proposing to set up a dual fuel fired combined cycle power project with net generation capacity 589.75 MW on imported regasified natural gas (RLNG) and 541.22 MW on high speed diesel (HSD) at Meghnaghat Power Hub in Narayanganj District of Dhaka Division, Bangladesh (hereinafter referred to as "the project" of "Summit M2"). The project site is located approximately 30 km south-east of Dhaka on the right bank of River Meghna. Project location map is presented in ***Figure 0.1***.

This non-technical summary (NTS) presents salient features of the project, the main findings and the conclusions of the Environmental and Social Impact Assessment (ESIA). The ESIA has been prepared in accordance with the following:

- The Environment Conservation Act, 1995 and The Environment Conservation Rules, 1997 and amendments thereof by the Ministry of Environment and Forest, Government of Bangladesh;
- Applicable Bangladesh national, regional and local regulations;
- International conventions and agreements ratified by Bangladesh;
- ADB's Safeguard Policy Statement (SPS) (2009) and specific requirements;
- IFC Performance Standards for Environmental and Social Sustainability (2012);
- IFC General EHS Guidelines (2007) and for Thermal Power Plants (2008);
- Equator Principles III (2013).

Figure 0.1 Project Location



Project Components

The main power block of the plant will consist of one dual fuel GT, one ST and one HRSG along with bypass and main stacks. The key components are as follows:

- Gas Turbine;
- Heat Recovery Steam Generator;
- Steam Turbine;
- Steam Turbine Condenser;
- Fuel Gas Compression and Conditioning System;
- Water System including cooling water system;
- Electrical System;
- Connection from Summit M-2 switch yard to PGCB sub-station;
- Air Conditioning and Ventilation System;
- Control and Instrumentation System;
- Regulating and metering station (RMS) for natural gas compression and conditioning;
- Natural gas pipeline from Valve Station to the RMS of the plant;
- Water intake structure;
- Effluent Treatment Plant (ETP);
- Sewage Treatment Plant (STP); and
- Cooling water discharge channel/ pipeline.

PGCB is currently having a 230 kV grid sub-station within the Meghnaghat power hub, which is supporting the existing power plants. PGCB has planned to set up a 400 kV grid sub-station to cater the need of proposed power plants in Meghnaghat Power hub. The 400 kV transmission line (T/L) network (Madunaghat and Aminbazar) are already completed and currently connected with the 230 kV GSS. Proposed 400kV GSS is close to the project boundary of Summit M-2 and therefore will not require construction of new transmission line

Figure 0.2 illustrates the overall raw material, land and natural resources footprint:

Figure 0.2 Raw Material, Land and Natural Resource Footprint



Treated effluent and cooled water will be discharged into Meghna River through a 500m buried pipeline from the guard pond. The project will also include fire protection systems and pollution monitoring systems as per regulatory requirements and the industry good practices.

Project Lifecycle and Timelines

Early works prior to commencement of construction will include:

- Clearing of site including vegetation clearance and scrap removal. No earth filling is expected considering that the site is already developed, however, site levelling may be required depending upon ground conditions.
- Construction of boundary wall, identifying space for construction offices of the sub-contractors of vendors, temporary fire-fighting system, construction water and construction power facility;
- This would be followed by site levelling and grading, construction of in-plant road network for ease of movement of plant and equipment and developing temporary drainage facility; development of laydown area/s and workers camp for construction etc.

All the mechanical, electrical, civil and I&C construction materials along with consumables will be procured by the contractors of individual package. Aggregates, sand and cement etc. will be procured locally.

SMIIPCL will recruit the required personnel to operate and maintain the power station. Beside the operators will be trained by the OEM specialists at their shops and at site to develop requisite expertise for operation of the GE GT in line with OEM recommendation. The O&M staff would be in place during commissioning stage so that they will be associated with the OEM team during pre-commissioning stage of the unit.

The construction and commissioning schedule of the project from first notice to proceed (FNTP) to commissioning of combined cycle operations is about 30 months.

The design life of the power plant is estimated to be 30 years, which is almost 8 years more than the Power Purchase Agreement term. If the Power Purchase Agreement, Land Lease Agreement, Gas Supply Agreement and the other relevant agreements are not extended or renewed and an alternative economical fuel is available, the power plant may be retrofitted to support alternative power generation. This option would be possible, provided the required retrofits and new emission rates meet the applicable standards and guidelines.

If retrofitting is not feasible and the operational life of the Power Plant expires, the power plant will be decommissioned according to the requirements of the authorities at that time.

0.2 PROJECT ALTERNATIVES

The ESIA has reviewed the process by which specific considerations into the location, design and extent of adverse impacts were assessed and the

alternatives that have been considered during the development and pre-feasibility process.

No Project

Actual electricity demand in the country has not been met due to a shortage of available generation capacity. In addition, due to a shortage of gas supply, some power plants are unable to reach their full generation capability. The current supply-demand in Bangladesh also has a knock on effect on all other key sectors including agriculture, industry, commercial and domestic sectors. There is therefore no alternative to adding more power generating units to the existing power system of Bangladesh, to help improve and meet the energy demand for both domestic and industrial requirements.

The 'No Project Scenario' is also likely to have a negative effect on opportunities for employment, both directly from the proposed power project and its dependant sectors such as agriculture, industries and manufacturing that require stable power supply in order to operate and be competitive.

Site Location

The proposed site was acquired by BPDB in 1997-98 to develop a power generation complex in order to utilise the natural gas available from the Titas Gas Field. Three power plants with total generation capacity of about 900 MW are operational at the Meghnaghat Power Hub. The site location is well suited for setting up of power plant with availability of adequate availability of land, water, access to road, and waterways, fuel source/supply arrangement. Associated facilities, such as, water intake and abstraction mechanism, pump house location, construction laydown and camp areas have also been selected based on the basis of alternative analysis and selection of best suited option.

Design

The project design has considered embedded pollution control systems, which include NOx control, stack height for dispersion of pollutants, use of cleaner primary fuel (RLNG), use of Meghna River water for the Project as opposed to ground water, induced draft cooling tower for reducing water requirement and no direct discharge of cooling water into Meghna River. Best suited technological options have been considered by SMIIPCL and the dual fuel system has been selected to provide more reliability of power generation.

Box 0.1 ***Key Environmental and Social Considerations***



Location

- No residential receptor within 500 m
- No major sensitive environmental receptors such as protected forests, wetlands in close proximity
- No physical cultural resources on-site or in close proximity
- No eco-sensitive area within 5 km radial zone

Land footprint

- Site within an industrial area earmarked for power projects
- Site in the close vicinity of associated utilities
- No requirement of additional land outside the power hub
- No physical and/or economic displacement involved.

Water

- Consideration of induced draft cooling system to reduce fresh water requirement
- This entails control of discharge water temperature as well as volume.

0.3 PROJECT AREA OF INFLUENCE

The area affected by the Project and the infrastructure to be built includes the following:

- The project activities and facilities that are directly owned, operated or managed by the project proponent (including by contractors);
- Impacts from unplanned but predictable developments caused by the project that may occur later or at a related location such as increase in traffic on the approach road;
- Impacts on biodiversity or on ecosystem services upon which affected communities' livelihoods are dependent;
- Associated facilities, that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable; and

- Cumulative impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned power plants within the Meghnaghat Power Hub.

In order to ascertain the project's area of influence, a study area of 10 km from the project site was considered. However, considering that majority of impacts will be well within 5 km radial zone, more focus was provided on project site and immediate vicinity.

0.3.2 Land Environment

Land Use

The use and land cover study has been carried out through analysis of satellite imagery and ground verification. The predominant land use in the 5.0 km radius AOI is agricultural land (29. 34 sq. km or 37.35%); this is followed by water bodies (29.22 sq. k; i.e. 37.21%), rural settlement & homestead plantation (11.09 sq. km; i.e. 14.12%), built up area includes industry and urban settlement (7.03 sq. km; i.e. 8.95%) and wasteland (1.86 sq. km; i.e. 2.37%).

Physiography

Proposed project site belongs to the Old Brahmaputra Floodplain area of the National Classification. Soils of the area are grey, loamy on the ridges and grey to dark grey clayey in the basins.

Topography

The proposed project and study area (10km around the proposed project site) is predominantly a flat terrain with elevation of 5 m above mean sea level. The proposed project site is also a flat terrain and its gentle slope is towards east; i.e. towards Meghna River.

Social Baseline

The socio-economic baseline has been developed on the basis of integrating existing quantitative data with some additional qualitative assessments that was undertaken through primary data collection as illustrated subsequently.

Geology

The proposed project site is located in meander floodplains (Holocene floodplains). The proposed project site was developed by fill material to raise the site elevation to a point approximately one meter above the 200-year flood line.

Soil Quality

Soil quality of the study area was analysed through primary soil quality monitoring in two locations as well as comparing secondary information. The

soil was slightly acidic in nature (pH level 5.33 to 6.20). Available NPK varied between 59 to 110 mg/kg; <3 to 6.4 mg/kg and 23 to 27 mg/kg respectively. The levels of iron level in the soil samples ranged between <5.0 mg/kg to 17 mg/kg, copper ranged between <2.0 mg/kg, zinc was ranged between 11 mg/kg to 14 mg/kg. The concentration of toxic metals was low compared Dutch targeted and intervention values.

Sediment Quality

To assess the sediment quality in the river primary monitoring was carried out in six representative locations in Meghna Minor Channel and Meghna River. The concentration of Chromium and Cadmium in all the monitoring locations were observed <2.0 mg/kg. The concentration of Arsenic in all the monitoring locations were observed <0.25 mg/kg. The concentration Cobalt was varied from <4.0 to 7.0 mg/kg. The concentration of nickel was varied from 9.0 to 21 mg/kg. The concentration of toxic metals was low compared Dutch targeted and intervention values.

0.3.3 Water Environment

Drainage

The study area falls within the watershed of Meghna River. The proposed site has flat terrain; however, the gentle slope of the site is towards west, i.e. Meghna minor channel.

Surface Water Resource & Availability

The river water in the Meghnaghat Industrial area is used for industrial cooling and process water. The rivers serve as a sink for treated effluents from industries including thermal discharges from power plants which mostly have once through cooling systems. Meghna is a wide river and water is available throughout the year for consumptive uses of industry as well as for river transport and fish propagation.

Surface Water Quality

The quality of surface water was assessed through primary monitoring and collection of secondary data from various sources. Surface water was monitored at six different locations from the study area. Temperature of the surface water samples varied from 26°C to 29°C; the difference of temperature may be due to increase of air temperature during sampling period. The pH of the surface water samples varied from 5.92 to 6. The DO levels at all locations exhibited values ranging from 5.7 to 6.6 mg/l. BOD values of the sample varied from <2.0 to 2.9 mg/l. COD values of the samples varied from 5 to 21 mg/l. Concentrations of heavy metal like lead (<0.005 mg/l), total chromium (<0.01 mg/l), and cadmium (<0.001 mg/l), mercury (0.001 mg/l), nickel (<0.02 mg/l) were found to be below detection limits in the surface water sample.

Ground Water Resources

Groundwater is abundant in Bangladesh and the aquifers are highly productive. Analysis of the comprehensive data set collected from BWDB and DPHE for Meghnaghat industrial area, presents a clear trend of a gradual decline in the water table over the years. The declining water tables can be attributed to the increasing utilisation of ground water by industries as well as domestic use.

Ground Water Quality

The quality of surface water was assessed through primary monitoring and collection of secondary data from various sources. Groundwater samples were collected from 4 different locations during study period.

pH of the groundwater samples were found in the range of 6.75 to 7.2 -within drinking water standard (6.5-8.5). The concentration of TSS were found in range of <2.5 mg/l to 49.0 mg/l - within the permissible limit (10 mg/l), except Islampur village. Arsenic, barium, copper, mercury, cadmium, nickel, zinc and vanadium contents in all ground water samples were found to be below detection limits and in compliance to the drinking water standard. Concentration iron ranged from 0.1 to 16 mg/l - compliance to the acceptable limit (0.3-1.0 mg/l) except Islampur village.

0.3.4 Climate and Meteorology

Climate

Bangladesh is located in the tropical monsoon region and its climate is characterised by high temperature, heavy rainfall, often excessive humidity, and fairly marked seasonal variations.

Temperature

The mean monthly maximum temperature is experienced in May (29.4°C) and the mean monthly minimum temperature is experienced in January (19.8°C).

Humidity

The relative average humidity varied between 56.9% (March) to 81.9% (September).

Rainfall

Average annual rainfall in the Narayanganj district is about 2000 mm. Rainfall was highest in June and July (373 and 374 mm respectively), followed by August (335.1mm), May (245 mm) and September (253 mm).

Wind Speed and Direction

The wind speed varied from 0.9 km/hr to 4.4 km/hr. The average wind speed during the period was 2.2 km/hr. The predominant wind direction of the study period is from south-east.

0.3.5 Natural Hazards

Earthquakes

As per the Seismic Zoning Map of Bangladesh, the project site and study area is located in Seismic Zone II resulting in a basic seismic coefficient z of 0.20.

Cyclones

Devastating cyclones hit the coastal areas of Bangladesh almost every year usually accompanied by high-speed winds and high waves, causing extensive damage to life, property and livestock. The proposed project site is away from coastal area and cyclonic risk is very less.

Storm Surge

The proposed project has no risk of storm surge based on cyclone affected map of Bangladesh.

Flooding

The proposed project site is falling under flood prone zone. However, BPDB had developed the Meghnaghat Power Hub; the site was elevated to one meter above the 200 year highest flood level (HFL).

0.3.6 Air Environment

Ambient air quality

Ambient Air quality was monitored at 8 locations across the study area. The average SPM concentration ranged from 212.13 to 323.13 µg/m^3; which was s higher than the NAAQS (200 µg/m^3). The average PM_{10} concentration ranged from 117.25 to 172.63 µg/m^3, which was within the NAAQS (150 µg/m^3) except two monitoring locations. The average $PM_{2.5}$ concentration ranged from 58.75 to 82.38 µg/m^3, which was within the NAAQS (65 µg/m^3) except three monitoring locations. The concentrations of NOx, SO_2, CO and O_3 were with the NAAQS.

Noise quality

Ambient noise quality was monitored in 10 locations, which includes industrial area, mixed zone and residential area. The daytime and night time noise level in the industrial zone ranged between 59.4 to 71.2 dB(A) and 53.4

to 64.6 dB(A) respectively, which were in compliance to the National Ambient Noise Standard.

The daytime and night time noise levels in the mixed zone ranged between 61.3 dB(A) to 69.8 dB(A) and 49.7 dB(A) to 60.9 dB(A); respectively, which were in compliance to the National Ambient Noise Standard.

The daytime and nigh time noise level in the residential area ranged between 57.5 dB(A) to 59.5 dB(A) and 46.9 dB(A) to 48.9 dB(A) respectively, which were higher compared to National Ambient Noise Standard .

0.3.7 Ecological Environment

The ecological baseline survey was conducted by ERM team during study period. The fishery survey and bio-monitoring (plankton & benthos) study was conducted by Fishery Expert and Limnolocical Expert.

The study area has no natural forests; it is modified habitat. The proposed project site has no tree species, only 3 shrub species and few herb species were recorded. The habitats in the study area are as follows:

Homestead plantation was observed on marginal and fallow lands of villages. The major species are *Samanea saman, Acacia auriculiformis, Azadirachta indica, Eucalyptus* sp., *Pongamia pinnata, Acacia nilotica, Ziziphus mauritiana,* etc.

Agricultural land- The major crop cultivated in the agricultural lands is paddy. The other crops are vegetable –like chilli, onion, ladies finger, long yard bean, tomato, watermelon etc.

Riparian vegetation are present along the sides of ponds, canals etc. Main type of plant species observed is *Syzygium cumini, Samanea saman, Cocos nucifera* etc.

Fauna

Herpetofauna: 11 species of herpeto-fauna (4 species of amphibians and 7 species of reptiles) are reported from the study area.

Avifauna: A total of 51 species of Avifaunal species were observed in the study area.

Mammals: A total 11 species of mammalian species were enumerated within the study area.

Fish- species reported in the fishery study conducted by SMPCL 2016[1] were Ayre, Bele, Baim, Boal, Bujuri tengra, Batashi, Chanda, Chela, Common carp,

[1] Survey report on Fisheries resources at the Meghna River within the study area of SMPCL; conducted by Sustainable Development Associates (SDA) June 2016

Chapila, Garua, Hilsa, Kaski, Kalbasu, Katla, Kakila, Kholisa, Koi, Meni, Mola, Prawn, Pabda, Puti, Rui, Shorputi, Shingi, Shol, Taki, Rayek bata and Tengra. The aquatic habitat of the Meghna River is highly stressed but the biotic diversity is good. Consultation with local communities revealed that effluent discharged from chemical and pulp & paper industries periodically caused fish kills in the river.

Phytoplankton- 14 species under 4 groups were reported from the study area.
Zooplankton- 7 species under three zooplankton group were reported from the study area.

0.3.8 Socio-economic Environment

Study area: This study area comprises of the area within the 5 km radius of the proposed project site boundary. The preliminary assessment shows that the potential direct socio- economic impacts would be restricted within 2 km. The study area therefore is further divided into core zone (within 2 km) and buffer zone (between 2 -5 km). The core zone covers 3 Unions; namely Pirijpur, Shambhupura, Hossaindi; and buffer zone cover 9 Union Parishads- Mugrapara, Sanmandi, Bandar, Musapur, Gazaria, Baluakandi, Tengerchar Sonargaon Sadar Pourashabha and Chalibhanga.

Demography: The demography profile of the core and buffer zone are as follows:

	Core Zone	Buffer zone
Population	45,440	2,21,040
Sex ratio	109	99
Literacy	56.23	56.04

Occupation & Livelihood

In core study area Pirijpur, Shambhupura and Hossaindi, the rate of employment is 42.02, 35.68 and 48.94 percent respectively. Within Buffer area male population are more employed than the female population; and female population are mainly involved in household work.

0.4 KEY IMPACTS FOR DECISION MAKING

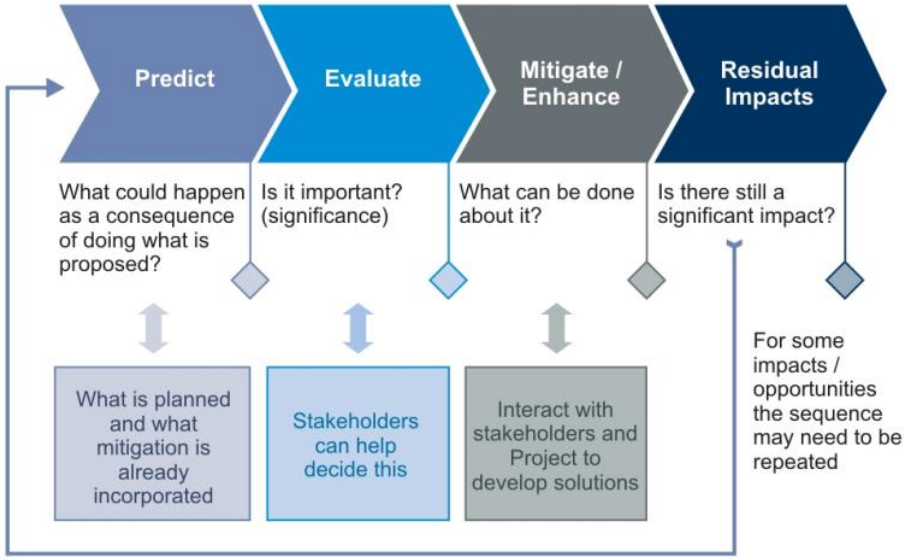
Approach

The impact assessment process comprised of the following steps:

- The potential impacts of Summit M2 were initially identified during the scoping phase;
- Thereafter, environment, ecological and socio-economic baseline studies were undertaken to understand the likely changes that may occur during the construction and operations of Summit M2 within a defined study area;

- Meetings were held with local communities and key informants to share information, answer questions and understand and respond to concerns about the Project (a process called 'Stakeholder Engagement' which is described further below);
- Specialist experience and knowledge, coupled with modelling (e.g. air quality) in some cases, was used to quantitatively and qualitatively assess which impacts will cause the most significant adverse changes as a result of Summit M2. The implications of the operations of Summit M2 in conjunction with other power plants in Meghnaghat were also understood for specific environment receptors;
- Measures of reducing the adverse changes and enhancing project benefits were also identified and discussed with the project proponent;
- Based on the above, a project and context specific Environmental and Social Management Plan was prepared for SMIIPCL and their contractors.

Figure 0.3 *Impact Assessment Process*



Impacts were assessed by specialists to understand their significance or importance for those affected by the project. The significance levels used for this assessment are described subsequently:

Box 0.2 *Implication of Impact Significance*

Significance	Levels
Negligible	There will be no or very limited impact.
Minor	There will be a small impact of limited concern or interest.
Moderate	There will be a moderate change to the environment and people that will be of some concern, and efforts will need to be made to manage these to the extent possible.
Major	There will be a very large change to the environment or people which will be of great concern, and which will need a great deal of effort to be managed.
Positive	There will be a positive impact.

Environmental Impacts

During the construction phase of the Project, the key environmental issues are noise and dust generation. There is also a risk of contamination of soil, groundwater and the Meghna River from accidental spills and leaks of hazardous materials (e.g. oil) during handling, transportation, and storage at the site.

Various mitigation measures have already been developed by the Project Developer, as part of their "*Master Specification Manual*" for the EPC Contractor. The adverse impacts identified are generally manageable through good housekeeping and a diligent implementation of the ESMP by the EPC Contractor and its supervision by the Project Developer and their team of consultants. The nearest air quality and noise sensitive receptors will be a focus for monitoring of any impact arising due to the construction activities.

During the operation phase of the Project, the two key impacts will be from the increase in ambient noise and air quality levels due to operation of plant equipment and auxiliary machinery. It has been demonstrated through air quality dispersion modelling with natural gas as primary fuel as well as HSD as secondary fuel, the incremental ground level concentrations due to the operation of the Plant will be well within the applicable ambient air quality standards. Continuous emission monitoring from the stacks and periodic ambient air quality monitoring throughout operations will confirm compliance to the applicable standards/ guidelines and enable identification of further measures to reduce impacts to ALARP. Incremental noise levels due to the operation of Plant will meet the applicable GOB standards/IFC guidelines for industrial areas. However, the nearest noise sensitive receptors will have slightly higher noise levels than the applicable standards/ guidelines due to the higher background noise levels which are resulted primarily due to anthropogenic activities.

Induced draft cooling towers have been proposed in the project to reduce the water intake and outfall. About 300 m^3/hr of cooling tower blowdown and treated wastewater will be discharged into Meghna River. The cooling tower blowdown will maintain increase in temperature difference between intake and outfall water temperature < 3°C and due to that the warming of surface water will be limited to a smaller area at outfall location, which will mix within a short distance (< 50 m) from the outfall location. A surface water quality monitoring program, along with quarterly monitoring of aquatic ecology and fisheries has been formulated to further understand the extent of impact, if any, and to alert SMIIPCL to take additional mitigation measures.

Cumulative Environmental Implications

There are three operating power plants in Meghnaghat Power hub; these are 337 MW Duel Fuel CCPP, 450 MW Meghna CCPP and 100 MW Engine based Power Plant. A 750 MW CCPP power plant within Meghnaghat Power Hub and a 650 MW coal based power project at Char Balaki are also proposed

within or near to the Meghnaghat Power hub. Therefore, this is an important aspect of the environment, ecological and socio-economic baseline, especially in view of the local community's perceptions towards the land procurement process, community health & safety, impacts to environmental parameters, employment and business opportunities and land-use change.

Some of the key impact conclusions are as follows:

- **Combined water requirement** – the source of water for existing operational power plant s as well as proposed power plants is Meghna River. Meghna is a wide river and water is available throughout the year for consumptive uses of industry as well as for river transport and fish propagation. The impact of water abstraction on Summit-2 for the proposed plant would be **negligible;**
- The treated water from existing power plants is being discharged into the river. The surface water quality monitoring results indicated no significant impact from power plant discharge. The treated wastewater (300 m^3/hr) will be discharged into the river. In the event that effluent discharge is detected above the effluent discharge limit criteria, isolation valves will automatically close and stop the discharge and hence, the impact is assessed as minor;
- For **ambient air quality**, the maximum ground level concentration (maximum baseline concentration + predicted maximum concentration) in the project AOI **with natural gas** as fuel will be within the applicable air quality standard and hence, impact significance due to operation of power plant projects with natural gas as fuel is assessed to be negligible;
- For **ambient air quality, while using HSD** as fuel, the maximum ground level concentrations (maximum baseline concentration + predicted maximum concentration) of NOx, SO_2 and PM10 will be within the applicable standard and overall project contribution will be < 25% of the applicable standard. Therefore, using the operation of SMIIPCL project using HSD as fuel along with other power plants is assessed to be minor;
- As per the latest report (26 December 2012) of **GHG emission** submitted by Bangladesh to the United Nations Framework Convention on Climate Change (UNFCCC)[1], electricity generation sector contribution to GHG emission in year 2005 was 1.192 x 10^7 tons CO_2e and projection of aggregate GHG emissions using LEAP modelling program indicates that the annual GHG emissions from this sector in year 2020 and 2030 will be 2.752 x 10^7 tons CO_2e and 5.9168 x 10^7 tons CO_2e, respectively. Taking this into consideration, GHG emission contribution of the proposed Project in the year 2020 will be between 6.32% and 3.30%[2] of the electricity generation sector in Bangladesh depending upon the use of natural gas and HSD as fuel for power generation. Considering this fact, the GHG emission impact will be **moderate**;

[1] **http://unfccc.int/resource/docs/natc/bgdnc2.pdf**

[2] Considering use of HSD as fuel only during peak generation requirement.

- Impact on ambient noise levels due to the operation of Summit M2 was also evaluated by using noise prediction model. Ambient noise levels due to operation of proposed project will be within the applicable standard during day time. The noise impact from proposed plant during day time is expected to be **negligible** to **minor**. Furthermore, noise levels at night time will be higher than the applicable standard (with < 5 dBA increase from the applicable standard). Due to this the cumulative noise impact during night time is expected to be **minor** to **moderate.**

Ecological Impacts

For ecological impacts, interactions that are likely to lead to impacts on ecology and biodiversity within the study area are presented as follows:

- Construction Phase:
    - Loss of Habitat due to:
        - Clearance of vegetation;
    - Habitat Disturbance:
        - Fugitive dust emission and noise generation;
        - Surface runoff from construction site
- Operations Phase:
    - Habitat Disturbance due to:
        - Emission from plant
        - Discharge of waste water and surface runoff;

The proposed Summit M2 project will be constructed within the Meghnaghat Power Hub. The site is already developed- the low-lying riverine Island was filled up with white sand. The major vegetation was observed two species of shrubs and few species of herbs. The species composition in the Power Hub is not unique to site; these are common the study area. The potential impact on terrestrial habitat including protected species due to vegetation clearance is assessed to be **minor.**

The increased level of noise and vibration in and around proposed project site will cause minimal disturbance to local faunal species. The impact on the terrestrial flora and fauna is assessed to be **minor**.

The increase of NOx emission from proposed expansion unit may not cause significant impact on ecosystem and vegetation. The impact on flora and fauna due to process emission from the plant is assessed to be **minor.**

Discharge of surface runoff from construction site with high sediment load to Meghna River has the potential to affect the water quality of the river by increase in turbidity. To contain this surface runoff from construction site will be channelized to sedimentation tank. The potential impact on aquatic ecology is assessed to be minor

The cooling tower blowdown and boiler blow down water will be discharge into the river after meeting the discharge norms applicable for hot water

discharge into the river. The discharge of treated effluent may not cause perceptible changes in the water quality of the river as the maximum discharge will be about 250 to 300 m^3/hr and will be limited for maximum 3 to 4 hours per day. The potential impact on aquatic habitat is assessed to be **minor**.

Potential Impact on Land Acquisition

As discussed earlier, the project does not involve fresh acquisition of private land. As the project does not propose to acquire any private land, there will be no physical or economic displacement. Therefore, no adverse impact on land acquisition is envisaged.

Impact on Livelihood of Local Wage Labours

The project is expected to provide opportunity to unskilled wage labours in the locality. The wage earning will supplement their earnings from agriculture, fishing and household industries. Hence, the project is expected to impact livelihood of the local unskilled labourers positively.

Impact on fishing

A small section of local fishermen population is engaged into kata fishing practise in that area of Meghna River, especially in the post monsoon season. They practice kata fishing, especially in the channels of the Meghna River, south-west of proposed plot. During the construction period a temporary jetty will be set up on the south-wester part of the power hub, beside the jetty of the Orion Power Plant. It is reported that barges coming to the Orion Power Plant jetty follow a particular path to avoid any impact on the kata fishing nets. Movement of the barges during the construction phase may put the kata fishing activities of the local fishermen at risk. This may potentially impact the kata fishing practice during construction phase.

The project will provide the facility of cooling towers, both to reduce the temperature of the discharge water and to reduce the water requirement for the Plant and the blow down will be about 1/5th of the total water intake. Hence, impact on fishing activity due to thermal discharge from the power plant is assessed to be low

Community Health and Health & Safety

The potential health impacts due to a change in the environmental conditions are expected to be of a temporary nature, restricted to the project site and their immediate vicinity. Keeping this in mind, the health and safety impact associated with changes in environmental quality is considered to have ***moderate*** significance when assessed against the receptors location and the various mitigation measures in place**.**

Influx and In-migration

During the construction phase there will be impact from migration of labour into the Project area, construction activities and increased movement of traffic. The range of impacts identified include: conflicts with the local community, health and safety issues inconvenience due to vehicle movements, risk of spread of communicable and sexually transmitted diseases, waste disposal and unhygienic conditions. The magnitude and significance of most of these impacts would be limited to the construction period, with limited spill over to the operation phase.

As the project intends to have a construction camp outside the premises of the allotted land, the interaction between the community and migrant workers would require to be monitored.

The Project will develop a Labour and Influx Management Plan (LIMP) that addresses how the Project will seek to: minimise Project-induced in-migration as far as possible; manage and direct the flow of in-migrants in accordance with the regional planning objectives; and implement mitigation measures to address the adverse environmental and social consequences, and maximise the benefits, of in-migration.

0.5 PROJECT BENEFITS

The present installed generation capacity in Bangladesh as on 1 January 2017 is 13,151 MW, which includes 600 MW of imported electricity. In addition to this, there is captive power generation of about 2,200 MW. The GOB has given highest priority to power sector development in the country and has committed to making electricity available to all citizens by 2021, including significant development programs for participation of the private sector. The proposed power development projects in Meghnaghat Power Hub are one of the Greenfield projects that have been proposed to realise the above strategy. Overall, the annual electricity generation is expected to be ~1,696 million kW-hr.

Summit M2 project will provide reliable power supply to the region and will also bring about ancillary development, such as industrialisation in sectors such as small and medium scale manufacturing. The project development of SMIIPCL's power plant in addition to existing power plants in Meghnaghat industrial area will enable local economic benefits linked to employment generation, local procurement, encouragement of local enterprise development and skill development within the communities.

In addition, by specific stakeholder engagement activities and community development programs, the Project will further enhance the good will and cooperation of the community. The Project in its entirety can bring prosperity and development into the region and pave the way for further

industrialisation in sectors such as food and fish processing, local manufacturing etc.

0.6 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

A number of mitigation measures to manage adverse impacts and recommendations to enhance benefits are captured in the Environmental and Social Management Plan (ESMP) for Summit M2. The ESMP also includes the following:

- Environmental Monitoring Plan;
- Framework Environmental and Social Management Plans:

The ESMP and other management plans have been developed in accordance to the requirements of regulations in Bangladesh, and good international industry practice, notably the IFC Performance Standards (2012). The ESMP and other plans will be implemented during construction and operation of the project. The ESMP takes each of the impacts identified in the impact assessment of the ESIA and sets out the management measures needed to deal with the impacts as well as describing responsibility for implementing these.

Box 0.3 Important Implementation Commitments



An overview of E&S impacts and significance of residual impacts after implementation of environmental and social management plan is presented in Figure 0.4.

Figure 0.4 Overview of E&S Impacts and Significance of Residual Impacts

Project Activities/ Impacts	Nature of Impact	Significance of Residual Impacts	
		Before Mitigation	With Mitigation
Construction Phase (Summit M2 Project)			
Soil compaction	Negative	Negligible	Negligible
Soil erosion	Negative	Negligible	Negligible
Soil and sediment contamination	Negative	Minor	Negligible
Soil contamination from waste handling	Negative	Negligible	Negligible
Waste water discharge	Negative	Minor	Negligible
Ground water contamination	Negative	Minor	Negligible
Air quality degradation due to dust generation	Negative	Moderate	Minor
Air quality degradation due to exhaust emissions	Negative	Minor	Minor
Noise from Construction Activities and transportation of man/ material (Day and Night time)	Negative	Negligible to Minor	Negligible to Minor
Terrestrial ecology (vegetation clearance, terrestrial habitat)	Negative	Minor	Negligible
Aquatic habitat disturbance (Temporary jetty, vessel movement)	Negative	Minor	Minor
Influx and in-migration	Negative	Moderate	Minor
Community health from changes in environmental conditions	Negative	Moderate	Minor
Local economy and skills development	Positive		
Operation Phase (Summit M2 Project)			
Contamination of soil and sediment from wastes	Negative	Negligible	Negligible
Surface water abstraction	Negative	Negligible	Negligible
Water pollution from wastewater discharge	Negative	Negligible	Negligible
Ground water contamination	Negative	Minor	Negligible
Ambient Air Quality (by use of natural gas and HSD as fuel for power generation)	Negative	Minor to Negligible	Minor to Negligible
GHG Emission due to Summit M2 project	Negative	Moderate	Moderate
Noise from Operation of Plant and vehicular movement in Access Road (Day and night time)	Negative	Negligible to Minor	Negligible to Minor
Electric and magnetic field	Negative	Minor	Negligible
Impact on Terrestrial habitat	Negative	Minor	Negligible to Minor
Risks due to hazardous materials handling and storage	Negative	Minor	Negligible to Minor
Community health and safety due to project induced traffic	Negative	Minor	Negligible
Risks of industrial accidents and fatalities to workers	Negative	Minor	Negligible
Impact on fishing communities	Negative	Minor	Negligible
Employment generation and in-migration of skilled workforce	Positive		
Cumulative Impacts due to Operation of Proposed Power Projects			
Ambient Air Quality (Operation of Summit M2, Reliance and Orion Coal Project)	Negative	Minor	Negligible to Minor
Noise from Operation Summit M2 and Reliance Power Projects	Negative	Negligible to Minor	Negligible to Minor

It is to be noted that some of the residual impact significances such as impact on air quality and ambient noise levels may not change even after application of the mitigation measures, primarily due to higher background

concentrations and/or noise levels, even though the project contribution is minimal.

0.7 CONCLUSION

To conclude, a majority of the adverse the environmental and social impacts are localised, short-term or temporary although some of them are permanent in nature like health associated risks due to air emissions and effluent release, but can be mitigated with good design, appropriate application of mitigation measures and regular supervision of implementation of the Environmental and Social Management Plan (ESMP). Based on the analysis conducted in this environmental and social assessment, it is concluded that overall the Project will result in positive socio-economic benefits.

1 INTRODUCTION

1.1 BACKGROUND

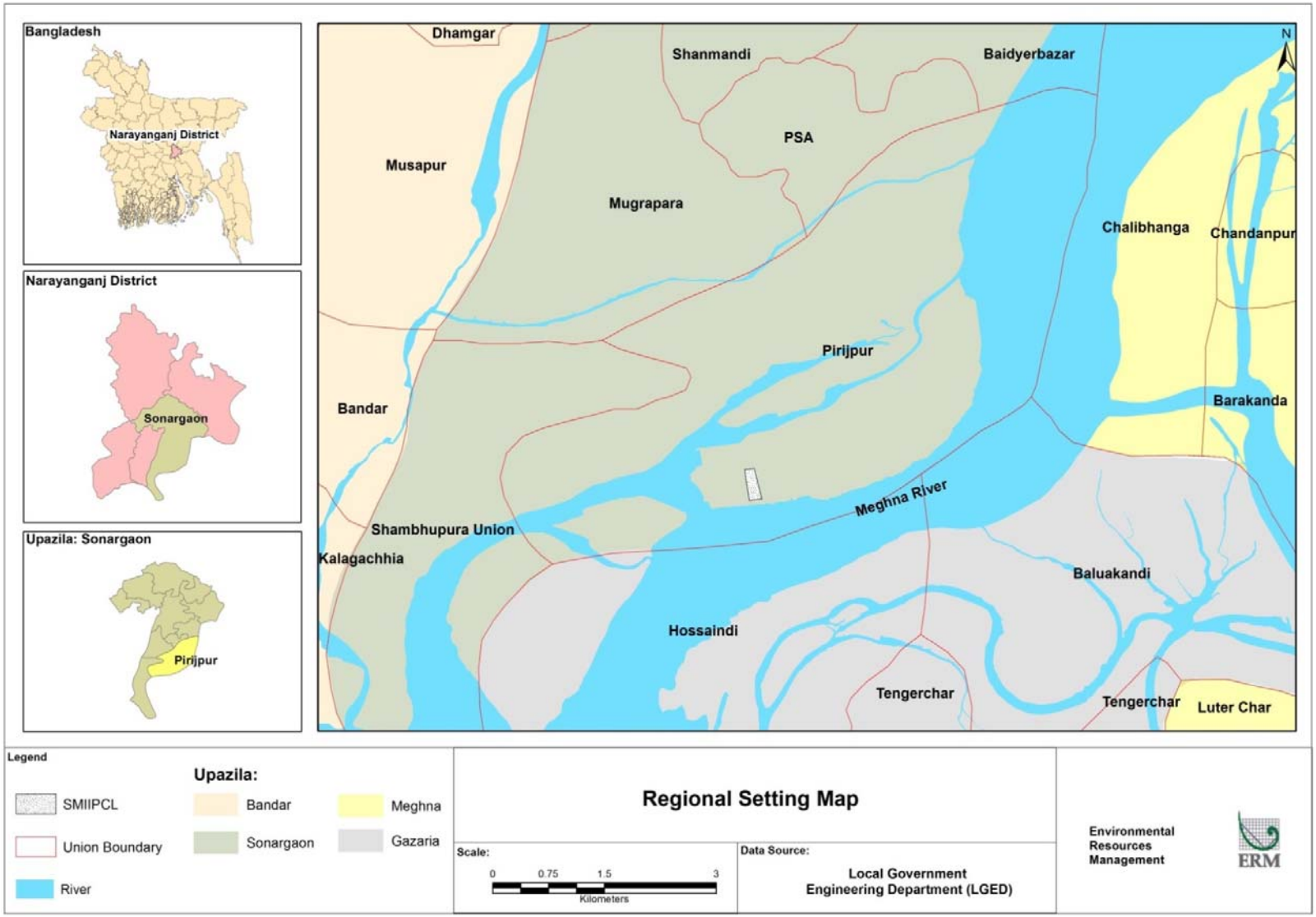
Summit Meghnaghat II Power Company Limited (*hereinafter referred to as "SMIIPCL" or the "Project Proponent" or the "client"*), a wholly owned subsidiary of Summit Corporation Limited (*"SCL"*), is proposing to set up a dual fuel fired combined cycle power project with net generation capacity 589.75 MW on Gas (NG/RLNG) and 541.22 MW on Liquid Fuel (HSD) at Meghnaghat Power Hub (*hereinafter referred to as the "project" or the "plant" or "Summit M-2"*), in Narayanganj District of Dhaka Division, Bangladesh (Refer to ***Figure 1.1***). The project site is located approximately 30 km south-east of Dhaka on the right bank of River Meghna.

According to the Bangladesh Environment Conservation Rules 1997 (ECR), power plant comes under Red category and requires Initial Environmental Examination (IEE) and environmental impact assessment (*"EIA"*) approval prior to start of construction activities at site. With respect to the same, SMIIPCL is yet to apply for IEE approval to Department of Environment (DoE), Bangladesh. However, in parallel, the project is also intended to take project financing from international financial institutes, such as International Finance Corporation (IFC), Asian Development Bank (ADB) and the Equator Principle Financial Institutions (EPFIs).

The project is at present in pre-construction planning stage. *SMIIPCL* has engaged ERM India Private Limited (*hereinafter referred to as "ERM"*) to perform environmental and social impact assessment (ESIA) study of the project.

This draft ESIA report has been prepared based on primary monitoring data, stakeholder consultations and relying on the secondary data available from previous studies carried out in the same study area for disclosure of environmental and social impacts due to the project. This report will be updated to include the results of bio-monitoring and fisheries study as well as inputs received from public consultation meeting/s during the disclosure of the findings of this draft ESIA report. The report will also include the requirements of the approved terms of reference (ToR) for EIA study by the DoE.

Figure 1.1 Regional setting of the proposed project



1.2 OVERVIEW OF THE PROJECT

1.2.1 Need for the project

The supply of electricity has a great impact on the national economy of any country. Bangladesh, with its 152 million people in a land mass of 147,570 sq. km, has shown tremendous growth in recent years. A booming economic growth, rapid urbanization and increased industrialisation and development have increased the country's demand for electricity. Presently, 68% of the total population has access to electricity and per capita generation is 348 kWh, which is significantly lower when compared to other developing countries (Power Division 2015). The present installed generation capacity as on 1 January 2017 is 13,151 MW, which includes 600 MW of imported electricity. In addition to this, there is captive power generation of about 2,200 MW.

The GOB has given highest priority to power sector development in the country and has committed to making electricity available to all citizens by 2021 (Power Division 2015). The GOB has further extended its vision for power supply out to 2030 and prepared the Power System Master Plan (PSMP), 2010. The plan forecasts a supply surplus scenario by 2030 with power demand expected to be approximately 34,000 MW against a generation capacity of 40,000 MW (Power Division 2015). To realize these targets, the GOB since 2011 has undertaken the implementation of reforms in the power sector, including significant development programs for participation of the private sector of which this Project constitutes one of the important parts.

1.2.2 Project Background

The GOB has adopted a strategy for the development of the power sector which envisages private participation in the sector. As part of that strategy, the GOB decided that some new generation capacity will be installed and operated by the private sector.

In line with this strategy, the GOB decided to (a) implement a new greenfield dual fuel fired combined cycle power project with net generation capacity 589.75 (net) MW on Gas (NG/RLNG)/ 541.22 (net) MW on Liquid Fuel (HSD) at Meghnaghat Power Hub on Build, Own and Operate ("BOO") basis under the GOB's Independent Power Producer (IPP) program in Narayanganj District of Dhaka Division, Bangladesh (the "Project"); (b) to execute the Implementation Agreement ("IA"), the Power Purchase Agreement ("PPA"), the Gas Supply Agreement ("GSA"), the Fuel Supply Agreement ("FSA") and the Land Lease Agreements ("LLA"), (together, the IA, PPA, GSA, LLA, and FSA are hereinafter referred to as the "Project Agreements") and other contracts required for the financing, construction, operation and maintenance of the Facility; (c) implement the Project, and (d) upon Commissioning (combined-cycle mode), operate and maintain the Facility for a period of 22 years.

SMIIPCL after a reconnaissance study and discussions with the BPDB and in due consideration of efficiency aspects, environmental considerations, availability of gas and space, has decided to set up a combined cycle power plant in Meghnaghat Power Hub, beside Summit Corporation Limited (*"SCL"*) existing Meghnaghat I Power Station.

1.2.3 The project

The project has received Letter of Intent (LOI) from BPDB for the development of dual fuel fired CCPP at Meghnaghat Power Hub vide Memo No. – 27.11.0000.101.14.076.17-3722 dated 27 November 2017 (refer to ***Annex A***). Total land available for the project is 14.28 acres, which is owned by the BPDB. This land parcel is part of the Meghnaghat Power Hub, for which land was acquired by BPDB way back in 1997-98. Land is developed with flood embankment.

The project will be based on regasified liquid natural gas (RLNG) and high speed diesel (HSD). The project will have 1 gas turbine (GT), 1 heat recovery steam generator (HRSG) and 1 steam turbine (ST) (i.e. 1+1+1 configuration). RLNG will be supplied by Petrobangla's nominated entity, whereas HSD will be supplied by Bangladesh Petroleum Corporation (BPC) at pontoon of existing *Summit M-1* project. HSD storage will be maintained at existing fuel tanks of *Summit M-1* project and will be supplied to *Summit M-2* project, if required. Summit M-1 project is having HSD storage capacity of 24,000 m^3 and is adequate to run both Summit M-1 and M-2 plants with liquid fuel for more than 7 days with 80% load. Summit M-2 will also erect another fuel tank 7,000 m^3 capacity. Aggregated capacity of 31,000 m^3 liquid fuel storage is sufficient for operating both projects.

A new gas pipeline for RLNG supply to the Meghnaghat Power Hub is planned to be constructed by the Gas Transmission Company Limited (GTCL). Currently one Gas pipeline is in service at Meghnaghat Hub and one new Gas pipeline will have interconnection with the present Gas pipeline to cater present and future projects at Meghnaghat Power Hub site.

400 KV transmission line is already built and in service charged with 230 KV. It will take approximate 26 month to build and commissioning of New 400 KV GSS after WO is issued.

MII will erected another fuel tank 7,000 m3 capacity. Aggregated capacity of 31,000 m3 liquid fuel storage is sufficient for operating both projects. The new gas transmission pipeline between Kutumbapur in Comilla and Meghnaghat in Narayanganj will provide natural gas to the commissioned and proposed power plants, which include Summit M1 project, which is currently running by HSD due to gas supply constraint. It is reported that GTCL has received finance and will start construction in next 2 months and will be commissioned by June 2020.

It is understood that the project will not require construction of new transmission line; however, it may require around 300-400 m power evacuation line to connect Power Grid Company of Bangladesh (PGCB) grid sub-station (GSS) to be situated on the Meghnaghat Power Hub site.

1.2.4 Project company

Summit Meghnaghat II Power Company Limited ("SMIIPCL") has been duly formed and registered under the Laws of the People's Republic of Bangladesh as a Limited company to develop, design, finance, build, own, operate and maintain the Plant. The Company has been set up for the sole purpose of developing, owning and operating the Project. SMIIPCL is having shareholding of Summit Corporation Limited (SCL) and General Electric (GE) Company with 80% and 20% shareholding respectively.

1.3 PURPOSE AND OBJECTIVE OF THE STUDY

The objectives of this ESIA are to:

- Facilitate an understanding of the elements of the existing baseline conditions that are relevant to resources/receptors that could be significantly impacted by the Project;
- Identify the aspects of the Project likely to result in significant impacts to resources/receptors;
- Document how stakeholders have been engaged during the ESIA Process, and how stakeholder feedback has been considered in the ESIA;
- Predict and evaluate the significance of the impacts of the Project;
- Identify the (environmental, social and health) aspects of the Project that need to be managed, and recommend appropriate and justified mitigation and enhancement measures;
- Determine the significance of residual impacts, taking into account the implementation of mitigation measures; and
- Generate plans for the management and monitoring of impacts, including plans for ongoing stakeholder engagement.

1.4 SCOPE OF ESIA STUDY

1.4.1 Applicable reference framework

The applicable reference framework for this study includes:

- The Environment Conservation Act, 1995 and The Environment Conservation Rules, 1997 and amendments thereof by the Ministry of Environment and Forest, Government of Bangladesh;
- Other relevant Bangladeshi Laws, Rules and Regulations for environment, health, safety and social aspects;
- The IFC Performance Standards (2012) for Environmental and Social Sustainability;

    - The IFC General EHS Guidelines (2007);
    - The IFC/ WB Guidelines for Thermal Power Projects (2007);
- The ADB Safeguard Policy Statement (2009); and,
- The Equator Principles – III (2013).

The administrative framework in details is discussed in ***Section 3*** of this report.

1.4.2 Coverage of ESIA study

The coverage of ESIA includes the proposed Summit M-2 project and its 10 km radius from centre of the Project site. The assessment also includes cumulative impacts due to proposed power plants within the Meghnaghat Power Hub and neighbouring Char Balaki, particularly on air quality and noise.

1.4.3 Scope of work

The detailed scope of the ESIA study is as outlined below:

- Screening of the Project based on applicable reference framework based on reconnaissance survey and desk based review of Project documents;
- Scoping for the ESIA study;
- Development of an integrated project description of the Project components including its sub-components, which are under the purview of the Project Proponent (PP);
- Development of a regulatory, policy and administrative framework relevant to the Project;
- Monitoring, analysis and reporting of the environmental and social baseline data of the study area including consultation with local communities and other stakeholders;
- Assessment of the environmental impacts of the Project in the study area;
- Assessment of social impacts on the local community as well as Project affected people and any other stakeholders, which have been identified during the social consultation process;
- Assessment of cumulative impacts due to the neighbouring power plants based on available information;
- Risk assessment and consequence analysis of the Project;
- Formulation of an Environment and Social Management Plan and associated/specific mitigation plans for identified impacts; and
- Formulation of Public and Stakeholder Consultation and Grievance Redress Mechanism for the Project.

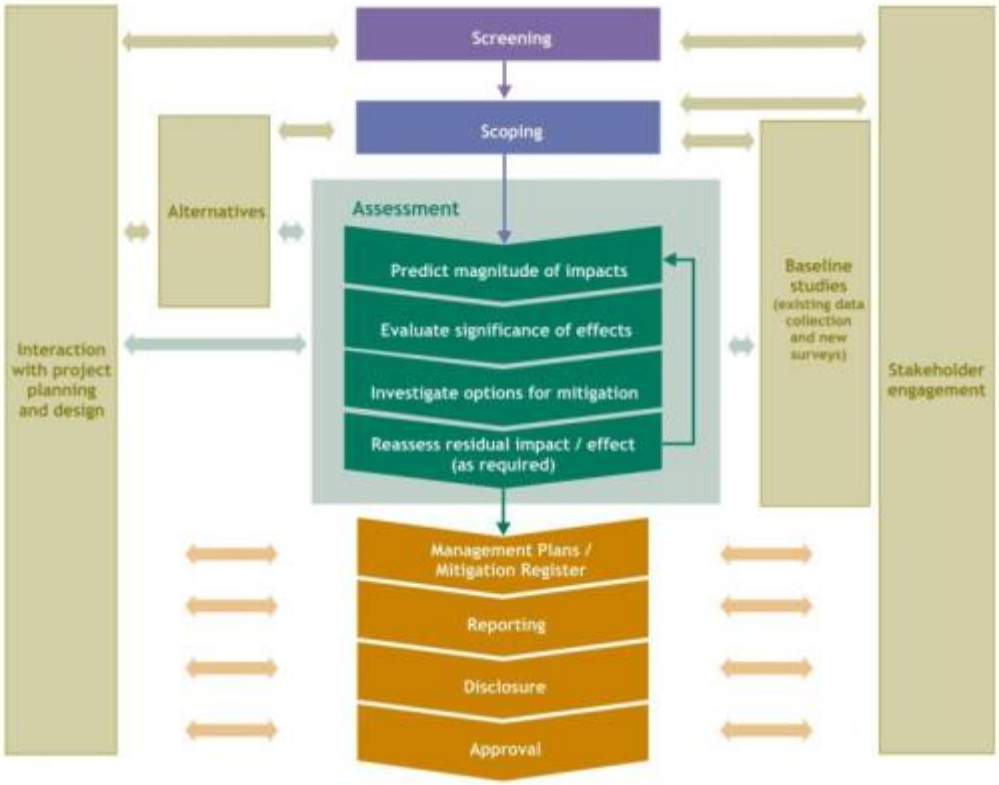
1.5 APPROACH AND METHODOLOGY

The ESIA has been undertaken following a systematic process that predicts and evaluates impacts the Project could have on aspects of the physical, biological, social/socio-economic and cultural environment. Further, identifies

measures that the Project will take to avoid, minimise/reduce, mitigate, offset or compensate for adverse impacts; and to enhance positive impacts where practicable. The ESIA methodology follows the overall impact assessment approach illustrated in Figure 1.2.

The approach and methodology adopted for screening and scoping of the project is discussed below, while the approach and methodology for baseline data collection and assessment has been described in the beginning of the respective chapters of this report.

Figure 1.2 ***Impact Assessment Process***



1.5.1 Screening

At the initial stage of the ESIA, preliminary information was obtained and discussions held to aid in the determination of what legal and other requirements apply to the Project. This step was conducted utilising a high level description of the Project and its associated facilities.

1.5.2 Scoping

Scoping was undertaken to identify the potential Area of Influence for the Project (and thus the appropriate Study Area), to identify potential interactions between the Project and resources/receptors in the Area of Influence and the impacts that could result from these interactions, and to prioritize these impacts in terms of their likely significance. Table 1.1 presents the resources/receptors considered in the scoping stage, together with the changes that could/might indicate a Project-related impact.

Table 1.1 Resources/Receptors and Impacts Considered in Scoping

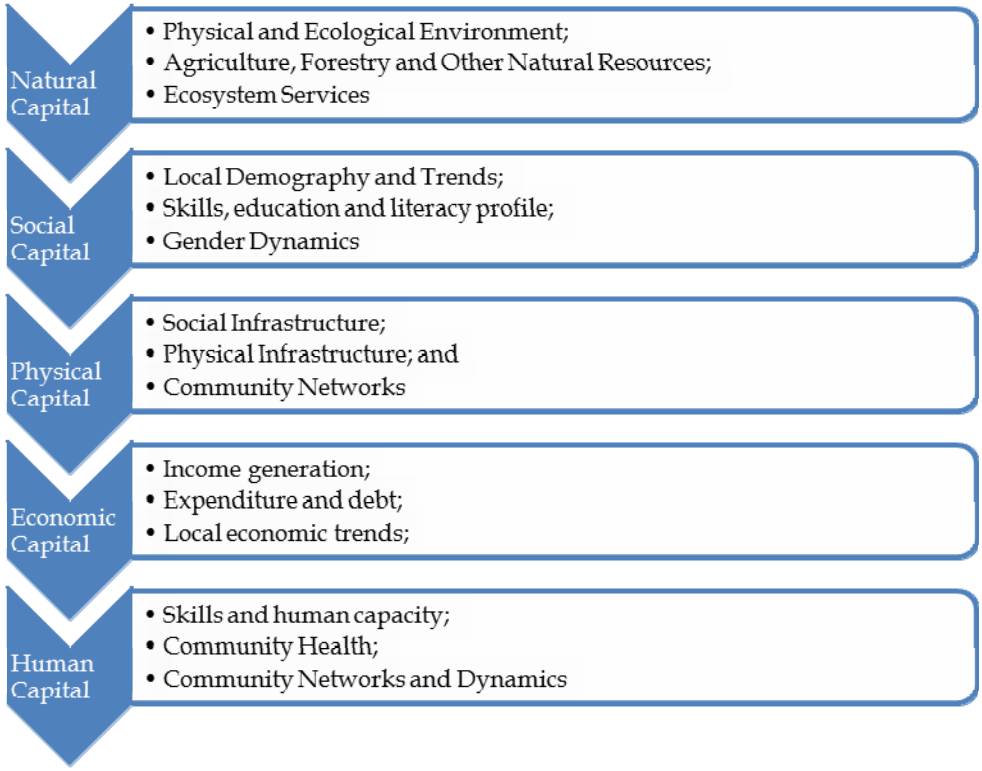
Resources/Receptors	Impacts
Environmental	
Land Forms/Profile	Changes to • Geology • Geomorphology • Topography
Soil Quality	Changes to • Physical and chemical properties • Soil ecology • Erosion
Sediment Quality	• River/waterbed morphology, • Physical and chemical properties, • Benthic organisms.
Land use	• Changes in Landuse/land cover profile • Logistics
Air Quality	Emissions of • Gaseous pollutants (e.g. NOx, SOx, etc.); and • Particulate matter (e.g. PM_{10} and $PM_{2.5}$)
Climate Change	• Greenhouse gases (CO2, CH4, and N2O) emissions, • Increase in global warming; • Flooding.
Drainage Pattern	Changes in the • Drainage pattern, • Submergence, • Floods etc.
Surface Water Quantity and Quality	Changes to • Physical, chemical or biological quality of Meghna River • Changes in surface water quantity • Changes in habitat quality, abundance, diversity; • Effluent discharge.
Ground water Quality	• Contamination of shallow or deep groundwater resources, • Change in ground water resource.
Ambient Noise Levels	• Change in noise levels
Vibration	• Changes in Vibration levels
Waste Solid Waste and liquid waste	• Generation of wastes-hazardous and non-hazardous
Terrestrial Ecology	• Impact on flora and fauna
Aquatic Ecology (Biodiversity)	• Changes in fisheries productivity and impact on aquatic form of various activities as dredging, water intake and discharge
Social/Socio-Economic	
Demographics (i.e. Displacement)	Changes in • Population, total population, gender ratio, age distribution. • Physical displacement from residence as a result of Project land take, or activities
Economy and livelihood	Change in • Local economy, • Employment, • Standard of living, • Occupation
Social and Cultural Structures	• Disruption in local authority and governance structure; • Change in social behaviours; alterations to social and cultural networks; • Intra and inter-ethnic conflict.
Economy and Livelihood	• Impact in Livelihood pattern.
Infrastructure and Services	• Improvement or pressure on existing urban/rural infrastructure or services including: transportation; power, water, sanitation, waste handling facilities etc.

Resources/Receptors	Impacts
Cultural Resources	• Physical disturbance of shrines, burial grounds, archaeological resources or other desecration;
Social/Community Cohesion	• Any social/community cohesions/ conflicts due to workers from outside or due to Project related activities
Vulnerable Groups	• Impact on livelihood, community networks, displacement induced impacts
Health	
Community Health and Safety	• Changes in the incidence and /or prevalence of sexually transmitted diseases and the factors that contribute to this (external workforce, transport routes etc. Changes in the incidence and or prevalence of vector borne diseases, the density of these vectors and their breeding grounds. • Changes in availability of and access to health care, nutritional status, food security etc.

1.5.3 Baseline Data Generation

The primary objective of the environmental, ecological and socio-economic baseline study is to provide a baseline against which potential impacts from the construction, operation and decommissioning phases of the Project can be assessed. ERM has adapted the Sustainable Livelihoods Framework propagated by the Department for International Development (DFID) (1) to present the environmental, ecological and socio-economic baseline study.

Figure 1.3 Sustainable Livelihoods Framework



The methodologies of baseline data collection for the environmental, ecological and socio-economic baseline are presented in ***Section 4***.

(1) DFID Sustainable Livelihoods Guidance (www.livelihoods.org)

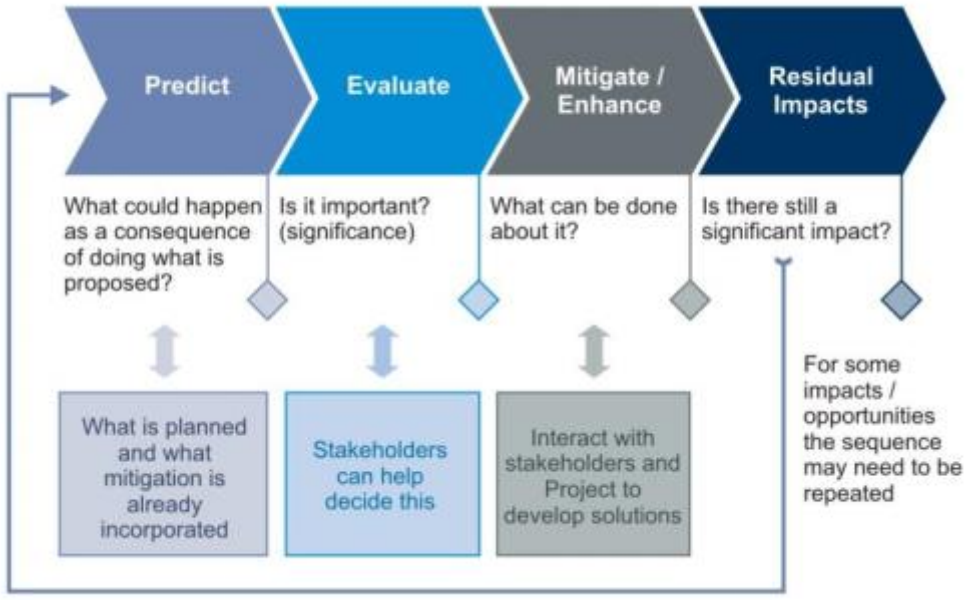
Note: The fisheries study report was awaited at the time of writing this report. Same will be included in the updated report at a later stage.

1.5.4 Impact Assessment and Management

Impact identification and assessment starts with scoping and continues through the remainder of the IA Process. The principal IA steps are summarized in Figure 1.4 and comprises of:

- **Impact prediction:** to determine what could potentially happen to resources/receptors as a consequence of the Project and its associated activities.
- **Impact evaluation:** to evaluate the significance of the predicted impacts by considering their magnitude and likelihood of occurrence, and the sensitivity, value and/or importance of the affected resource/receptor.
- **Mitigation and enhancement:** to identify appropriate and justified measures to mitigate negative impacts and enhance positive impacts.
- **Residual impact evaluation:** to evaluate the significance of impacts assuming effective implementation of mitigation and enhancement measures.

Figure 1.4 Impact Assessment Approach



The detailed impact assessment methodology is presented in ***Section 6.2***.

1.6 ESIA TEAM

ERM constituted a team comprising of various experts to carry out the ESIA study as detailed out in the table below:

Table 1.2 ESIA team and their roles

S. No.	Name	Specialist
1.	Neena Singh	Project Director and Technical review for Social aspects
2.	Debanjan Bandyopadhyay	Technical review for Environment
3.	Dr. Arun Venkataraman	Technical review for Ecology and Biodiversity
4.	Naval Chaudhary	Environmental Specialist (Air and Noise) & Project Manager
5.	Dhritiman Ray	Environment Specialist (Water)
6.	Salil Das	Environmental Specialist (baseline monitoring & waste)
7.	Dr. Rahul Srivastava	Ecology and Biodiversity Specialist
8.	Subhradeb Pramanik	Risk assessment Specialist
9.	Souvik Basu	Stakeholder Consultation
10.	Shyamal Kanti Barman	Fisheries Specialist
11.	Dr. Md. Mahbub Iqbal	Limnological Expert
12.	Dr. Swayam Panda	Socio-economic Expert
13.	Soumi Ghosh	Socio-economic baseline and stakeholder consultation
14.	Dibyendu Chakraborty	GIS and mapping
15.	Mitra S. K. Bangladesh	Environmental baseline monitoring and analysis

1.7 REPORT STRUCTURE

The ESIA report has been largely structured based on the generic ToR issued by the DoE for other similar projects in the recent past and as per ToR shared by SMIIPCL meeting the applicable reference framework (refer to ***Section 1.4.1***). The layout of the Report has been divided into 10 sections as *briefly* described in Table 1.3:

Table 1.3 Layout of the Report

Chapter No.	Chapter Title	Description
0	Executive Summary	This section includes • Brief summary of the entire ESIA report [To be included later]
1	Introduction	This section includes • Introduction about the project, • Project background, • Brief description, • Scope of the ESIA study • Approach and Methodology • ESIA team
3	Project Description	This section describes • The proposed project; • Its major components; and • Its geographic, ecological, social, and temporal context, including This section also examines • alternatives to the proposed project site, technology, design, and operation—including the no project alternative—in terms of their potential environmental and social impacts; the feasibility of mitigating these impacts; their suitability under local conditions; and their institutional, training, and monitoring requirements.

Chapter No.	Chapter Title	Description
		• It also states the basis for selecting the particular project design proposed and, justifies recommended emission levels and approaches to pollution prevention and abatement.
3	Policy, Legal and Administrative Framework	This section discusses • The national and local legal and institutional framework within which the environmental assessment is carried out. It also identifies project-relevant international environmental agreements to which the country is a party. • It also covers the applicable reference framework being used for the ESIA study in addition to the national regulatory requirements for project financing.
4	Description of the Environment	This section describes • relevant physical and biological conditions within the study area, and • looks at current and proposed development activities within the project's area of influence, including those not directly connected to the project. It indicates the accuracy, reliability, and sources of the data.
5	Socio-economic Environment	This section describes • relevant socioeconomic conditions within the study area, and • looks at current and proposed development activities within the project's area of influence, including those not directly connected to the project. It indicates the accuracy, reliability, and sources of the data.
6	Anticipated Environmental and Social Impacts and Mitigation Measures	This section • predicts and assesses the project's likely positive and negative direct and indirect impacts to physical, biological, socioeconomic (including occupational health and safety, community health and safety, vulnerable groups and gender issues, and impacts on livelihoods through environmental media, and physical cultural resources in the project's area of influence, in quantitative terms to the extent possible; • identifies mitigation measures and any residual negative impacts that cannot be mitigated; explores opportunities for enhancement; identifies and estimates the extent and quality of available data, key data gaps, and uncertainties associated with predictions and specifies topics that do not require further attention; and examines global, transboundary, and cumulative impacts as appropriate.
7	Environmental and Social Management Plan (ESMP)	This section deals with • the set of mitigation and management measures to be taken during project implementation to avoid, reduce, mitigate, or compensate for adverse environmental and social impacts; • describes the mitigation, monitoring, implementation arrangements and performance indicators for effective implementation of the ESMP; and • Framework management plans for construction phase of the project. This section also describes: • the grievance redress framework, setting out the time frame and mechanisms for resolving complaints about environmental performance; and

Chapter No.	Chapter Title	Description
		• structure of the grievance redress cell to be formed for the project.
8	Stakeholder Consultations and Participation	This section • describes the process undertaken during project design and preparation for engaging stakeholders, including information disclosure and consultation with affected people and other stakeholders; • summarizes comments and concerns received from affected people and other stakeholders and how these comments have been addressed in project design and mitigation measures, with special attention paid to the needs and concerns of vulnerable groups; and • describes the planned information disclosure measures and the process for carrying out consultation with affected people and facilitating their participation during project implementation.
9	Risk Assessment	This section entails risk assessment to personnel and environment from consequences of accidental events as well as natural hazards and includes hazard identification, risk reduction measures and recommendations
10	Conclusion and Recommendation	This section provides • the conclusions drawn from the impact assessment; and • Recommendations for environmental and social management during the project lifecycle.

1.8 LIMITATIONS

Uses of this report

This report is prepared based on primary data collected in December 2017 and January 2018 as well as secondary data available from other studies carried out in the past in and around Meghnaghat Power Hub. Remaining baseline data which include bio-monitoring data and fisheries study was not available at the time of writing this report. Same will be included in the updated report at a later stage and can change the significance and magnitude of impacts based on recent aquatic ecological conditions in and around the project site.

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Nothing contained in this report shall be construed as a warranty or affirmation by ERM that the site and property described in the report are suitable collateral for any loan or that acquisition of such property by any lender through foreclosure proceedings or otherwise will not expose the lender to potential environmental or social liability.

2 PROJECT DESCRIPTION

2.1 THE PROJECT

The project has received in-principle approval from the Bangladesh Power Development Board (BPDB) to set up dual fuel fired combined cycle power project at Meghnaghat Power Hub and total land available for the project is 14.28 acres, which is owned by the BPDB. This land parcel is part of the Meghnaghat Power Hub, for which land was acquired by BPDB way back in 1997-98. Land is developed with flood embankment.

The project will be based on regasified liquid natural gas (RLNG) and high speed diesel (HSD). The project will have 1 gas turbine (GT), 1 heat recovery steam generator (HRSG) and 1 steam turbine (ST) (i.e. 1+1+1 configuration). RLNG will be supplied by Petrobangla's nominated entity. The new gas transmission line of GTCL is currently under construction and likely to be completed by Year 2020. This will supply gas (NG/RLNG) to all the proposed power plants within Meghnaghat Power Hub as well as Summit M-1 project, which is currently running with HSD due to non-availability of natural gas. HSD will be supplied by Bangladesh Petroleum Corporation (BPC) at pontoon of existing *Summit M-1* project. HSD storage will be maintained at existing fuel tanks of *Summit M-1* project and will be supplied to *Summit M-2* project, if required. The project will not require construction of new transmission line; however, it may require around 300-400 m power evacuation line to connect Power Grid Company of Bangladesh (PGCB) grid sub-station (GSS) to be situated on the Meghnaghat Power Hub site.

2.1.1 The Project Site

The project site is approximately 10 km (aerial distance) east of Narayanganj District headquarters and about 28 km (aerial distance) south-east of Dhaka (Division headquarters). General site location is shown in ***Figure 2.1***.

The project site is located at Mouza: Char *Ramjan Sonaullah*, Union: *Pirijpur* of Sonargaon Upazilla in Narayanganj District as shown in ***Figure 1.1.*** The site is well connected by a dedicated access road to Meghnaghat Power Hub from the Dhaka-Chittagong Highway (N1).

2.1.2 Key Features of the Site and Surroundings

The project site is flat developed land and covers an area of 14.28 acres, owned by the BPDB. The site is fenced and earlier used as laydown area during construction of *Summit M-1* project. It was observed during the site visit that scrap material from previous construction activities is still lying on the site. Site photographs showing current status of the site are shown in ***Figure 2.2***.

The Project site co-ordinates are as follows:

- NW corner: 23°36'36.73"N, 90°35'46.53"E
- NE corner: 23°36'37.31"N, 90°35'50.69"E
- SE corner: 23°36'24.10"N, 90°35'54.10"E
- SW corner: 23°36'23.56"N, 90°35'48.50"E

Figure 2.1 Project Location

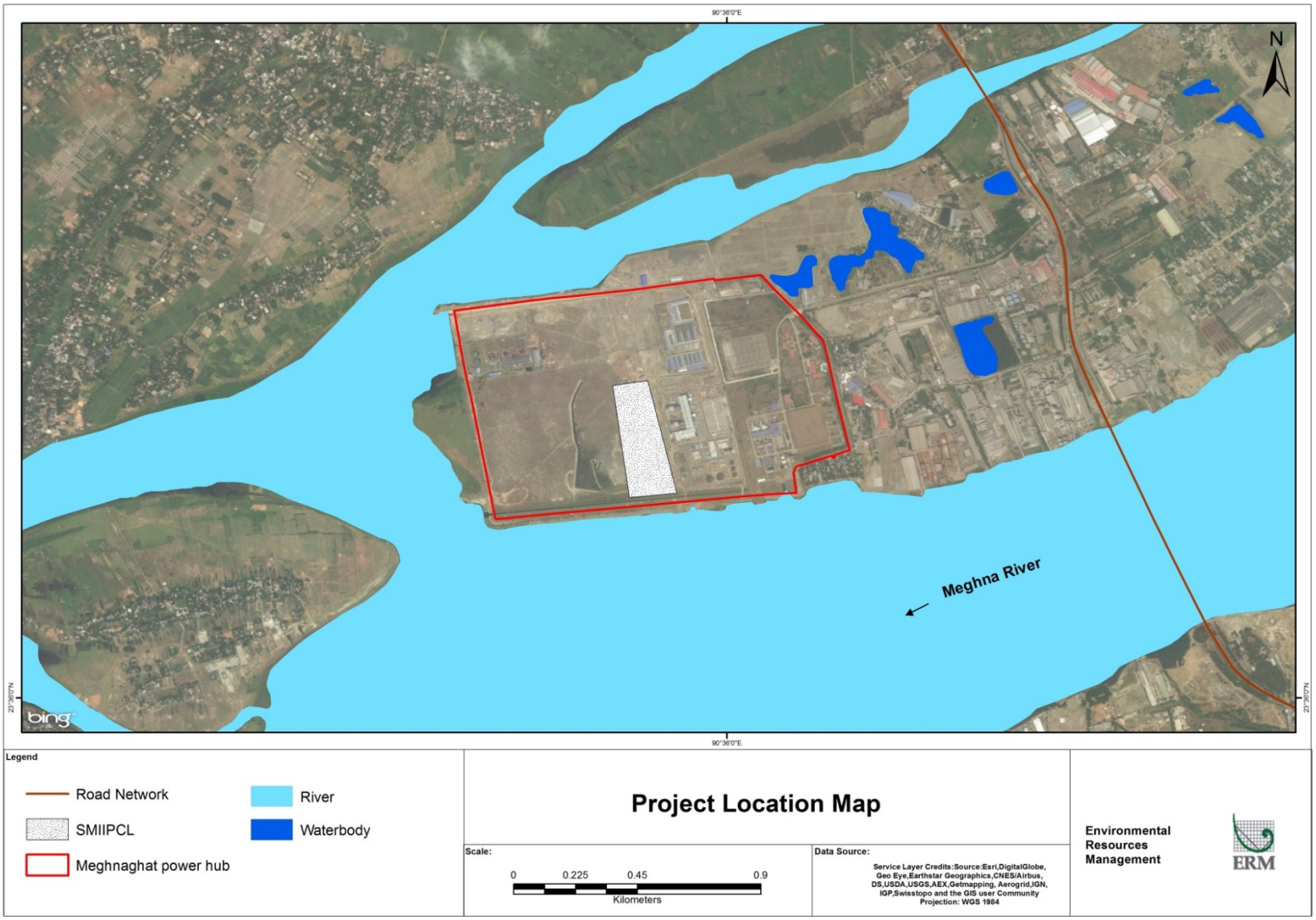


Figure 2.2 Site Photographs



Source: Site Visit (4th October 2017)

Salient features of the site and surrounding areas are given in ***Table 2.1***.

Table 2.1 Salient features of the site and surroundings

S. No.	Particulars	Details
1	Site location	Mouza: Union: Pirijpur Upazilla: Sonargaon District: Narayanganj
2	Site topography	Generally plain with average elevation of 3 m above mean sea level
3	Site land use	Empty BPDB land with part of land used for storage of scrap material from previous construction activities in the area
4	Nearest highway	Dhaka – Chittagong highway (N1) : 1.5 km* east
5	Nearest railway station	Narayanganj railway junction : 9.3 km* west
6	Nearest airport	Hazrat Shahjalal International Airport, Dhaka: 32 km* west-north-west
7	Nearest waterbody	River Meghna: adjacent to project site from three sides (0.080 km south; 0.370 km north and 0.500 km west)
8	District headquarters	Narayanganj: 10 km* west
9	Upazilla headquarters	Sonargaon:
10	Nearest town/ city	Sonargaon
11	Nearest village	Settlement near approach road: 0.65 km* north-east (Islampur) Dudghata village: 0.95 km* north-west
12	Cultural Heritage/ Archaeologically important sites	Sonargaon: Tomb of Sultan Ghiasuddin, the shrines of Panjpirs and Shah Abdul Alla and a beautiful mosque at Goaldi village (about 5 km* north) Idrakpur Fort: 9.5 km* south-west in Munshiganj
13	Protected areas as per Wildlife (Conservation and Security) Act, 2012	None, within 10 km radial zone (No forest land within Narayanganj and Mushiganj districts)[1]
14	Reserved and protected forests	None within 10 km radial zone
15	Ecologically critical area	Shitalakshya River: 9.2 km* west
16	Hills/ valleys	No hills and valleys within 10 km radial zone
17	Seismicity	Seismic zone II (z = 0.20)
18	Defence installations	None within 10 km radial zone

* Aerial distance

Layout of the land already under possession of the BPDB for the Meghnaghat Power Hub with demarcation of existing power projects, proposed power projects and land available for other utilities is presented in ***Figure 2.3*** and aerial view of the site is shown in ***Figure 2.4***. Meghnaghat power hub is surrounded by Meghna River in the north, west and south directions, which also creates a buffer between the Meghnaghat power hub and nearby villages.

[1] http://cis.moef.gov.bd/das/LinkPage/Dist-Wise-Forest-Land-2016.pdf

Figure 2.3 Master Layout Plan of Meghnaghat Power Hub

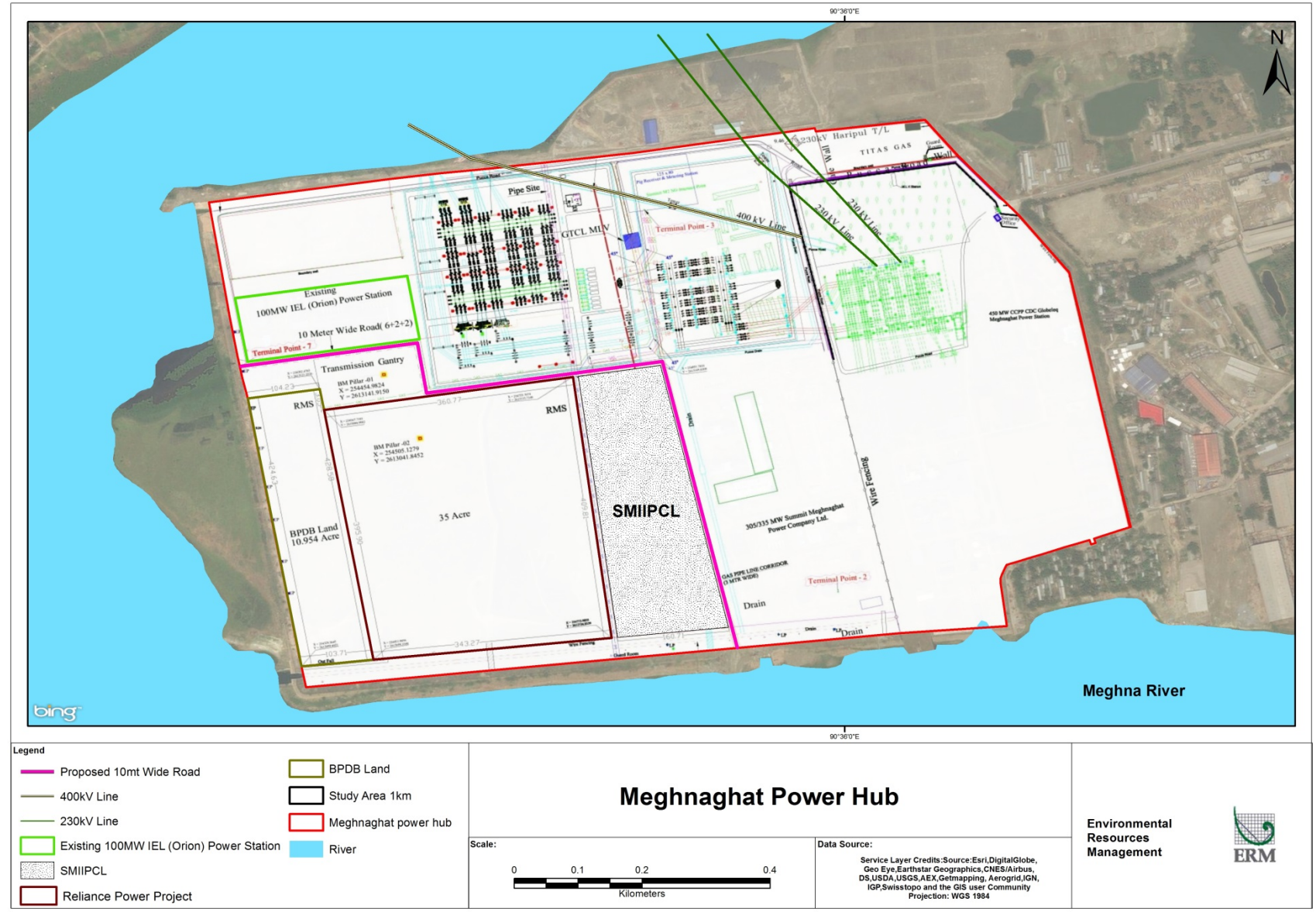


Figure 2.4 Aerial View of Meghnaghat Power Hub



Source: Google Earth Imagery Dated 12.01.2017 (Accessed on 31.10.2017)

2.1.3 *Site Access*

The project site is accessible from Dhaka-Chittagong highway (N1) near the Meghnaghat Toll Plaza through a dedicated access road of about 2.0 km. This access road was completed by the BPDB in August 1999. This access road has been raised to the same elevation as the Meghnaghat power hub using fill from the Meghna River. The inland waterway accessibility via Meghna River is also feasible for the project site and logistics purpose. Same had been used during the construction of existing projects within the power hub.

2.1.4 *Other Industries*

Meghnaghat Power Hub

The Meghnaghat Power Hub is currently having following power projects and utilities:

- 450 MW (gas) Meghnaghat Power Station (operational)
- 100 MW (HFO) Orion Power Station (operational)
- 305/335 MW (gas/HSD) Summit Meghnaghat-I CCPP (operational)
- 230 kV PGCB Sub-station (operational)
- Gas supply pipelines for power hub and towards Siddhirganj (operational)
- Pig receiver and metering station (operational)
- 600 MW (RLNG/HSD) Summit Meghnaghat-II CCPP (proposed)
- 750 MW (RLNG) Reliance Power CCPP (proposed)
- 400 kV PGCB Sub-station (proposed)
- Pig receiver and metering station (proposed)

Meghnaghat-North Industrial Area

The Meghnaghat north industrial cluster is located on north bank of the Meghna River. It is located in the Sonargaon Upazila of Narayanganj district. Different industries in this cluster are listed in **Table 2.2.**

Table 2.2 Industries in Meghnaghat (N) Industrial Cluster

Power / Industrial Sectors	Number	Details
Power Plant	3	▪ 100 MW Engine based Power Plant of Orion Group ▪ 337 MW Dual Fuel CCPP of Summit Group ▪ 450 MW Meghna CCPP of Pendakar Energy
Steel Mill	1	▪ Tanveer Steel Mill
Paper Mill	5	▪ Basundhara Paper Mill Unit-1 ▪ Basundhara Paper Mill Unit-2 ▪ Magura Paper Mill ▪ Multi Paper Mill ▪ Tanveer Paper Mill
Cement Plant	5	▪ Tiger Cement Plant Unit 1 ▪ Tiger Cement Plant Unit 2 ▪ Holcim Cement Plant Unit 1 ▪ Holcim Cement Plant Unit 2 ▪ Fresh Cement Plant

Power / Industrial Sectors	Number	Details
Textile / RMG Unit	-	
Shipyard	3	▪ Ananda Shipyard ▪ Islampur Shipyard ▪ Meghna Shipbuilding & Dockyard
Food Processing Unit	2	▪ Meghna Group of Industry ▪ Abdul Monem Sugar Refinery
Chemical Industry	2	▪ Meghna Chemicals ▪ Meghna Group of Industry
Others	-	
TOTAL	**21**	

Power Plants

As stated earlier, presently there are three operating power plants in this cluster with total capacity of 887 MW. These three power plants are operated by natural gas, high speed diesel (HSD) and heavy furnace oil (HFO). Type and capacity of plant is presented in **Table 2.3**.

Table 2.3 Power Plants in Meghnaghat North Industrial Cluster

Sl. No.	Name & Capacity	Location	Operator	Fuel Used	Cooling System
1	100 MW Engine based Power Plant	Meghnaghat Power Hub	Orion Power Meghnaghat Ltd.	HFO	-
2	337 MW Duel Fuel CCPP	Meghnaghat Power Hub	Summit Meghna Power Co. Ltd	Natural gas/ HSD	Once through cooling system
3	450 MW Meghna CCPP	Meghnaghat Power Hub	Power Tech, Pendekar	Natural gas	Once through cooling system

Major air emissions from gas based power plant include NOx and CO whereas for oil based power plant it is NOx, SOx, CO and PM. Both combined cycle power plants in this region are using river water for cooling, DM water intake and other water uses. The combined cycle power plants require large quantities of cooling water. Both the plants have once through cooling systems and cooling water is discharged into the Meghna River usually from separate point of discharges. The distance between discharge locations of Meghnaghat CCPP and Summit M1 is about 700 m.

Industries

Prominent type of industries located in this industrial includes cluster cement plants, pulp and paper mills, ship building yards and food processing industries mostly of the Meghna Group of Industries.

Cement Plants

The Meghnaghat north industrial cluster has 5 cement grinding mills owned by three different companies (*Holcim, Meghna Group and Madina Group*). All these units are located adjacent to each other. Raw material is generally transported through ships and unloaded at the jetties and transported to storage silos through conveyor belts. Major emissions from the cement plants

is of PM. Emissions from raw material storage areas and from milling, packing and storage of cement from such units have been mitigated through installation of bag filters at adequate locations. Consultation with local people revealed that PM from clinker and fly ash unloading facilities regularly creates dust nuisance and health related problems for the local communities.

Food Processing Industries

Meghna Group of Industries, a private industrial group in Bangladesh has set up various food processing units in the Meghnaghat region. These units are mainly located on western side of Dhaka-Chittagong road and along the eastern part of this industrial cluster. Major source of pollution from these industries is from process wastewaters. The units located in this cluster are:

Table 2.4 Meghna Group of Industries – Units in Meghnaghat

Units	Product
Tanveer Food Ltd.	Powder Milk, Spices
United Sugar Mills Ltd.	Sugar
Janata Flour and Dal Mills Ltd.	Flours and Pulses
Tanveer Oil Ltd.	Refined Soybean, Palm Oil and Dalda
United Mineral Water & Piety Industries Ltd.	Piety Bottles, Mineral Water
United Feeds Ltd.	Poultry and Fish Food
Tanveer Food Ltd.	Tea
Sonargaon Salt Ltd.	Salt
Surma Mustard Oil Mills Ltd	Mustard Oil

Pulp & Paper Industries

There are four operating pulp and paper mills in this region while a fifth unit is presently under construction. Capacity of the plant and information on pollution load from these units could not be gathered. The consultation with local people revealed that pulp is mostly imported and waste /recycled paper is also used in making of pulp. Major pollution from these industries is from process effluents.

Chemical Industry

Meghna Group has a chemical plant within this cluster; however information on type of chemicals manufactured / processed in this plant could not be established at this stage of the study. Consultation with locals reveals that discharge of effluent from chemical industry and pulp and paper mills causes of periodic fish kills in the Meghna River.

Shipbuilding Units

There are two ship building units (*Ananda and Islampur Shipyards*) located in the western part of the Meghnaghat North industrial cluster. Emission from these units primarily include PM and VOCs. High noise levels are also generated from these units.

Steel Rerolling Mill

There is only one small steel re-rolling mill located adjacent to Dhaka-Chittagong Highway. Major emission from this unit includes PM and NOx.

Meghnaghat-South Industrial Area

Meghnaghat south industrial cluster is located on the south bank of Meghna River. It is located in Gazaria Upazila of Munshiganj district. Different industries in this cluster are listed in **Table 2.5.**

Table 2.5 Industries in Meghnaghat (S) Industrial Cluster

Power / Industrial Sectors	Number	Details
Power Plant	-	
Steel Mill	-	
Paper Mill	-	
Cement Plant	1	▪ Anwar Cement Plant
Textile / RMG Unit	2	▪ Esquire Colour Coating Mill ▪ Esquire Accessories
Shipyard	2	▪ T K Shipyard ▪ Khan Brother Shipbuilding
Particle Board Factory	1	▪ Super Board Mills Ltd.
Chemical Industry	1	▪ Samuda Chemicals
Oil Depots / Tank Farm	1	▪ Rupsha Tank Farm
Others	-	
TOTAL	**8**	

Power Plants

No power plants are located within this cluster.

Industries

Prominent industry types located in this cluster include cement plants, ship building units and textile and garment industries.

Ship Building Units

There are two ship building units (*Khan Brothers Shipyard and Samuda Shipyard*) located within this industrial cluster. Major pollution from these units is in the form of fugitive dust and VOCs from use of paints. High noise levels are also generated from these units.

Particle Board Factories

There is a particle board manufacturing unit of T.K. (Samuda) Group located in this cluster. Major pollution is from fugitive emissions from industrial processes. Local people complained about regular dust nuisance.

Chemical Industries

The T.K Group has a chemical plant within this cluster. However at present information on type of chemical manufactured / processed here was not available for review.

Cement Plant

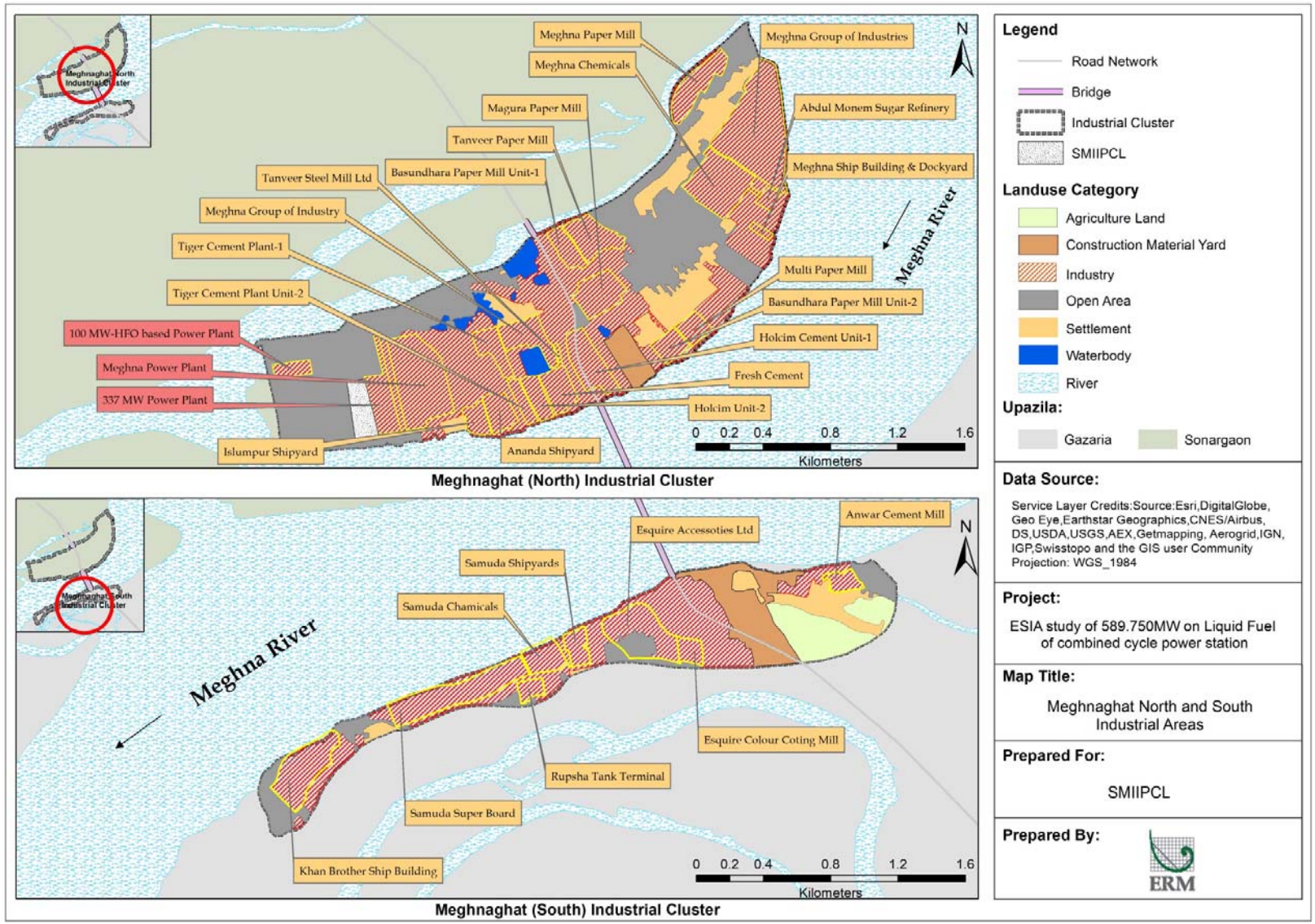
One cement grinding unit (*Anwar Cement Mill*) is also located in this industrial cluster. Major emission from the unit is of PM.

Garment & Textile Industry

Two textile and garment units (*Esco Colour Coating Mill and Esquire Accessories*) are also located in this industrial cluster. Process effluents are the principal source of pollution from these units.

The industries present in Meghnaghat (North) and Meghnaghat (South) industrial areas are presented in **Figure 2.5.**

Figure 2.5 Map showing Industries in Meghnaghat-North and Meghnaghat-South Industrial Areas



2.2 KEY PROJECT COMPONENTS

2.2.1 Power Plant

The main power block of the plant will consist of one dual fuel GT, one ST and one HRSG along with bypass and exhaust stacks. The plant will be constructed to have a maximum continuous rating (MCR) capacity output of 589.75 (net) MW on Gas (NG/RLNG)/ 541.22 (net) MW on Liquid Fuel (HSD), at the high voltage side of the outgoing terminals of the 400 kV transformer corrected to the reference conditions at 0.80 power factor (lag) at Generator Terminal.

Key components of Summit M-2 project will be as follows:

- Gas Turbine;
- Heat Recovery Steam Generator;
- Steam Turbine;
- Steam Turbine Condenser;
- Fuel Gas Compression and Conditioning System;
- Water System including cooling water system;
- Electrical System;
- Connection from Summit M-2 switch yard to PGCB sub-station;
- Air Conditioning and Ventilation System;
- Control and Instrumentation System;
- RMS for natural gas compression and conditioning;
- Natural gas pipeline from Valve Station to the RMS of the plant;
- Water intake structure;
- Effluent Treatment Plant (ETP);
- Sewage Treatment Plant (STP); and
- Cooling water discharge channel/ pipeline.

Tentative plant layout with general arrangement of equipment is shown in ***Figure 2.6***.

2.2.2 Fuel Transportation and Supply

Regasified LNG

Currently one Gas pipeline is in service at Meghnaghat Hub and one new Gas pipeline will have interconnection with the present Gas pipeline to cater present and future projects at Meghnaghat Power Hub site. A regasified LNG supply and treatment system to deliver gas will be installed in the vicinity of the plant to meet the required gas quality and pressure specified by the GT manufacturer. Gas specification as per the IEC contract has been provided in ***Table 2.6***.

Table 2.6 Gas Specification

Constituent	Composition for Performance Guarantee (% by Volume)
Methane	97.33

Constituent	Composition for Performance Guarantee (% by Volume)
Ethane	1.72
Propane	0.35
Butane-N	0.06
Butane-I	0.08
Other	0.08
Carbon monoxide	-
Carbon dioxide	0.11
Hydrogen sulphide	-
Air	-
Hydrogen	-
Oxygen	-
Nitrogen	0.30
Water	-
Low heating value (LHV), kJ/kg	49,506
High heating value (HHV), kJ/kg	54,668

Note: Total sulphur content may be in some cases 48mg/m³
Source: SMIIPCL (Extracted from IEC contract)

Liquid fuel

HSD will be supplied by BPC through its nominated vessels at the existing pontoon of Summit M-1 project located on the River Meghna at the south-eastern corner of the Summit M-1 project. The project is not intended to develop a separate system for HSD storage within the site. It has been planned that HSD storage will be maintained at existing fuel tanks of Summit M-1 project and will be supplied to Summit M-2 project, if required. Summit M-1 project is having storage facility of about 24,000 m³ of liquid fuel, which includes 2 tanks of 7,000 m³ capacity and 5 tanks of 2,000 m³ capacity. The storage capacity is adequate to run both Summit M-1 and M-2 plants with liquid fuel for more than 7 days with 80% load[1]. Summit M-2 will also erect one fuel tank of 7,000 m³ capacity and aggregate capacity of 31,000 m3 HSD storage will be sufficient for operating both the plants. HSD supply arrangement of Summit M-1 project is shown in ***Figure 2.7***. HSD specifications as per the IEC contract are shown in ***Table 2.7***.

Table 2.7 HSD Specification

Test	Method	Limit
Density at 15 °C, Kg/L	ASTM D 1298	Min. 0.820 Max. 0.870
Colour, ASTM	ASTM D 1500	Max. 3.0
Neutralization Value: Strong Acid No, mg KOH/gm Total Acid No, mg KOH/gm	 ASTM D 664 ASTM D 974	 Nil Max. 0.2
Ash , % mass	ASTM D 482	Max. 0.01
Carbon Residue (Conradson) On 10% bottom, % wt.	ASTM D 189	Max. 0.2
Cetane Number	ASTM D 613	Min. 45
Cetane Index Calculated)	ASTM D 976	Min. 45
Pour point, °C	ASTM D 97	Max. 9 (Winter)** Max.12 (Summer)**
Copper Strip Corrosion	ASTM D 130	Max. No. 1

[1] It is also to be noted that as per Power Sector Master Plan in Bangladesh, Coal and RLNG have been considered to be two main primary fuels for power generation after depletion of indigenous natural gas reserves. Therefore, HSD will always be used for peak generation.

Test		Method	Limit
(3 hours at 100 °C)			
Flash point, PM(cc) / Abel,°C		ASTM D 93/ IP 170	Min. 32
Kinematic viscosity at 38 °C, cst		ASTM D 445	Max. 9.0
Sulphur total, % mass		ASTM D 4294	Max. 0.25
Sediment, % mass		ASTM D 473	Max.-0.01
Water content, % vol.		ASTM D 95	Max. 0.1
Distillation: 90 % vol. recovery, °C		ASTM D 86	Max. 375
Sediments and particulates for light distillate)	Total d < 10 µm 10 ≤ d ≤ 25µm d > 25 µm	D6217/DIN EN12662 DIN51575	Max. 20.0 Max. 18.0 Max. 2.0 Max. 0
Ash		D482 / ISO6245 DIN51575 / DIN EN 2645	Max. -100
Vanadium		DIN 51790 ASTM D 3605	0.4 to 0.99
Lead		DIN 51790 ASTM D 3605	Max. 1
Zinc		DIN 51790 ASTM D 3605	Max 2.0
Total of Sodium + Potassium		DIN 51790 ASTM D 3605	< 1
Nitrogen (FBN = Fuel Bound Nitrogen)		ASTM D 4629	Max. 0.015
Sulphur		D3246/D5453/ ISO6326	Max. 0.25
Acid Number		D664	Max. 0.1
Calorific Value Kcal/Kg			Max. 10280

Note:
* [Fuel oil will be tested by the Company, to confirm compliance with the above specification. The test result will be attached with this Agreement]
** Winter shall be the period from November to February (both months inclusive) and rest of the months of the year shall be deemed as Summer.

Source: SMIIPCL (Extracted from IEC Contract)

2.2.3 *Power Evacuation*

PGCB is currently having a 230 kV grid sub-station within the Meghnaghat power hub, which is supporting the existing power plants. In order to cater the need of proposed power plants within the Meghnaghat power hub, PGCB has planned to set up a 400 kV grid sub-station and land for the 400 kV GSS is already earmarked by the BPDB. The 400 kV transmission line (T/L) network (Madunaghat T/L and Aminbazar T/L) are already completed and currently connected with the 230 kV GSS. Proposed 400kV GSS is close to the project boundary of Summit M-2 and therefore will not require construction of new transmission line; however, it will require around 300-400 m power evacuation line for connecting to the 400 kV GSS. It has been reported that the GSS will be ready prior to the start of simple cycle operation.

In case of any delay in the completion of 400 kV GSS, it has been planned to have temporary connection with the 400 kV existing T/L, such as a line-in line-out (LILO) arrangement, however the connection type is yet to be finalised.

Figure 2.6 Tentative Plant Layout

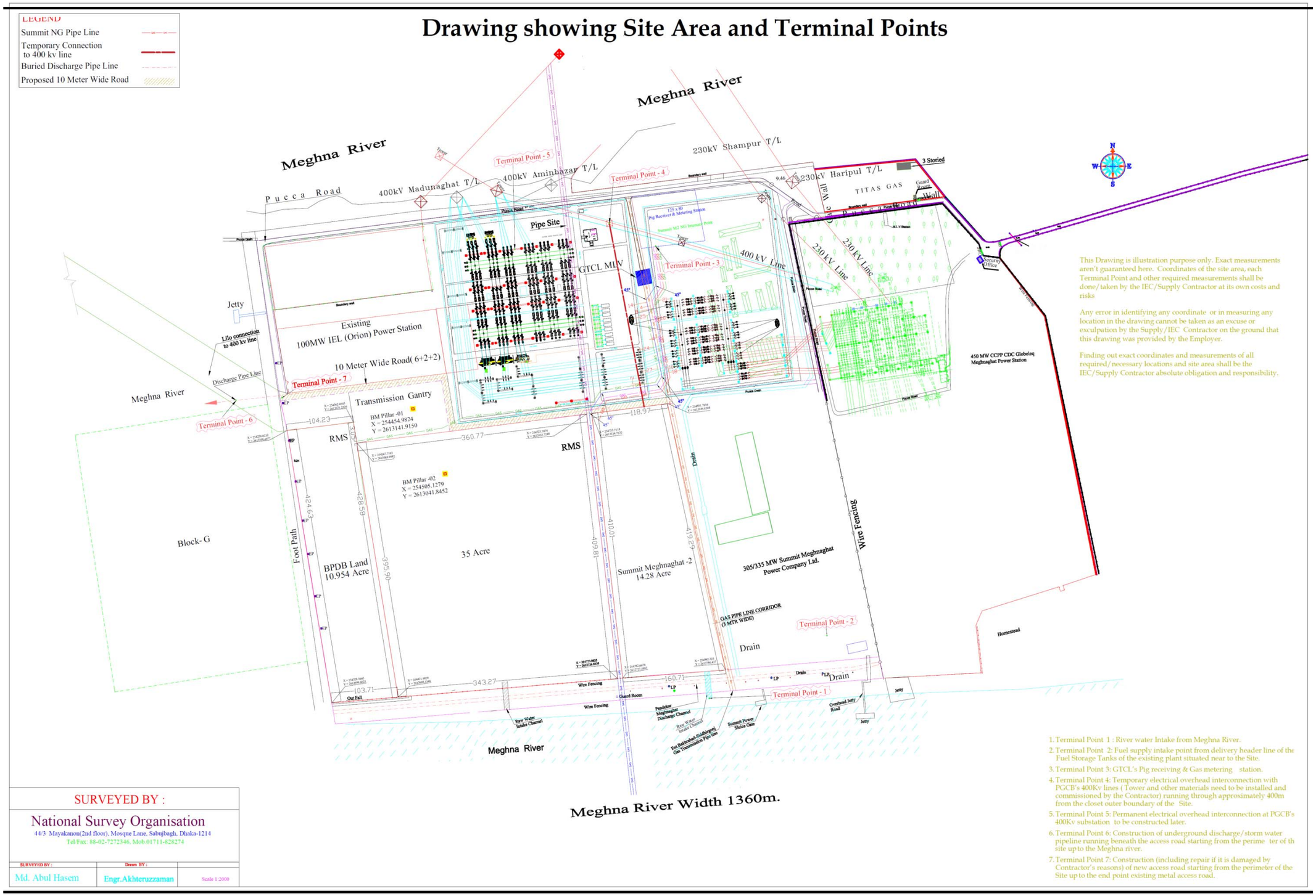
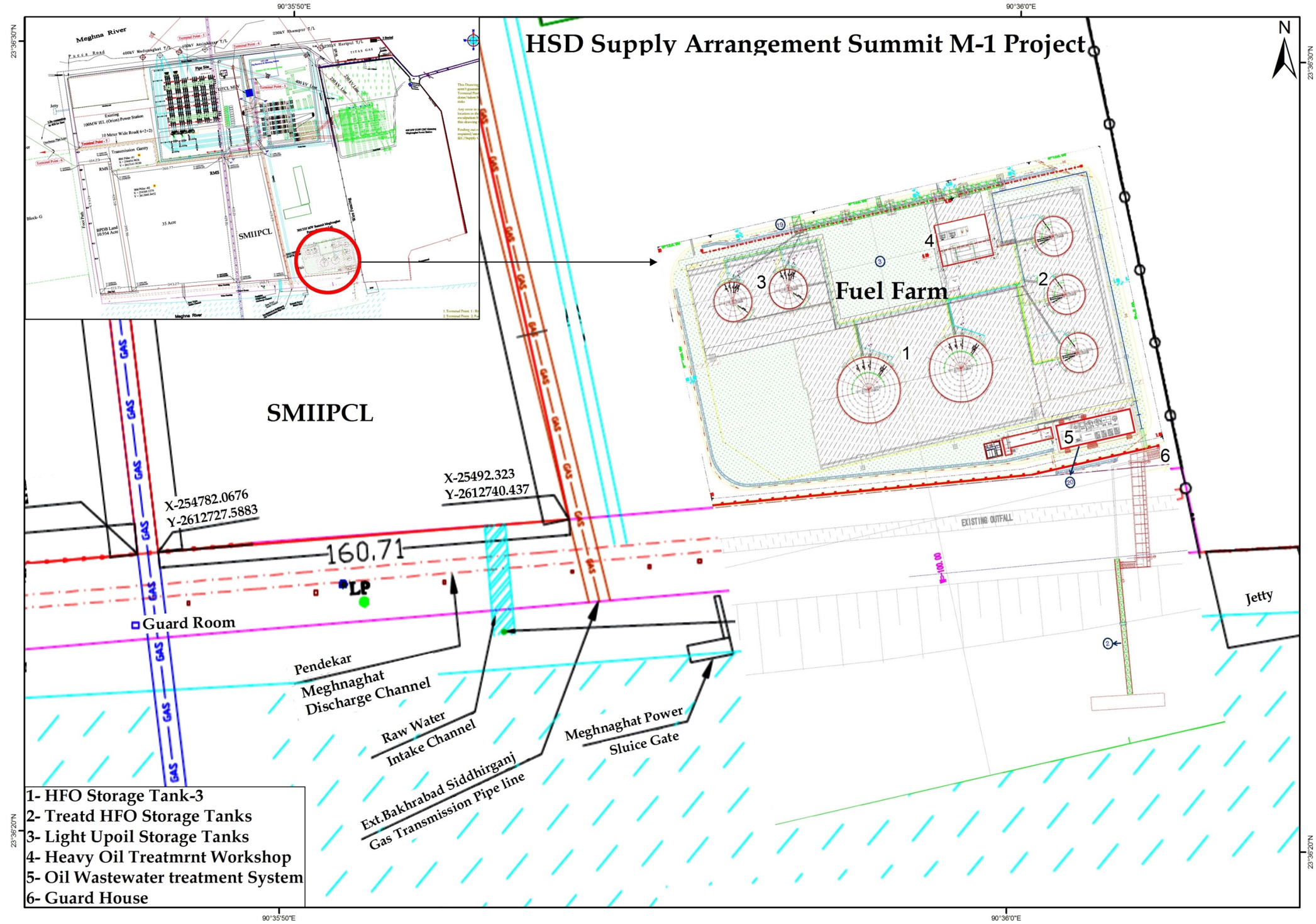


Figure 2.7 HSD Supply Arrangement of Summit M-1 Project



2.3 RESOURCES REQUIREMENT AND UTILITIES

2.3.1 Land

Land available for setting up the plant is about 14.28 acres, which is currently owned by the BPDB and will be leased to SMIIPCL after execution of land lease agreement (LLA). Necessary infrastructure such as access road, transmission line/s, fuel unloading facility, fuel storage tank farm are already existing within power hub. In addition to that natural gas pipeline of GTCL upto Meghnaghat Power Hub, gas receiving station and 400 kV grid sub-station of PGCB are also planned to be developed by the respective government agencies responsible for fuel supply and power evacuation. Additional land requirement during construction stage will include laydown area, construction camp/s and temporary jetty for heavy lifts and materials. ***Table 2.8*** provides a summary of the land requirement for various components of the project for both the construction and operation phase.

Table 2.8 ***Break-up of Land Requirement for the Project and Associated Utilities***

Project Component	Required Land Area (In acres)	Current Status of Land	Proposed Mode of Land Acquisition
Power Plant	14.28	Under Possession of BPDB and SMIIPCL will apply for allocation.	The land will be obtained under a land lease agreement (LLA) for 22 years covering the entire period of Implementation Agreement.
Approach Road	0	Under Possession of BPDB	BPDB will grant SMIIPCL the right to the non-exclusive, free and unfettered use of the Access road throughout the term of the LLA.
Gas Supply Line*	0	Under Possession of BPDB	The RoW for gas pipeline from project boundary to Valve Station of Petrobangla nominated company will be obtained through a Land Lease Agreement with BPDB.
Transmission Line*	0	Owned by PGCB	A 400 kV sub-station of PGCB is planned to be constructed within power hub. Hence there will be no land requirement for transmission line for connecting to the Grid. The project will require about 300 – 400 m length of power evacuation line.
HSD Supply System	0	Under possession of SMPCL	No additional land is required as SMPCL is already having HSD unloading facility and tank farm of about 24,000 m^3 capacity for HSD storage. BPC will use the SMPCL facility to deliver the HSD.
HSD pipe line (From SMPCL tank farm to Summit M-2 site)	0	Under possession of BPDB and SMPCL	Summit M-2 project site is adjacent to Summit M-1 project and a natural gas pipeline corridor of about 10 m is located between the two projects. The RoW will be granted by BPDB/ Petrobangla to SMIIPCL for the same.

Project Component	Required Land Area (In acres)	Current Status of Land	Proposed Mode of Land Acquisition
Water Intake, pump house and water pipeline	0	Land is under possession of BPDB and Meghnaghat Power Project	The RoW for water intake will be obtained through a Land Lease Agreement with BPDB for water intake pontoon at Meghna River and a RoW from 450 MW Meghnaghat Power Project, to use the embankment and crossing of land used for discharge channel, respectively. Length of pipeline will be about 100 m.
Water discharge pipeline	0	Land is under possession of BPDB.	The discharge channel is planned to be constructed along the site access road of 10 m width, which will be obtained through a land lease agreement with the BPDB. Length of discharge pipeline (buried) will be about 500 m.
Laydown Area (Construction Phase)	6.2	Land is under possession of BPDB and SMPCL	Within the power hub in government land and this will be leased to the Project.
Worker Accommodation (Construction Phase)	3.2	Land is under possession of BPDB	60-70%% of the labour will be locally employed. A small worker accommodation for migrant workers including expatriates will be established within the Meghnaghat power hub.
Total	**23.68**		

*Note: Existing facilities like access road, 400 kV transmission lines and proposed facilities like GTCL gas pipeline up to Meghnaghat Power Hub and PGCB GSS at Meghnaghat Power Hub are/will cater to other existing and proposed power plants as well. Therefore these will not be considered as associated facilities for the project.

2.3.2 *Fuel*

Regasified LNG

Total gas requirement for the project is about 70,904 kg/hr @ 100% load, which will be supplied by from national gas grid pipeline of Gas Transmission Company Limited (GTCL) – a company of Petrobangla. Summit M-2 will connect to common point of delivery of GTCL to be constructed within the Meghnaghat power hub by a high pressure gas transmission system (underground) comprised of approximately 200 – 300 m long pipeline and as per design to be operated at maximum operating pressure of 1000 psig. This pipeline will provide a safe and efficient method for transporting gas. A Regulating and Metering Station ("RMS") will be installed by the Company to control the gas flow to the Plant. The interface between GTCL and the project will be at the RMS. The gas received from GTCL will be regulated at the site to ensure its suitability for the GT. The gas regulation station will include two 100% gas compressors, a filter, a pressure control valve and a flow control valve with full NFPA (National Fire Protection Association, United States of America) fire protection system.

It is to be noted that a new gas pipeline for RLNG supply to the Meghnaghat Power Hub is planned to be constructed by GTCL. The new gas transmission pipeline between Kutumbapur in Comilla and Meghnaghat in Narayanganj will provide natural gas to the commissioned and proposed power plants, which include Summit M1 project, which is currently running by HSD due to gas supply constraint. It is reported that GTCL has received finance and will start construction in next 2 months and will be commissioned by June 2020..

Liquid fuel (HSD)

HSD will be supplied by BPC through its nominated vessels at the existing pontoon of Summit M-1 project located on the River Meghna at the south-eastern corner of the Summit M-1 project. Total liquid fuel requirement for the project is about 74,870 kg/hr @ 100% load. Based on the current liquid fuel requirement of Summit M-1 project and additional liquid fuel requirement of Summit M-2 project, the storage capacity will be adequate for 7 days storage @ 80% load.

2.3.3 Water

The water requirement for the construction phase of the Project will be met from Meghna River and/or borewell. Peak water demand during this phase will be about 800 m^3/day, which will be used for civil works construction and mechanical and electrical works including hydrotest, flushing and commissioning as well as for dust suppression and domestic usage. The potable water requirement during the construction phase will be provided by the Engineering, Procurement and Construction (EPC) contractor. The contractor will ensure that the quality of drinking water is compliant with the applicable drinking water standards (Schedule 4 of ECR, 1997).

Water requirement during operation phase of the project will be primarily for cooling water and "make up" water requirements. Peak water demand during this phase will be about 1,000 m^3/hr. Project will have a pump house on pontoon on the river for abstraction of raw water by a pipeline of about 100 m length (above or underground). The potable water requirement during the operation phase will be met either through river water or through groundwater abstraction for which a bore well will be installed. Necessary permission for installation and abstraction of groundwater will be required from Upazilla Parishad. A potable water treatment plant will be installed so that quality of drinking water is compliant with the applicable drinking water standards (Schedule 4 of ECR, 1997).

Water balance diagram of the project is presented in ***Figure 2.8***.

Water Pre-Treatment Plant

A pre-treatment plant will be installed to clarify the raw water. Chemicals such as alum and soda ash will be dosed to the water in flash mixer. The clarified water from the over flow of Clarifloculator will be stored in a twin

compartment clarified water reservoir of 2 hours storage capacity and used for Cooling Tower make-up, service water, potable water and input water to the DM Plant. The sludge from the water pre-treatment plant will be treated and disposed of suitably following the requirements as per the *Bangladesh Standards and Guidelines for Sludge Management (February 2015),* which requires analysis of the sludge characteristics prior to disposal of the same.

Cooling water system

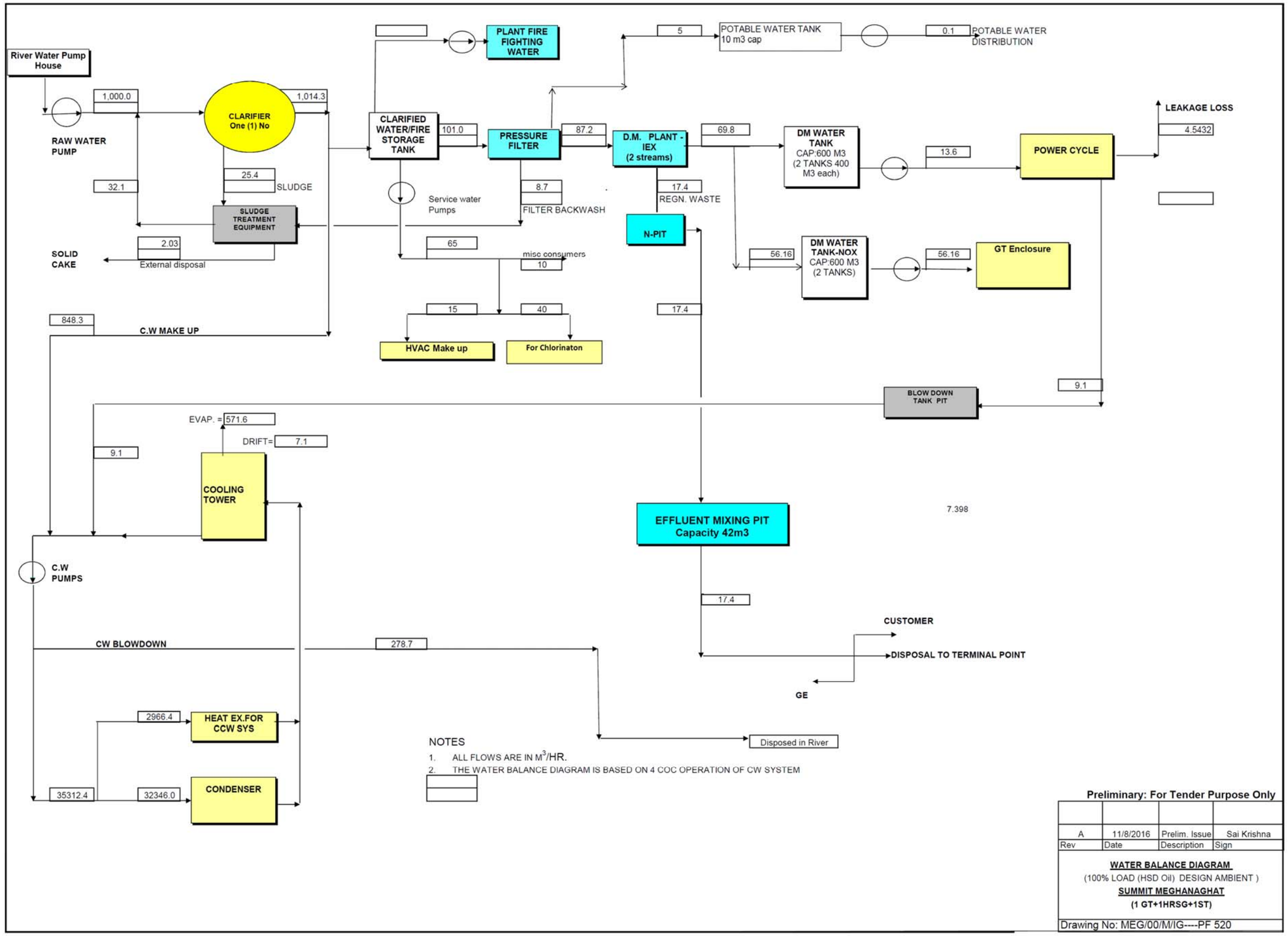
The main cooling water system will provide cooling water to the steam turbine condenser by means of cooling water pumps installed in the cooling tower basin. The warm water from the condenser is returned to the multi-cell induced draft cooling tower, where it is cooled and collected in the cooling tower basin for return to cool the condenser. The induced draft cooling tower will be provided with the capacity for maximum heat rejection duty under all steam turbine operation conditions for the design conditions specified. The cooling tower shall have sufficient cells to allow for one cell to remain in standby under reference operating conditions.

The cooling tower will contain clarified water. A cooling tower chemical injection system will be provided to maintain the appropriate cooling tower chemistry. Cooling tower blow down will be quenched and treated to meet environmental requirements before being sent to the Meghna River and the temperature difference (ΔT) between intake and outfall locations will be maintained below $3^{o}C$. The cooling tower blow down will be collected in the CMB along with other treated effluent from the plant. The discharge from the CMB will not be continuous and will only discharge after water in the CMB will reach to a threshold level and automatically discharge pump will activate. The maximum discharge from the plant will be about 300 m^3/hr and will be limited for maximum 3 to 4 hours per day.

Effluent Treatment Plant

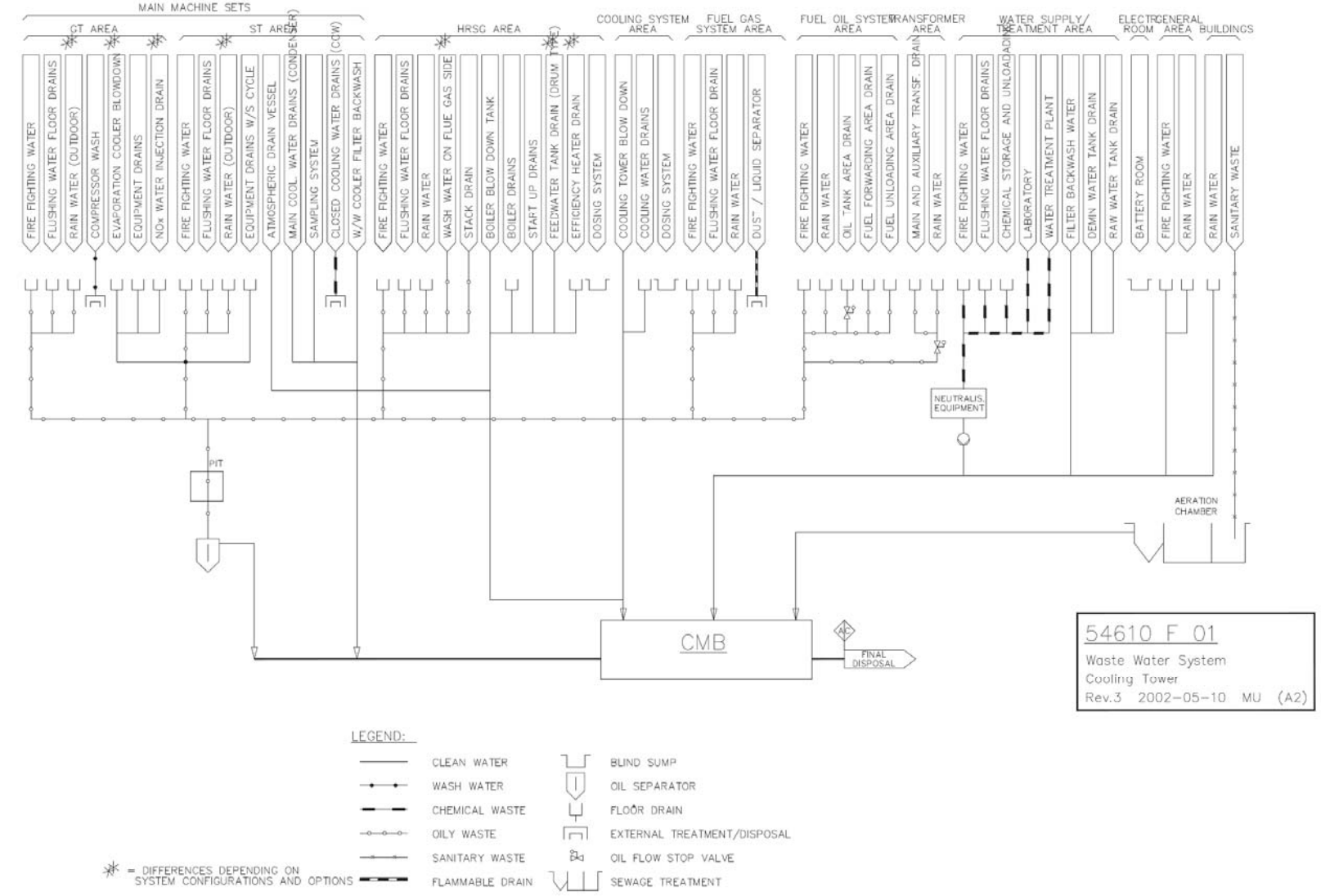
All the effluent from DM plant, HRSG blowdown, Cooling tower blowdown, STG building floor wash, oily waste from transformer yard will be collected in a water collection/settling tank and will be discharged after proper treatment in effluent treatment plant. Considering the nature of effluent generated from the plant, the treatments will be limited to neutralisation and oil separation. Oil-water separation through corrugated plate interceptor 'or' equivalent methods will be done and will have capacity of about 20 m^3/hr. In addition to that a sewage treatment plant (STP) will be provided to treat the sanitary waste generated from buildings, dormitory and kitchen with a capacity of maximum 10 m^3/day. All treated effluents will be collected at CMB, which will acts as an equalization basin having at least four (4) hours detention period. Acid and alkali dosing facility is provided at CMB to maintain the pH, BOD and COD. Treated effluent from CMB will be either discharged to the Meghna River through a buried pipeline of about 500 m length or will be used for plantation/ green areas. Wastewater treatment system schematic for the proposed project is shown in ***Figure 2.9***.

Figure 2.8 Water Balance Diagram



Source: SMIIPCL

Figure 2.9 Proposed wastewater treatment system



Source: SMIIPCL

2.3.4 Materials Storage and Handling

The plant operation will require chemicals for water treatment and process requirements. A list of the hazardous chemicals which will be used in the Plant and the maximum quantity stored is presented in ***Table 2.9***.[1]

Table 2.9 Chemicals and Storage Capacity

S. No.	Chemical Name	Maximum Storage Quantity
1.	Hydrochloric Acid	60 m^3 (33% concentration)
2.	Caustic Lye	50 m^3 (48% concentration)
3.	Sulphuric Acid	30 m^3 (98% concentration)
4.	Sodium Hypochlorite	5 m^3 (Gas chlorination is used as per the specification for raw water treatment and cooling tower)
5.	Liquid Ammonia	150 L (25% concentration)
6.	Carbon Dioxide	550 Nm^3 (approx. 11 m^3 at 50 bar g pressure) considered for generator purging only
7.	Hydrogen	1300 Nm^3 (approx. 8 m^3 at 165.5 bar g pressure)
8.	Nitrogen	1200 Nm^3 (approx. 6 m^3 at 199 bar g pressure)
5.	Lube Oil	1.5 - 2 KL
6.	HSD	No storage at site (as existing tank farm of Summit M1 project will be used)

Acids and other hazardous materials will be stored in a dedicated storage areas/ room with adequate ventilation.

2.3.5 Auxiliary Power

Power requirement during the construction phase will be met through supply from local power distribution company. In addition to that power back-up will be provided by diesel generator (DG) sets. Average electricity requirement during this phase will be about 3 MWh.

During operation phase, auxiliary power consumption at full load will be approximately 3.5% of the gross generation capacity of the plant. During the start-up of the plant auxiliary power will be taken from grid and after synchronisation, same will be available from the plant.

2.3.6 In-house Laboratory

The Project will be having an In-house Laboratory for quality control as well as for testing and monitoring of quality of the intake water, treated water and discharge water. In addition to that the stack emissions will be directly being monitored through the Continuous Emission Monitoring System (CEMS) and the emissions will be monitored by the Plant Control Room. The portable instrument for the noise testing will be provided for the plant noise monitoring. All the monitoring, testing and analysis will be carried out by trained technicians.

[1]Hazardous or toxic materials/waste shall not be imported as raw material for industry.

Furthermore, the project will engage recognized third party monitoring agency for periodic monitoring of stack emissions, ambient air quality, water quality and noise (plant noise and ambient noise) monitoring and analysis, as per the proposed environmental monitoring programme for operation phase as well as based on the recommendations of the DoE.

2.3.7 Manpower

During the peak construction phase, the project will require about 800 personnel. A site camp will be provided for EPC contractor/ subcontractor personnel. It is reported that majority of unskilled and semi-skilled workforce will be engaged from neighbouring areas and this will reduce the requirement of housing arrangement for these workers.

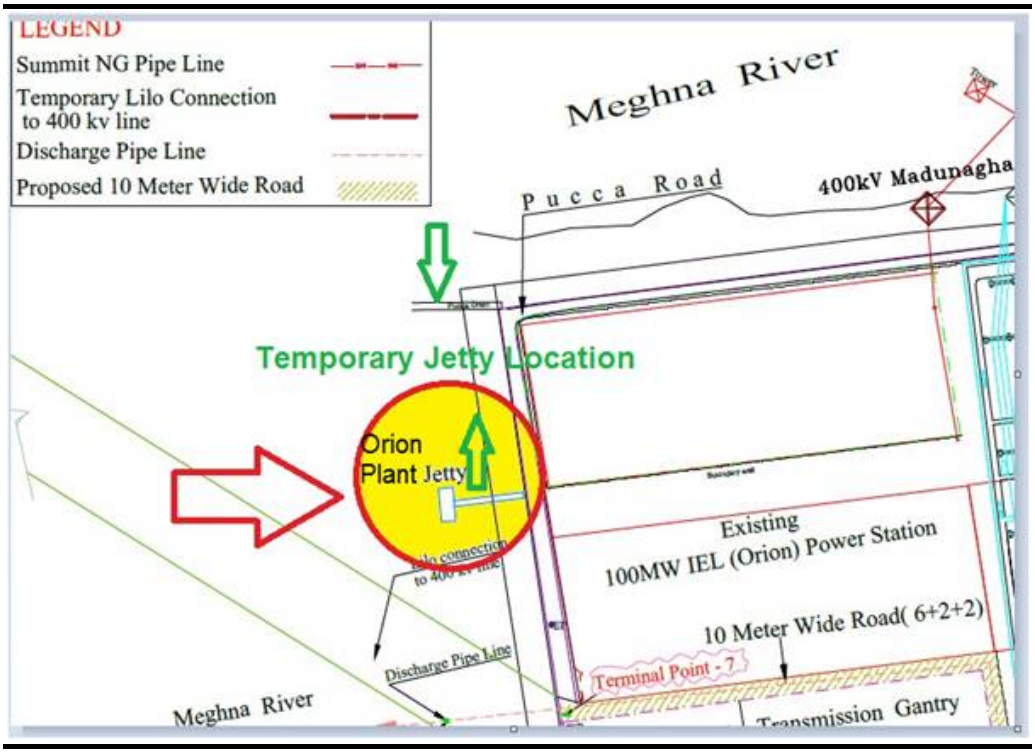
During the operation phase, manpower requirement will be between 60 to 75 personnel. A dormitory will be provided for O&M team within the project site.

2.3.8 Logistics during Construction Phase

Civil construction materials like cement, steel, reinforcement, sand, gravel etc. will be transported to site by using existing access road as well as waterway. Majority of machinery and equipment (heavy lifts) will be transported to site by using waterway. A temporary jetty is planned to be constructed near the outfall location of Summit M-1 project for bulk material handling.

Aggregates, sand and cement etc. will be procured locally. Main steel will be procured from China/India/South Korea or any other country. Secondary steel/reinforcement /fabrication shall be from Bangladesh or from any other country.

Figure 2.10 Map Showing Temporary Jetty Location



Source: SMIIPCL

2.3.9 *Laydown Areas and Staff Camp*

Laydown area during the construction phase as well as construction camp will be located within 500 m from the project site and break-up of area requirement for various purposes are presented below:

Table 2.10 Laydown and Camp Area Requirement

S. No.	Particular	Area (sq. m.)
1	Laydown area, covered stores, contractor's office	25,000
2	Contractor's staff camp	3,000
3	Workers camp	10,000
	Total Area Requirement	**38,000**

Source: SMIIPCL

Tentative laydown areas locations within the Meghnaghat Power Hub are shown in ***Figure 2.11***.

2.4 *PROJECT LIFE CYCLE OVERVIEW ALONG WITH KEY ACTIVITIES AND SCHEDULE*

Life cycle analysis of the project identifies the key issues and concerns that are likely to evolve over the entire lifespan of a project. In the case of the proposed Project, these issues may arise during the site preparation and construction, operation and maintenance, and decommissioning. These issues have been considered in this ESIA study, prior to any irreversible actions being undertaken by the Company, contractors and other project associates.

The following sub-sections identify the key activities to be completed and facilities to be constructed and operated over the lifetime of this Project.

2.4.1 Construction Activity

Site Preparation

The land adjacent to existing dual fuel fired CCPP of SMPCL owned by BPDB within the Meghnaghat Power Hub would be utilized to locate the proposed Power Plant. For developing suitable construction facilities, it would be necessary to develop some of the enabling facilities viz. boundary wall, some of the in-plant roads, identifying space for construction offices of the sub-contractors of vendors, temporary fire-fighting system, construction water and construction power facility etc. prior to taking up any construction work. This preparatory work would be followed by site-levelling and grading, construction of in-plant road network for ease of movement of plant and equipment and developing temporary drainage facility and ensuring other facilities viz. construction gate, watch tower, greenery, identifying area for labour camp etc.

Construction Equipment

The Contractors would bring their own construction equipment. To facilitate site work, the EPC contractor would also procure a few useful construction equipment, viz. crawler mounted heavy-duty crane, tractor-trailer, road roller, some transport equipment etc.

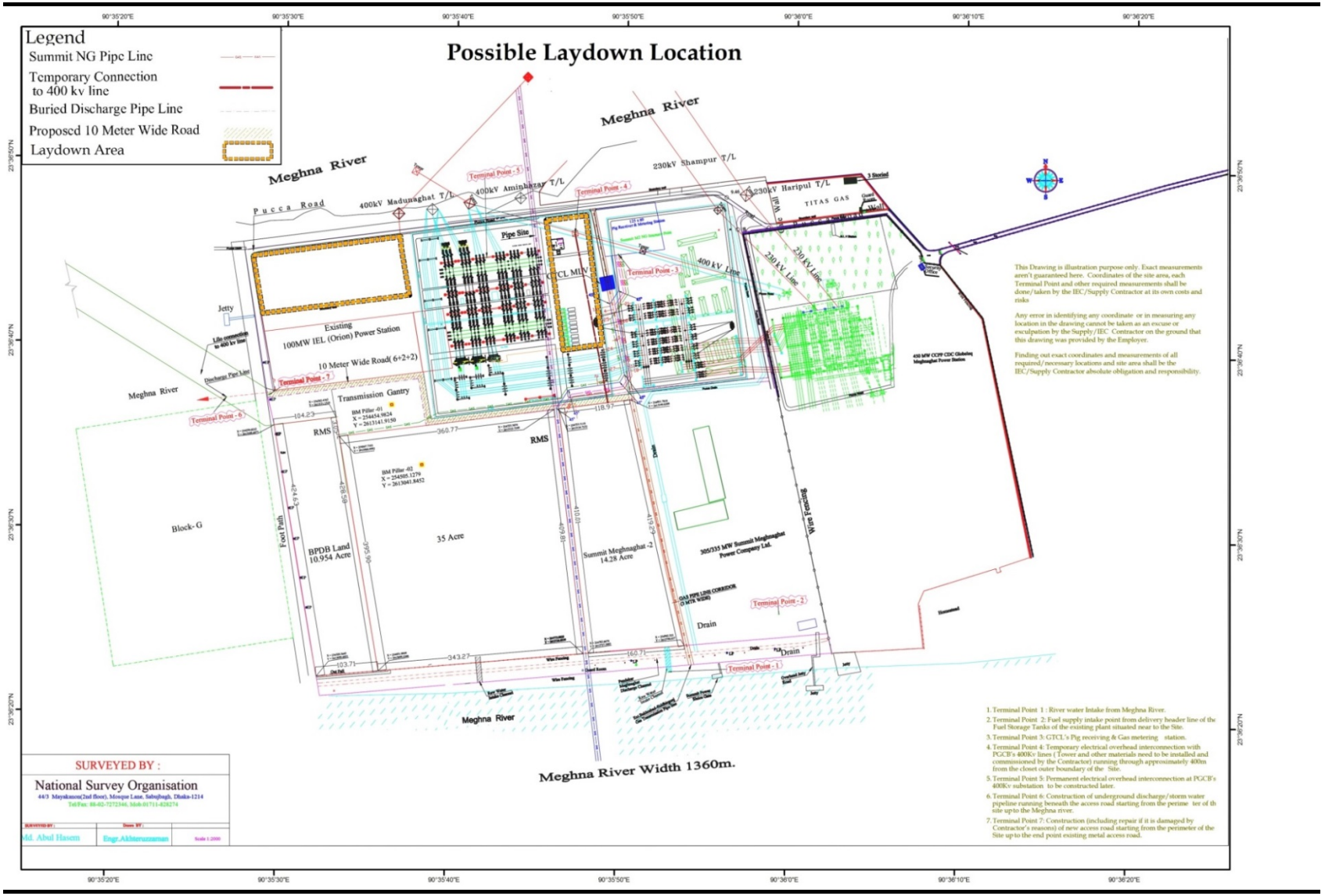
Construction Materials

All the mechanical, electrical, civil and I&C construction materials along with consumables will be procured by the contractors of individual package. Cement and reinforcement materials will be sourced from Dhaka, sand and gravels will be sourced from Sylhet and sand is available nearby.

Manpower

Being a power project with adequate industrial activity in and around the area, skilled/unskilled worker would have to come from nearby districts/towns.

Figure 2.11 Map showing Areas Available for Laydown and Camps within Meghnaghat Power Hub



2.4.2 *Operation and Maintenance*

SMIIPCL will recruit the required personnel to operate and maintain the power station. Beside the operators will be trained by the OEM specialists at their shops and at site to develop requisite expertise for operation of the GE GT in line with OEM recommendation. The O&M staff would be in place during commissioning stage so that they will be associated with the OEM team during pre-commissioning stage of the unit.

The operation and maintenance of the station would be the overall responsibility of the Plant O&M Manager, who would be assisted by a team of experienced executives and operators in the respective field.

Since the infrastructure for maintenance of the specialized plant and machinery may not be readily available near the site, adequate maintenance facilities for day-to-day and minor plant maintenance including a well-equipped workshop and trained technicians would be developed for the project. Major maintenance and annual overhaul will be contracted out to manufacturers or reputed agencies. Odd jobs like, plant cleaning, road and drainage maintenance, plant security, gardening etc. will be contracted out locally.

2.4.3 *Decommissioning*

The design life of the power plant is estimated to be 30 years, which is almost 8 years more than the Power Purchase Agreement term. If the Power Purchase Agreement, Land Lease Agreement, Gas Supply Agreement and the other relevant agreements are not extended or renewed and an alternative economical fuel is available, the power plant may be retrofitted to support alternative power generation. This option would be possible, provided the required retrofits and new emission rates meet the applicable standards and guidelines.

If retrofitting is not feasible and the operational life of the Power Plant expires, the power plant will be decommissioned according to the requirements of the authorities at that time.

2.5 *POLLUTION MONITORING SYSTEM*

Following environmental parameters will be monitored:

- Stack emission
- Ambient air quality
- Discharged water quality
- Workplace and ambient noise level

A Continuous Emission Monitoring System (CEMS) will be installed for round the clock monitoring of SO_2, NOx, PM and CO level from main stack of

HRSG would be carried out. Waste water would be checked for any harmful pollutants before discharging to outfall. Discharge water shall conform to the standards set by the DoE as well as temperature difference criteria of the World Bank/IFC EHS guidelines for Thermal Power Plants.

A well-defined environmental monitoring program would be instituted with trained and qualified staff that would monitor the ambient air as well as stack gas quality to ensure that the quality of effluents is maintained within the permissible levels. The stack of the heat recovery steam generator would be provided with suitable ports to monitor the flue gas quality from the stacks. Suitable analysers will be provided for exhaust gas quality analysis. The quality of the blow down water from the heat recovery steam generator drums and the other water effluents from the plant would be analysed as per environmental monitoring program or as required to ensure that effluents are maintained within the permissible levels.

2.6 SAFETY PROVISIONS

2.6.1 Fire Fighting System

For protection of the plant against fire, all plant will be protected by any one or a combination of the following systems:

- Hydrant system (also includes the required number of hydrant pumps electrical motor driven and diesel engine driven).
- Automatic high velocity and medium velocity sprinkler system.
- Portable and mobile chemical extinguishers.
- Inert gas system
- Fire detection and alarm system
- Fire Tender

Clarified water as supplied to the plant will be used for fire-fighting purposes. Dedicated firewater storage of two hours' fire-fighting requirement, will be maintained in the Clarified Water Reservoir itself for fire-fighting purpose. The system will be designed as per the applicable Codes and Standards of National Fire Prevention Association (NFPA), USA. Regulations of local statutory authority as applicable will also be followed.

2.6.2 Grounding

A grounding system designed for a fault level of 50 kA will be provided and designed in accordance with the applicable standards to meet the requirements of safety and protective relaying. The earthing system will consist of MS rods for buried applications and GI flats for exposed earthing connections.

2.6.3 Lightning Protection

A lightning protection system for the Plant designed to satisfy the requirements of IS/BS-6651-1991 and IEEE 142-1991 standards will be provided in the Plant.

2.6.4 Underground Gas Pipeline Protection

The gas supplier will design, construct, install, commission and test the gas pipeline as per specification spelled in GSA. The separation of this pipeline to the existing gas pipeline of Titas Gas Transmission and Distribution Company Limited (TGTDCL) as well as proposed natural gas pipeline of GTCL will be maintained as per **Gas Safety Rule 1991 and its amendment (2003) of Bangladesh**. It will be gas supplier's property as part of the gas supply network during our plant operation. Cathodic protection will be in place for the buried section of the pipeline and the design will be based on soil resistivity.

2.6.5 Health and Safety

Construction Phase

The Plant will be constructed, installed and commissioned and be operable and maintainable in full compliance with relevant health and safety requirements, all related acts, regulations, codes and statutory requirements of the Laws of Bangladesh.

The Construction Contractor will submit a Health and Safety Plan prior to commencing work on the Site in line with the requirement of Corporate Environmental and Social Management System (ESMS) of Summit Corporation Limited.

The Health and Safety Plan will have method statements, which will include, but not be limited to, working methods, plant utilisation, construction sequence and safety arrangements. The Contractor's key duties will be to:

- develop and implement the Health and Safety Plan, including rules for management of the construction work;
- ensure that Sub-Contractors and workers comply with the health and safety plan;
- monitor the health and safety performance of Sub-Contractors and give directions as appropriate;
- arrange for competent and adequately resourced Sub-Contractors to carry out the work safety where it is subcontracted;
- ensure the co-ordination and co-operation of Sub-Contractors;
- obtain from Sub-Contractors the main findings of their risk assessments, the steps to be taken to control and manage the risks, including method statements for all aspects of the work;

- ensure that Sub-Contractors and workers have information about risks on Site and that there are co-ordinated arrangements for workers to discuss health and safety and offer advice to the Contractor;
- ensure that all workers are properly informed, consulted and trained on health and safety issues;
- ensure that only authorised people are allowed onto the Site; and
- pass information to the Employer for the health and safety file.

EPC contractor of SMIIPCL will comply with requirements of certified systems for quality, environment and occupational health and safety of Summit Group.

Operation Phase

The Company will implement an international standard environment, health and safety (EHS) program in the Plant, which will be in full compliance with relevant health and safety requirements, all related acts, regulations, codes and statutory requirements of the Laws of Bangladesh and of the World Bank. In addition, the Plant aims to be certified to OHSAS and ISO 14001 within 2 years of commercial operation.

An offsite accident and emergency response plan to control and mitigate the effects of any catastrophic incidents in above ground installations (AGI) or underground installation (UGI) or road transportation will also be prepared by the project in consultation with the district administration. The offsite emergencies will also be communicated to the local people.

2.7 PROJECT SCHEDULE

The construction and commissioning schedule of the project from first notice to proceed (FNTP) to commissioning of combined cycle operations is about 30 months. Key milestones of the project schedule are presented below:

Table 2.11 Tentative Project Construction Schedule

S. No.	Activity	Month (from FNTP)
1	Site preparation	0 – 9
2	Gas Turbine building foundation	8 – 11
3	Gas Turbine building	10 – 20
4	GTG foundation	7 – 12
5	GT installation	15 – 20
6	BOP equip for Simple Cycle	7 – 18
7	Simple Cycle Commissioning	16 - 18
8	Steam Turbine building foundation	12 – 15
9	Steam Turbine building	12 – 23
10	STG foundation	10 – 16
11	HRSG foundation	9 – 13
12	HRSG installation	13 – 24
13	BOP for Combined Cycle	13 – 24
14	Combined cycle commissioning	25 - 30

Source: SMIIPCL

2.8 ANALYSIS OF ALTERNATIVES

The Project has considered alternatives in terms of design and technology options. An analysis of these alternatives has been undertaken for the proposed Project including consideration of a no-Project scenario.

2.8.1 No-Project Scenario

The generation and supply of electricity has a significant impact on the national economy of any country. Presently, 68% of the total population has access to electricity and per capita generation is less than 400 kWh, which is significantly lower than other developing countries (Power Division 2015). [1] The total installed capacity of power plants in Bangladesh as of December 2017 is 13,846 MW (derated capacity is 13,147 MW), which includes 660 MW of imported power.[2]

In the public sector a number of the generation units have become very old and have been operating at much reduced capacities. As a result, their reliability and productivity has been poor. For the last few years actual electricity demand in the country has not been met due to a shortage of available generation capacity. In addition, due to a shortage of gas supply, some power plants are unable to reach their full generation capability.

The current supply-demand in Bangladesh also has a knock on effect on all other key sectors including agriculture, industry, commercial and domestic sectors. There is therefore no alternative to adding more power generating units to the existing power system of Bangladesh, to help improve and meet the energy demand for both domestic and industrial requirements.

The 'No Project Scenario' is also likely to have a negative effect on opportunities for employment, both directly from the proposed power project and its dependant sectors such as agriculture, industries and manufacturing that require stable power supply in order to operate and be competitive.

2.8.2 With Project Scenario

Site Location

The proposed site was acquired by BPDB in 1997-98 to develop a power generation complex in order to utilise the natural gas available from the Titas Gas Field. Three power plants with total generation capacity of about 900 MW are operational at the Meghnaghat Power Hub. As per the master plan of the complex, space provision for three more power plants with capacity of about 1,500 MW has been made. Power would be available at 400 kV level and a new substation of 400 kV is planned to be constructed within Power Hub, whereas 400 kV transmission lines are already constructed. The regasified

[1] The neighbouring country India was having per-capita energy consumption in 1075 kWh in the year 2015-16 (www.cea.nic.in).
[2] www.bpdb.gov.bd (website of Bangladesh Power Development Board)

liquid natural gas for the Power Plant will be supplied from proposed gas pipeline of GTCL. Pipeline will be laid for this purpose. Since the site was already identified by the BPDB for power project development and availability of necessary infrastructure at site, no alternative site was considered.

As per the master plan of the power hub, space provision for two more power plants is available. It is also proposed to construct 750 MW CCPP by Reliance Power. BPDB has already allotted 14.28 acres of land to SMIIPCL for construction of 600 MW CCPP. Additionally, about 11 acres of land is available for one more plant, which is not yet allotted to any IPP by the BPDB.

A regasified LNG supply and treatment system to deliver gas will be installed in the vicinity of the plant to meet the required gas quality and pressure specified by the GT manufacturer. It is to be noted that a new gas pipeline for RLNG supply to the Meghnaghat Power Hub is planned to be constructed by GTCL. The new gas transmission pipeline between Kutumbapur in Comilla and Meghnaghat in Narayanganj will provide natural gas to the commissioned and proposed power plants.

PGCB is currently having a 230 kV grid sub-station within the Meghnaghat power hub, which is supporting the existing power plants. In order to cater the need of proposed power plants within the Meghnaghat power hub, PGCB has planned to set up a 400 kV grid sub-station and land for the 400 kV GSS is already earmarked by the BPDB. The 400 kV transmission line (T/L) network (Madunaghat T/L and Aminbazar T/L) are already completed and currently connected with the 230 kV GSS. Proposed 400kV GSS is close to the project boundary of Summit M-2 and therefore will not require construction of new transmission line; however, it will require around 300-400 m power evacuation line for connecting to the 400 kV GSS.

Technical

- Adequate area available for 600 MW dual fuel fired power plant and associated utilities;
- Access to road and nearby water transportation networks;
- Available water supply source for process including cooling water;
- Existing power evacuation infrastructure;
- Proximity to LNG supply pipeline proposed by GTCL.

Geological

- Geologically stable, low earthquake risks; and
- Developed land with elevation above the highest flood level;
- Away from coast line;

Social and Environmental

- No major sensitive environmental receptors (such as communities, hospitals, schools, etc.) in close proximity;
- No physical cultural resources on site and in close proximity (~500 m);
- No resettlement requirements.

Alternative Cooling Options

Two options available for cooling are once through cooling system and induced draft cooling tower. Construction of a cooling tower will have cost implications, but it will reduce the water requirement for the Project as well as limit the quantity of warm water discharge from the project. Once through cooling system will require about 40,000 m^3/hr of cooling water, whereas induced draft cooling system will require only about 800 m^3/hr for cooling tower make-up, which is only 2% of the once through cooling water demand.

Adverse environmental and social impacts of cooling tower with respect to once through cooling system are limited and therefore, induced draft cooling tower has been considered in the Project design. This will also help in reducing the raw water requirement of the plant significantly.

Alternative Fuel Options

As mentioned earlier, the supply of RLNG through proposed national gas grid pipeline of Gas Transmission Company Limited (GTCL) – a company of Petrobangla. The proposed new gas transmission pipeline will provide natural gas to the commissioned and proposed power plants, which include Summit M1 project, which is currently running by HSD due to gas supply constraint. As per the media reports, the project was scheduled to start from July 2017 and expected to complete by June 2020.

Summit M2 project has been conceptualised as dual fuel and alternate fuel for the project is HSD (with maximum sulphur content of 0.25%), which is cleaner fuel in comparison to HFO (with maximum sulphur content of 3.50%), as per the Bangladesh Petroleum Corporation (BPC) fuel specifications.

2.8.3 Conclusion

The 'No Project Scenario' is likely to have a negative effect on opportunities for employment, both directly from the proposed power project and its dependant sectors such as agriculture, industries and manufacturing that require stable power supply in order to operate effectively and be competitive. This will further affect the proposed industrial development in the Dhaka Region.

The site location is well suited for setting up of power plant with availability of adequate availability of land, water, access to road, and waterways, fuel source/supply arrangement. Associated facilities, such as, water intake and

abstraction mechanism, pump house location, construction laydown and camp areas have also been selected based on the basis of alternative analysis and selection of best suited option.

The project design has considered embedded pollution control systems, which include NOx control, stack height for dispersion of pollutants, use of cleaner primary fuel (natural gas), use of Meghna River water for the Project as opposed to ground water, induced draft cooling tower for reducing water requirement and no direct discharge of cooling water into Meghna River.

Best suited technological options have been considered by SMIIPCL and the dual fuel system has been selected to provide more reliability of power generation.

To conclude, many of the alternatives as site location, gross capacity, fuel options were not directly under purview of SMIIPCL as the proposed project will be implemented through an IPP model. Within the available alternatives, SMIIPCL has opted for best suited technological option for power generation.

3 ADMINISTRATIVE FRAMEWORK

3.1 INTRODUCTION

This chapter addressed the environmental and social risks of the proposed project and its associated components and protects and helps in conservation of the environment from any adverse impacts as per specified regulations, policy and guidelines of Government of Bangladesh (GoB). Potential Lenders' of the Project also have their own set of requirements - ADB Safeguard Policy Statement, 2009 and the IFC's Performance Standards – to which any project funded by them must operate.

This section focuses on the legal and administrative framework under the purview of which the Project will fall and the scoping study will be governed; they are namely:

- Bangladesh national and local, legal and institutional framework
- ADB Safeguard Policy Statement, 2009
- IFC Performance Standards (2012) and EHS Guidelines

3.2 ENVIRONMENT-RELATED POLICIES IN BANGLADESH

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

3.2.1 National Environmental Policy, 1992

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

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

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

- To phase-in corrective measures in polluting industries;

- To conduct Environmental Impact Assessments ("EIAs") for all new public and private industrial developments;
- To ban, or find environmentally sound alternatives for, the production of goods that cause environmental pollution; and
- To minimize waste and ensure sustainable use of resources by industry.

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

3.2.2 National Environment Management Action Plan, 1995

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

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

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

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

3.2.3 National Conservation Strategy, 1992

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

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

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

3.2.4 *Other Policies relevant to Environment*

Additional Bangladesh policies, their key features and applicability to the subject Project are detailed in ***Table 3.1***.

Table 3.1 Policies relevant to Environment

Policy	Key Features	Applicability
The National Forest Policy, 1994	• Afforestation of 20% land • Bio-diversity of the existing degraded forests • Strengthening of the agricultural sector • Control of Global warming, desertification • Control of trade in wild birds and animals • Prevention of illegal occupation of the forested land, tree felling and hunting of wild animals	Not applicable, as no diversion of forest land is involved in the Project.
National Land Transport Policy, 2004	• All new roads and major improvements will be subjected to an EIA • Funding will be provided for mitigation measures • The Government will publish environmental standards for new roads and new design standards addressing environmental issues	Not applicable as the existing approach road to the Power Hub will be used for the Project and no new approach road construction is necessary.
The National Water Policy, 1999	• Protection, restoration and enhancement of water resources • Protection of water quality, including strengthening regulations concerning agrochemicals and industrial effluent • Sanitation and potable water • Fish and fisheries • Participation of local communities in all water sector development	Applicable for the preservation of water quality in the project area. Applicable, as water for cooling is to be drawn from the Meghna River with discharge of hot water in to the river. The river course will also be used for transport construction material.
National Landuse Policy, 2001	• Deals with several land uses including: agriculture (crop production, fishery and livestock), housing, forestry, industrialization, railways and roads, tea and rubber • Identifies land use constraints in all these sectors	Not applicable, as landuse of the Project site is industrial and owned by BPDB.
Draft Wetland Policy, 1998	• Establishment of principles for the sustainable use of wetland resources • Maintenance of the existing level of biological diversity • Maintenance of the functions and values of	Not directly applicable, however may be applicable once the draft policy is finalised.

Policy	Key Features	Applicability
	wetlands • Promotion and recognition of the value of wetland functions in resource management and economic development	
National Fisheries Policy, 1998	• Preservation, management and exploitation of fisheries resources in inland open water • Fish cultivation and management in inland closed water. • Prawn and fish cultivation in coastal areas • Preservation, management and exploitation of sea fishery resources	Applicable for conservation of fishes in the Meghna River
The Energy Policy, 1996	• Provides for utilization of energy for sustainable economic growth, supply to different zones of the country, development of the indigenous energy source and environmentally sound sustainable energy development programmes • Highlights the importance of EIA's for any new energy development project	Applicable as subject Project is a Power Plant
The Power Policy, 1995	• Is an integral part of the Energy Policy and deals with policy statement on demand forecast, long term planning and project implementation, investment terms, fuels and technologies, load management, institutional issues, private sector participation, technology transfer and research programme, environmental policy and legal issues	Applicable as subject Project is a Power Plant
Industrial Policy, 1999	• Deals with industrial development, direct foreign investments, investment by public and private sector, introduction of new appropriate technology, women's participation, infrastructure development and environmentally sound industrial development	Applicable as the Project is industrial development and likely to attract investment from lenders.

3.3 *ENVIRONMENT AND SOCIAL RELATED LEGISLATIONS IN BANGLADESH*

The main Acts and Regulations guiding environmental protection and conservation in Bangladesh are outlined in the following subsections and ***Table 3.2***.

3.3.1 *The Environment Conservation Act, 1995 (subsequent amendments in 2000 and 2002)*

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

- Declaration of Ecologically Critical Areas;
- Obtaining Environmental Clearance Certificate;

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

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

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

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

Depending upon the location, size and severity of pollution loads, projects/activities have been classified in ECR, 1997 into four categories: *Green*, *Orange A*, *Orange B* and *Red* respectively as nil, minor, medium and severe impacts on important environmental components ("IECs").

3.3.3 Acquisition and Requisition of Immovable Property Ordinance, 1982

The basic principles behind compensation of property in Bangladesh are founded in Articles 42 and 47 of the Constitution (1972). The current legislation for governing land acquisition in Bangladesh is the "Acquisition and Requisition of Immovable Property Ordinance (ARIPO), 1982 and amended in 1983, 1993 and 1994. Key features of the ordinance are as follows:

- This Ordinance provides the Deputy Commissioner (DC) with the power to initiate the acquisition or requisition of any property in any locality within his district that is likely to be needed for a public purpose or in the public interest.
- It describes the entire procedure of notice and intimations prior to acquisition of any property and process and timeframes for raising objections.
- Section 8 deals with matters to be considered in determining compensation which is based on the market value of the property at the date of publication of the notice under section-3.
- It defines the role and authority of Divisional Commissioner in decision making, compensation issues and in case of dispute. Among the matters to be considered in determining compensation are the following:

- The damage that may be sustained by the person interested, by reason of the taking of standing crops or trees which may be on the property at the time of taking possession thereof by the Deputy Commissioner,
- The damage that may be sustained by reason of the acquisition injuriously affecting his other properties, movable or immovable, in any other matter, or his earnings; and
- If in consequence of the acquisition of the property, the person interested is likely to be compelled to change his residence or place of business, the reasonable expenses, if any, incidental to such change; In terms of compensation, the Ordinance explicitly states that the DC, when determining compensation, shall neither consider any disinclination of the person to part with the property, nor any increase in the value of the property to be acquired likely to accrue from the use of it after it has been acquired.

- The Ordinance also covers the case of temporary acquisition of property for a public purpose or in the public interest.

The 7(1)(b) makes provision for apportionment of the compensation among all the persons interested in the property. Further, Section 10A makes specific provision for payment of compensation to bargadar (share cultivators).

Section-18 deals with requisition of property which is required for temporarily for a public purpose. Section 20 deals with the award of the compensation for requisition of the property under section 18. The amount of compensation payable for the requisition of any property consist of a recurring payment in respect of the period of requisition (equal to rent of lease that would be revised in every two years) and other associated damages such as expenses on account of vacating, expenses on account of re-occupying the property, and damages other than wear and tear, caused to the property during the period of requisition. Section 23 makes provision for protection of the property to prevent deterioration and to ensure proper maintenance of the requisitioned property.

Note: *It is understood that land available for setting up the plant is currently owned by the BPDB and will be leased to SMIIPCL after execution of land lease agreement (LLA). So land is not likely to be acquired under the above regulation for the present project.*

3.3.4 Administrative and Regulatory Guidelines and Instructions

In addition to the provisions in the law, the land acquisition process is regulated by certain administrative instructions and procedural requirements. The most important of these are summarised here.

- In 1976, the Government constituted a Land Allocation Committees (DLACs) at the district, divisional and central levels to control what was regarded as too lavish taking of land for public purposes. The committees were charged with ensuring 'the most rigid measures of economy in the use of land for purposes other than agriculture."

- The DLACs are chaired by the District Commissioner and have seven other members. These members include Executive Engineers of the Roads and Highways (R&H) Department, the Public Works Department, and the Civil Surgeon. They are entrusted with land allocation within the district not exceeding two acres.
- The Divisional LACs are chaired by the Divisional Commissioner and have technical representation at the Superintending Engineer and Deputy Director level. These committees consider land acquisition cases involving between two and five acres of land. All cases of more than five acres go to the Central Land Allocation Committee (CLAC). This committee is chaired by the Minister of Land Administration and has technical representation at the Secretary level. In 1989, the Government ordered that in all cases involving the acquisition of land exceeding 10 *bighas*, the President would have to give consent.

3.3.5 Other Relevant National Legal Instruments for the Project

Table 3.2 presents an outline of other National legal instruments that will have relevance to the proposed Project with respect to the social and environmental considerations.

Table 3.2 National Legal Instruments relevant to the Project

Act/ Rule/ Law/ Ordinance	Enforcement Agency – Ministry/ Authority	Key Features	Applicability to Proposed Project
The Environment Conservation Act, 1995 and subsequent amendments in 2000 and 2002	Department of Environment Ministry of Environment and Forests,	• Define Applicability of environmental clearance • Regulation of development activities from environmental perspective • Framing applicable limits for emissions and effluents • Framing of standards for air, water and noise quality • Formulation of guidelines relating to control and mitigation of environmental pollution, conservation and improvement of environment • Declaration of Ecologically critical areas	Applicable
Environmental Conservation Rules, 1997 and subsequent amendments in 2002 and 2003	Department of Environment Ministry of Environment and Forests	• Declaration of Ecologically critical areas • Requirement of environmental clearance certificate for various categories of projects • Requirement of IEE/EIA as per category • Renewal of the environmental clearance certificate within 30 days after the expiry • Provides standards for quality of air, water and sound and acceptable limits for emissions/discharges from vehicles and other sources	Applicable Projects falls under Red Category and require environmental clearance
Environment Court Act, 2000 and subsequent amendments in 2002	Ministry of Environment and Forests and Judiciary	• GOB has given highest priority to environment pollution • Passed 'Environment Court Act, 2000 for completing environment related legal proceedings effectively	Applicable for completing environmental legal requirements effectively
The Vehicle Act, 1927; The Motor Vehicles Ordinance, 1983; and The Bengal Motor Vehicle Rules, 1940	Bangladesh Road Transport Authority	• Exhaust emissions • Vehicular air and noise pollution • Road/traffic safety • Vehicle Licensing and Registration • Fitness of Motor Vehicles • Parking by-laws.	Applicable for proposed Project in relation to road transport
The Removal of Wrecks and Obstructions in inland Navigable Water Ways Rules 1973	Bangladesh Water Transport Authority	• Removal of wrecks and obstructions in inland navigable waterways	Applicable as Meghna River-inland navigable waterway will be used for transport of equipment for the Project
Water Supply and Sanitation Act, 1996	Ministry of Local Government, Rural Development and	• Management and Control of water supply and sanitation in urban areas.	Not directly applicable, however, indirectly applicable when considering water usage

Act/ Rule/ Law/ Ordinance	Enforcement Agency – Ministry/ Authority	Key Features	Applicability to Proposed Project
	Cooperatives		management and sanitation facilities for the project
The Ground Water Management Ordinance, 1985	Upazila Parishad	• Management of ground water resources • Installation of tube-wells at any place after license from Upazila Parishad only	Proposed Project will use surface water source however, should groundwater also be required then licenses will need to be obtained prior to installation of any tube-wells.
The Forest Act, 1927 and subsequent amendments in 1982 and 1989	Ministry of Environment and Forests	• Categorization of forests as reserve, protected and village forests • Permission is required for use of forest land for any non-forest purposes	Not applicable as proposed Project is not on forest land
The Private Forests Ordinance Act, 1959	Regional Forest Officer, Forest Department	• Conservation of private forests and for the afforestation on wastelands	Not applicable
Bangladesh Wild Life (Preservation) Act, 1974	Ministry of Environment and Forest; Bangladesh Wild Life Advisory Board	• Preservation of Wildlife Sanctuaries, Parks, and Reserves	Not applicable as the Project study area does not have any wildlife areas
National Biodiversity Strategy and Action Plan (2004)	Ministry of Environment and Forest Bangladesh Wild Life Advisory Board	• Conserve, and restore the biodiversity of the country for well-being of the present and future generations • Maintain and improve environmental stability for ecosystems • Ensure preservation of the unique biological heritage of the nation for the benefit of the present and future generations • Guarantee the safe passage and conservation of globally endangered migratory species, especially birds and mammals in the country • Stop introduction of invasive alien species, genetically modified organisms and living modified organisms	Applicable for conservation of bio-diversity in the study area
National Water Bodies Protection Act, 2000	Town development authority/Municipalities	• The characterization of water bodies as rivers, canals, tanks or flood plains identified in the master plans formulated under the laws establishing municipalities in division and district towns shall not be changed without approval of concerned ministry	Applicable due to the proximity to and use of surface water bodies
The Protection and	Ministry of Fisheries and	• Protection and conservation of fish in Government owned	Applicable for the conservation of

Act/ Rule/ Law/ Ordinance	Enforcement Agency – Ministry/ Authority	Key Features	Applicability to Proposed Project
Conservation of Fish Act 1950 and subsequent amendments in 1982	Livestock	water bodies	fish as the intake and outfall point will be the Meghna River
The Embankment and Drainage Act 1952	Ministry of Water Resources	• An Act to consolidate the laws relating to embankment and drainage and to make better provision for the construction, maintenance, management, removal and control of embankments and water courses for the better drainage of lands and for their protection from floods, erosion and other damage by water	Applicable due to the site location
Antiquities Act, 1968	Ministry of Cultural Affairs	• This legislation governs preservation of the national cultural heritage, protects and controls ancient monuments, regulates antiquities as well as the maintenance, conservation and restoration of protected sites and monuments, controls planning, exploration and excavation of archaeological sites	Not applicable as the study area reportedly does not have any likely cultural heritage or ancient monuments of national or international significance. However in case, any such evidence of archaeological findings arise, the Project will need to act in consonance to the Act
The Acquisition and Requisition of Immovable Property Ordinance 1982 and subsequent amendments in 1994, 1995 and 2004	Ministry of Land	• Current GOB Act and Guidelines, relating to acquisition and requisition of land	Not applicable
Administrative and Regulatory Guidelines and Instructions for Land Acquisition	Ministry of Land	• Regulation of land acquisition process by certain administrative instructions and procedural requirements	Not applicable
The Building Construction Act 1952 and subsequent amendments	Ministry of Housing and Public Works	• This act provide for prevention of haphazard construction of building and excavation of tanks which are likely to interfere with the planning of certain areas in Bangladesh	Applicable
The Factories Act, 1965 Bangladesh Labour Law, 2006 and amendment 2013	Ministry of Labour	• This Act pertains to the occupational rights and safety of factory workers and the provision of a comfortable work environment and reasonable working conditions	Applicable
Ozone Depleting Substances (Control) Rules, 2004	Ministry of Environment and Forests	• Ban on the use of Ozone depleting substances • Phasing out of Ozone depleting substances	Applicable
Noise Pollution (Control) Rules 2006	Ministry of Environment and Forests	• Prevention of Noise pollution • Standards for noise levels	Applicable
Bangladesh Standards and	Ministry of Environment	• Analysis of sludge for proper disposal	Applicable

Act/ Rule/ Law/ Ordinance	Enforcement Agency – Ministry/ Authority	Key Features	Applicability to Proposed Project
Guidelines for Sludge Management (February 2015)	and Forests		
Medical Waste Management & Processing Rules, 2008	Ministry of Environment and Forests	• Disposal of medical waste and processing	Applicable

Sources: Websites of DOE, Legislative and Parliamentary Affairs Division: Bangladesh Laws and Bangladesh Board of Investment: Business laws

3.4 ADMINISTRATIVE SETUP RELATED TO ENVIRONMENT IN BANGLADESH

The Ministry of Environment & Forest ("MoEF") is the nodal agency in the administrative structure of the GOB, for overseeing all environmental matters relating to national environmental policy and regulatory issues in the country. The MoEF oversees the activities of the following technical/implementing agencies:

- Department of Environment ("DOE");
- Forest Department ("FD");
- Bangladesh Forest Industries Development Corporation ("BFIDC");
- Bangladesh Forest Research Institute ("BFRI"); and
- Bangladesh National Herbarium ("BNH").

3.4.1 *Other Related Organizations*

There are several other organisations under the administrative framework which would govern social and environmental functions related to the proposed Project, namely:

- Forest Department;
- Ministry of Land: Land reform and land acquisition directorate;
- Ministry of water resources: Bangladesh Water Development Board; and
- Local Government Engineering Department (LGED).

3.4.2 *Department of Environment ("DOE")*

The DOE has been placed under the MoEF as its technical wing and is statutorily responsible for the implementation of the *Environment Conservation Act, 1995.* The Department was created in 1989, to ensure sustainable development and to conserve and manage the environment of Bangladesh. The principal activities of the DOE are:

- Defining EIA procedures and issuing environmental clearance permits - the latter being the legal requirement before the proposed Project can be implemented;
- Providing advice or taking direct action to prevent degradation of the environment;
- Pollution control, including the monitoring of effluent sources and ensuring mitigation of environmental pollution;
- Setting the Quality Standards for environmental parameters;
- Declaring Ecologically Critical Areas ("ECAs"), where the ecosystem has been degraded to a critical state; and
- Review and evaluation of Initial Environmental Examinations ("IEEs") and EIAs prepared for projects in Bangladesh.

Environmental Clearance Process

As mentioned in the *Section 3.3.2*, ECR has classified projects to be assessed by the DOE in four categories based on the severity of impacts on IECs:

- Green: Nil;
- Orange A: minor;

- Orange B: medium; and
- Red: severe.

The applicability of environmental clearance and the process in Bangladesh is described in ***Figure 3.1***. The EIA process consists of three stages, screening, IEE, and detailed EIA:

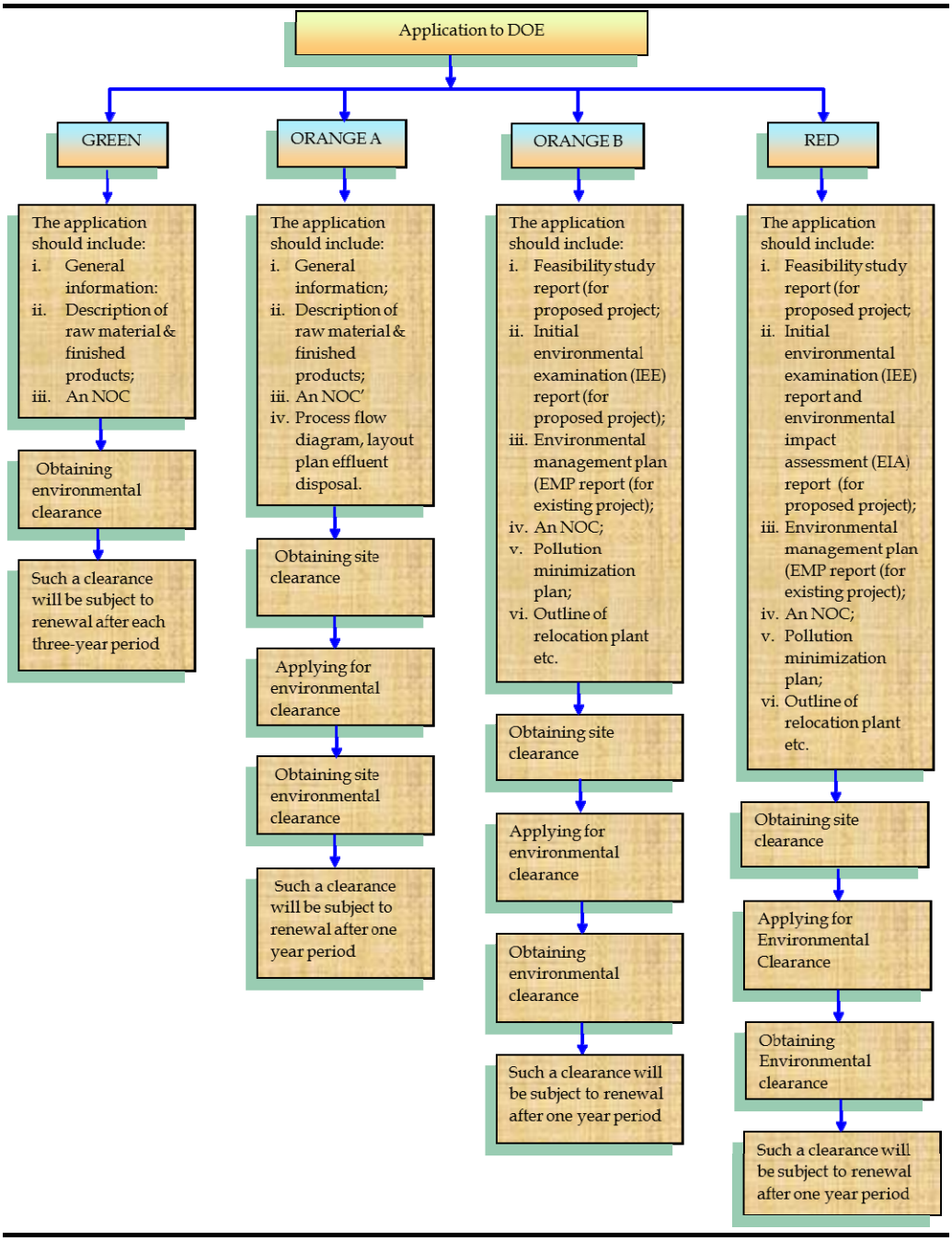
- Projects categorized as *Green* and *Orange-A* requires no IEE or EIA for environmental clearance however, the proponent has to submit an application in a prescribed format along with specified documents;
- Projects categorized as *Orange-B* require an IEE to be submitted to the DOE along with an application in a prescribed format and other specified documents; and
- *Red* category projects require both IEE and EIA. An IEE is required for the location clearance and an EIA is required for the environmental clearance.

As per the *ECR 1997*, power plants and the subject Project fall under the *Red* category as they fall within the following:

- *Item 6:* power plants;

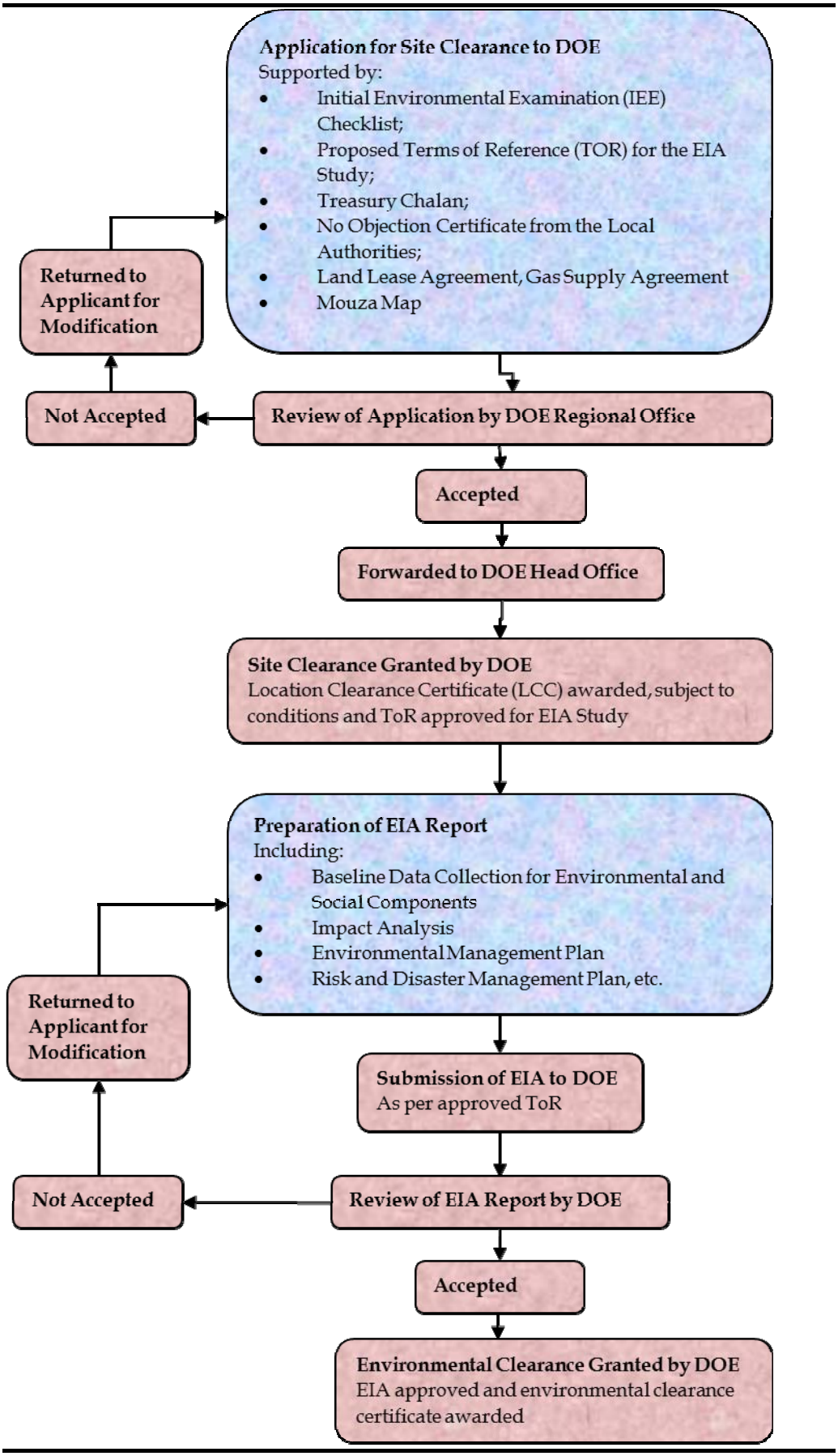
The process for obtaining an Environmental Clearance Certificate (ECC) for the proposed Project is outlined in ***Figure 3.2***

Figure 3.1 *DOE Environmental Clearance Applicability and Procedure*



Source: Adapted from DOE

Figure 3.2 Flow Chart of EIA Process Applicable to the Proposed Project



Source: Adapted from DOE

3.4.3 *Status of Project Approval from DOE*

The Project will apply for the site clearance based on letter of intent (LOI) received from the BPDB and EIA approval after signing of finalized Project agreements (such as LLA, IA, GSA, FSA etc.) with the regulatory authorities.

This ESIA Report is prepared to fulfil the environmental and social safeguard requirements of potential lenders and will be updated as and if necessary in accordance with the terms of reference (TOR) issued to be issued by the DOE and then submitted to the DOE for obtaining EIA approval.

3.5 *PROJECT RELEVANT INTERNATIONAL TREATIES AND CONVENTIONS*

Bangladesh is party to a number (30)[1] of international environmental convention, treaties and agreements. The Project relevant international treaties and conventions relevant to the project signed, ratified and in the process of ratification by Bangladesh are detailed in ***Table 3.3***.

Table 3.3 Project Relevant International Treaties and Conventions

Environment Related International Convention and Treaties	Status
International Plant Protection Convention (Rome, 1951.)	01.09.78 (ratified)
International Convention for the Prevention of Pollution of the Sea by Oil (London, 1954 (as amended on 11 April 1962 and 21 October 1969.)	28.12.81 (entry into force)
Plant Protection Agreement for the South East Asia and Pacific Region (as amended) (Rome, 1956.)	04.12.74 (accessed) (entry into force)
International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (Brussels, 1969.)	04.02.82 (entry into force)
Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar, 1971) ("Ramsar Convention").	20.04.92 (ratified)
Convention Concerning the Protection of the World Cultural and natural Heritage (Paris, 1972.)	03.08.83 (accepted) 03.11.83 (ratified)
Convention on International Trade in Endangered Species of Wild Fauna and flora (Washington, 1973.) ("CITES Convention")	18.02.82 (ratified)
United Nations Convention on the Law of the Sea (Montego Bay, 1982.)	10.12.82 (ratified)
Vienna Convention for the Protection of the Ozone Layer (Vienna, 1985.)	02.08.90 (accessed) 31.10.90 (entry into force)
Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal 1987.)	02.08.90 31.10.90 (accessed) (entry into force)
London Amendment to the Montreal Protocol on substances that Deplete the Ozone Layer (London, 1990)	18.03.94 (accessed) 16.06.94 (entry into force)
Copenhagen Amendment to the Montreal protocol on Substances that Deplete the Ozone Layer, Copenhagen, 1992	27.11.2000 (accepted) 26.2.2001 (entry into force)
Montreal Amendment of the Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal, 1997	27.7.2001 (Accepted) 26.10.2001 (Entry into force)
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (Basel, 1989.)	01.04.93 (accessed)
International Convention on Oil Pollution Preparedness, Response and Cooperation (London, 1990.)	30.01.90 (signed) In the process of ratification

(1) [1] Department of Environment, Bangladesh

Environment Related International Convention and Treaties	Status
United Nations Framework Convention on Climate Change, (New York, 1992.)	09.06.92 (signed) 15.04.94 (ratified)
Convention on Biological Diversity, (Rio De Janeiro, 1992.)	05.06.92 (signed) 03.05.94 (ratified)
International Convention to Combat Desertification, (Paris 1994.)	14.10.94 (signed) 26.01.1996 (ratification) 26.12.1996 (entry into force)
Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques, (Geneva, 1976.)	03.10.79 (accessed) (entry into force)
Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982 (New York, 1994.)	28.07.96 (signed)
Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction (Paris, 1993.)	14.01.93 (signed)
Convention on persistent Organic Pollutants, Stockholm	23.5.2001 (signed) 12.03.2007 (ratified)
Kyoto protocol to the United Nations Framework Convention on Climate Change	21.8.2001 (accessed)

Source: DOE, Bangladesh

3.6 INTERNATIONAL SAFEGUARD REQUIREMENTS

As understood from SMIIPCL, financing sources and financial support for the Project is being explored from the multi-lateral financial, such as the IFC, the ADB, and the EPFIs as well as from the export credit agencies of the countries where major pieces of equipment for the Project will be sourced. This support from the multi-lateral financial institutions/ export credit agencies also linked with the adherence of international best practices and environmental and social safeguard requirements of the lenders. The following subsections outline the key environmental and social requirements of the ADB and the IFC, applicable to the Project.

3.6.1 *ADB's Safeguard Policy Statement, 2009*

In July 2009, ADB's Board of Directors approved the new Safeguard Policy Statement (SPS) governing the environmental and social safeguards of ADB's operations. The SPS builds upon ADB's previous safeguard policies on the Environment, Involuntary Resettlement, and Indigenous Peoples, and brings them into one consolidated policy framework with enhanced consistency and coherence, and more comprehensively addresses environmental and social impacts and risks. The SPS also provides a platform for participation by affected people and other stakeholders in the project design and implementation.

The SPS applies to all ADB-financed and/or ADB-administered projects and their components, regardless of the source of financing, including investment projects funded by a loan; and/or a grant; and/or other means, such as equity and/or guarantees. ADB works with borrowers and clients to put into practice the requirements of SPS.

The SPS supersedes ADB's Involuntary Resettlement Policy (1995), Policy on Indigenous Peoples (1998), and Environment Policy (2002). In accordance with the SPS, these previous policies apply to all projects and tranches of multi-tranche financing facility projects that were reviewed by ADB's management before 20 January 2010.

The objectives of ADB's safeguards are to:

- avoid adverse impacts of projects on the environment and affected people, where possible;
- minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible; and
- assist borrowers and clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

ADB's SPS sets out the policy objectives, scope and triggers, and principles for three key safeguard areas:

- Environmental safeguards;
- Involuntary Resettlement safeguards; and
- Indigenous Peoples safeguards.

To help borrowers and clients and their projects achieve the desired outcomes, ADB adopts a set of specific safeguard requirements that borrowers and clients are required to meet in addressing environmental and social impacts and risks. These safeguard requirements are as follows:

- Safeguard Requirements 1: Environment (Appendix 1 of SPS);
- Safeguard Requirements 2: Involuntary Resettlement (Appendix 2 of SPS);
- Safeguard Requirements 3: Indigenous Peoples (Appendix 3 of SPS); and
- Safeguard Requirements 4: Special Requirements for Different Finance Modalities (Appendix 4 of SPS).

In addition, ADB does not finance activities on the prohibited investment activities list (Appendix 5 of SPS).Furthermore, ADB does not finance projects that do not comply with its safeguard policy statement, nor does it finance projects that do not comply with the host country's social and environmental laws and regulations, including those laws implementing host country obligations under international law.

Consultation and Disclosure requirements of ADB

ADB's *Safeguard Policy and Public Communications Policy (2011)* sets out disclosure requirements for various ADB activities, including safeguard requirement. Safeguard Requirements 2: Involuntary Resettlement (Appendix 2 of SPS); and Safeguard Requirements 3: Indigenous Peoples (Appendix 3 of SPS) sets out the need for meaningful consultation and information disclosure during project preparation and operation to the affected population and other stakeholders. Key requirements include:

- Information Disclosure: The borrower/client will submit the following documents to ADB for disclosure on ADB's website as per the applicability with respect to the Project:

- Draft EIA including draft EMP;
- Final EIA/IEE;
- Updated EIA/IEE and corrective active plan;
- Environmental Monitoring Reports.
- Resettlement Plan ("RP")
- Indigenous Peoples Plan ("IPP")

- Information disclosure to affected people or stakeholders: The borrower/client will provide relevant environmental information in a timely manner, in an accessible place and in a form and language(s) understandable to affected people and other stakeholders. For illiterate people, other suitable communication methods will be used.
- Consultation and Participation: The borrower/client will carry out meaningful consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation.
- Timing and Frequency for consultation and participation: Meaningful consultation begins early in the project preparation stage and is carried out on an on-going basis throughout the project cycle.

3.6.2 ADB Project Categorisation

The SPS, 2009 further outlines a classification system for the categorization of projects. The classification tentatively occurs at the project identification stage, during the initial screening of anticipated impacts. However, classification is an on-going process, and the classification can be changed at any time with the concurrence of the Chief Compliance Officer (CCO), as more detailed information becomes available and a project proceeds.

Environment

A project's environment category is determined by the category of its most environmentally sensitive component, including direct, indirect, induced, and cumulative impacts. Each proposed project is scrutinized as to its type, location, scale, sensitivity and the magnitude of its potential environmental impacts. The level of detail and comprehensiveness of the EIA or IEE are commensurate with the significance of the potential impacts and risks.

A proposed project is assigned to one of the following categories depending on the significance of the potential environmental impacts and risks:

- *Category A:* A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An EIA, including an environmental management plan ("EMP"), is required;
- *Category B:* A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category 'A' projects. An IEE, including an EMP, is required;
- *Category C:* A proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. An EIA or IEE is not required, although environmental implications need to be reviewed; and

- *Category FI:* A proposed project is classified as category FI if it involves the investment of ADB funds to, or through, a financial intermediary (paragraphs 53–58).

Involuntary Resettlement

A project's involuntary resettlement category is determined by the category of its most sensitive component in terms of involuntary resettlement impacts. The involuntary resettlement impacts of an ADB-supported project are considered significant if 200 or more persons will experience major impacts, which are defined as (i) being physically displaced from housing, or (ii) losing 10% or more of their productive assets (income generating). The level of detail and comprehensiveness of the resettlement plan are commensurate with the significance of the potential impacts and risks. A project is assigned to one of the following categories depending on the significance of the probable involuntary resettlement impacts:

- *Category A*: A proposed project is classified as category A if it is likely to have significant involuntary resettlement impacts. A resettlement plan, including assessment of social impacts, is required;
- *Category B*: A proposed project is classified as category B if it includes involuntary resettlement impacts that are not deemed significant. A resettlement plan, including assessment of social impacts, is required;
- *Category C*: A proposed project is classified as category C if it has no involuntary resettlement impacts. No further action is required; and
- *Category FI*: A proposed project is classified as category FI if it involves the investment of ADB funds to, or through, a financial intermediary (*paragraphs 53–58).*

Indigenous Peoples

ADB also screen all projects to determine whether or not they have potential impacts on Indigenous Peoples[1]. For projects with impacts on Indigenous Peoples, an Indigenous Peoples Plan needs to be prepared. The degree of impacts is determined by evaluating (i) the magnitude of the impact on Indigenous Peoples' customary rights of use and access to land and natural resources; socio-economic status; cultural and communal integrity; health,

[1] As per the working definition of indigenous peoples by ADB, two significant characteristics of indigenous peoples would be:

- descent from population groups present in a given area, most often before modern states or territories were created and before modern borders were defined; and
- maintenance of cultural and social identities; and social, economic, cultural, and political institutions separate from mainstream or dominant societies and cultures. In some cases, over recent centuries, tribal groups or cultural minorities have migrated into areas to which they are not indigenous, but have established a presence and continue to maintain a definite and separate social and cultural identity and related social institutions. In such cases, the second identifying characteristic would carry greater weight.

Additional characteristics often ascribed to indigenous peoples include

- self-identification and identification by others as being part of a distinct indigenous cultural group, and the display of a desire to preserve that cultural identity;
- a linguistic identity different from that of the dominant society;
- social, cultural, economic, and political traditions and institutions distinct from the dominant culture;
- economic systems oriented more toward traditional systems of production than mainstream systems; and
- unique ties and attachments to traditional habitats and ancestral territories and natural resources in these habitats and territories.

(Source: Policy on Indigenous Peoples, ADB)

education, livelihood systems, and social security status; or indigenous knowledge; and (ii) the vulnerability of the affected Indigenous Peoples.

Indigenous people's or ethnic minorities' issues are likely to be significant when it is established that groups in the project area have one or more of the following attributes: (i) self-identification or identification by others as a distinct cultural group; (ii) a display of a desire to preserve such cultural identity; (iii) a linguistic identity distinct from that of the dominant society; (iv) distinct social, economic, and political traditions and institutions; (v) an economic system oriented more toward a traditional system of production; and (vi) a unique tie with and attachment to traditional habitat and ancestral territory and its natural resources; such groups are found to exhibit historical, socioeconomic, political, or demographic vulnerability; project intervention will be (positively or negatively) affecting one of these areas: customary rights to (ancestral) land and natural resources; their socioeconomic status; their health, education, livelihood, and social security status; indigenous people's knowledge; the project involves new construction, rehabilitation or expansion of large-scale infrastructure; or such interventions as water supply, sanitation, education, health, nutrition, or social protection target indigenous people; the project is located within or nearby the habitat of indigenous people; and/or project impacts are potentially long term, or irreversible or permanent, affecting a substantial portion of the indigenous community or the community as a whole.

A project is assigned to one of the following categories depending on the significance of the probable impact on the indigenous peoples:

Category	Impact	Actions Required
Category-A	Expected to have significant impact	Both IPP and SIA are required
Category-B	Expected to have limited impact	Both IPP and SIA are Required. A specific action favourable to indigenous peoples/ethnic minority is required and addressed through a specific provision in RRP and in related plans such as a resettlement action plan, a gender action plan, or a general community participatory plan.
Category-C	Not expected to have any impact on ethnic minority	No specific action required.

Annex B, C and ***D*** have screened the Summit M-2 project in accordance to the requirements of the above standards. Based on the information made available, the project is categorised as follows:

- Category A for Environmental Assessment – thus requiring an ESIA and Management Plan;
- Category B for Involuntary Resettlement: The land will be obtained by the Project Proponent through land lease agreement from BPDB. No land acquisition will take place for the proposed project. During scoping visit

no evidence of any form of land related dependence (homestead area or livelihood) was observed at the site location.

- Category C for Indigenous Peoples: The project is not expected to have any impact on designated indigenous peoples.

3.6.3 IFC Performance Standards

The Performance Standards ("PS") (January 2012) established by IFC stipulates that the Project shall meet certain requirements throughout the life cycle of an investment by IFC or other relevant financial institution such as other DFIs (eg DEG, FMO) or commercial banks, which have adopted the *Equator Principles*.

A brief description of the Performance standards is provided in ***Table 3.4.***

Table 3.4 IFC Performance Standards

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

IFC Performance Standards, January 2012

These PS and guidelines provide ways and means to identify impacts and affected stakeholders and lay down processes for management and mitigation of adverse impacts. A brief on the requirements as laid down in the performance standards is described in the following subsections.

Following sub-sections tries to provide the requirements of the specific PS, so as to set up the context for matching the requirements of these PS during the various stages of the life cycle of the Project.

PS 1: Assessment and Management of Environmental and Social Risks and Impacts

The *PS 1* requires Social and Environmental Assessment and Management Systems for managing social and environmental performance throughout the life cycle of this Project and runs through all subsequent PSs. The main elements of *PS 1* include:

- A Social and Environmental Assessment to understand the social and environmental impacts and risks;
- A Management Program for mitigating the impacts and minimizing the risks identified in the assessment;
- Establishing and ensuring organizational capacity and requisite trainings to the staff to implement the Management Programme;

- Identification and engagement with range of stakeholders that may be interested in their actions;
- Development and implementation of Stakeholder Engagement Plan that is scaled to the project risks and impacts and development stage and tailored to the characteristics and interests of the Affected Communities;
- Engagement and consultation with the affected communities, subject to identified risks and adverse impacts from a project;
- Informed Consultation and Participation ("ICP") process for projects with potentially significant adverse impacts on affected communities;
- For projects with adverse impacts to Indigenous Peoples, requirement to engage them in a process of ICP and in certain circumstances requirement to obtain their Free, Prior, and Informed Consent (FPIC);
- Implementation and maintenance of procedure for external communications to receive and register external communications from the public, and their Redressal;
- Adequate monitoring and reporting systems to measure and report the effectiveness of the Management Programs.

The social and environmental performance is a continuous process to be initiated by the management and would involve communication between the organisation, its workers and local communities directly affected by the Project. The PS requires that Project proponent initiate regular assessment of the potential social and environmental risks and impacts and consistently tries to mitigate and manage strategy on an ongoing basis.

PS 2: Labour and Working Conditions

The economic growth through employment creation and income generation is recognised and balanced protecting the basic rights of workers. *PS 2* is guided by the various conventions of International Labour Organization ("ILO") and outlines the minimum requirements of working conditions, protection to the workforce (including issues of child and forced labour) and ensuring occupational health and safety of both its 'employees' as well as 'non employees' working through contractors. The PS requires:

- Establishment of a sound worker-management relationship;
- Encouraging equal opportunity and fair treatment of workers;
- Promoting compliance with national labour and employment laws;
- Management of accommodation services with provision of basic services;
- Promoting healthy and safe working conditions for workers; and
- Analysis of alternatives for retrenchment prior to implementing any collective dismissals.

PS 2 requires project proponents to conduct its activities in a manner consistent with the four core labour standards (child labour, forced labour, non-discrimination, and freedom of association and collective bargaining). In addition, *PS 2* also addresses other areas such as working conditions and terms of employment, retrenchment, and occupational health and safety issues.

Some of these requirements refer to the applicable national law. Whereas national law establishes standards that are less stringent than those in *PS 2*, or are silent, the project proponent is expected to meet the requirements of *PS 2*.

PS 3: Resource Efficiency and Pollution Prevention

PS 3 outline a project level approach to resource efficiency and pollution prevention and control in line with internationally disseminated technologies and practices with objectives to:

- avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from activities;
- promote more sustainable use of resources, including energy and water; and
- reduce project-related greenhouse gas ("GHG") emissions.

Key requirements of *PS3* are to consider ambient conditions and apply technically and financially feasible resource efficiency and pollution prevention principles and techniques that are best suited to avoid or where avoidance is not possible, minimize adverse impacts on human health and the environment during the entire project life-cycle. In addition, a project need to follow good international industry practice ("GIIP"), as reflected in various internationally recognised sources including the World Bank Group Environmental, Health and Safety Guidelines.

PS 4: Community, Health, Safety and Security

PS 4 concentrates on the responsibility that must be undertaken by the client to avoid or minimize the risks and impacts to the community's health, safety and security that may arise from project activities. *PS 4* requires a project to evaluate risks and impacts to the health and safety of the affected community during the Project life cycle and establish measures to avoid minimize and reduce risks and impacts from the Project.

A project needs to evaluate the risks and impacts to the health and safety of the Affected Communities during the project life-cycle and require establishing preventive and controlling measures consistent with good international industry practice ("GIIP"), such as in the World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines) or other internationally recognized sources.

PS 4 recognises that project activities, equipment, and infrastructure often bring benefits to communities including employment, ecosystem services, and opportunities for economic development. However, projects can also increase the potential for community exposure to risks and impacts arising from equipment accidents, structural failures, and releases of hazardous materials.

The performance standard details out project proponents responsibility to avoid or minimise the possible risks and impacts to community health, safety and security that may arise from project activities.

PS 5: Land Acquisition and Involuntary Resettlement

The objectives of this PS are to:

- avoid, and when avoidance is not possible, minimize displacement by exploring alternative project designs;
- avoid forced eviction;
- anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets at replacement cost, and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation and the informed participation of those affected;
- improve, or restore, the livelihoods and standards of living of displaced persons;
- improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites.

PS 5 require a project to consider various processes and systems to avoid /minimise social and economic impacts related to land acquisition and resettlement.

This PS applies to physical or economic displacement resulting from the following types of land transactions:

- Land rights or land use rights acquired through expropriation or other compulsory procedures in accordance with the legal system of the host country;
- Land rights or land use rights acquired through negotiated settlements with property owners or those with legal rights to the land if failure to reach settlement would have resulted in expropriation or other compulsory procedures;
- Project situations where involuntary restrictions on land use and access to natural resources cause a community or groups within a community to lose access to resource usage where they have traditional or recognizable usage rights;
- Certain project situations requiring evictions of people occupying land without formal, traditional, or recognizable usage rights;8 or
- Restriction on access to land or use of other resources including communal property and natural resources such as marine and aquatic resources, timber and non-timber forest products, freshwater, medicinal plants, hunting and gathering grounds and grazing and cropping areas.9.

This PS does not apply to resettlement resulting from voluntary land transactions (i.e., market transactions in which the seller is not obliged to sell and the buyer cannot resort to expropriation or other compulsory procedures sanctioned by the legal system of the host country if negotiations fail). It also does not apply to impacts on livelihoods where the project is not changing the land use of the affected groups or communities.

PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

PS 6 aims at protecting and conserving biodiversity, maintaining ecosystem services, the variety of life in all its forms, including genetic, species and ecosystem diversity and its ability to change and evolve, is fundamental to sustainable development. The objectives of this PS are to:

- protect and conserve biodiversity;

- maintain the benefits from ecosystem services; and
- promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.

The components of biodiversity, as defined in the *Convention on Biological Diversity*, include ecosystems and habitats, species and communities, and genes and genomes, all of which have social, economic, cultural and scientific importance. This PS addresses how clients can avoid or mitigate threats to biodiversity arising from their operations as well as incorporate sustainable management of renewable natural resources[1].

PS 6 recognises that protecting and conserving biodiversity—the variety of life in all its forms, including genetic, species and ecosystem diversity—and its ability to change and evolve, is fundamental to sustainable development. It reflects the objectives of the *Convention on Biological Diversity* to conserve biological diversity and promote use of renewable natural resources in a sustainable manner.

For the purposes of implementation of this PS, habitats are divided into modified, natural and critical. Critical habitats are a subset of modified or natural habitats. For the protection and conservation of biodiversity, the mitigation hierarchy includes biodiversity offsets, which may be considered only after appropriate avoidance, minimization, and restoration measures have been applied. A biodiversity offset should be designed and implemented to achieve measurable conservation outcomes that can reasonably be expected to result in no net loss and preferably a net gain of biodiversity; however, a net gain is required in critical habitats. The design of a biodiversity offset must adhere to the "like-for-like or better" principle and must be carried out in

PS 7: Indigenous Peoples

PS 7 acknowledges the possibility of vulnerability of indigenous people[2] owing to their culture, beliefs, institutions and living standards, and that it may further get compromised by one or other project activity throughout the life cycle of the project. The PS underlines the requirement of avoiding / minimizing adverse impacts on indigenous people in a project area, respecting the local culture and customs, fostering good relationship and ensuring that development benefits are provided to improve their standard of living and livelihoods.

[1] Given the complexity in predicting project impacts on biodiversity and ecosystem services over the long term, the client should adopt a practice of adaptive management in which the implementation of mitigation and management measures are responsive to changing conditions and the results of monitoring throughout the project's lifecycle.

[2] There is no universally accepted definition of "Indigenous Peoples." Indigenous Peoples may be referred to in different countries by such terms as "Indigenous ethnic minorities," "aboriginals," "hill tribes," "minority nationalities," "scheduled tribes," "first nations," or "tribal groups." This Performance Standard applies to communities or groups of Indigenous Peoples who maintain a collective attachment, i.e., whose identity as a group or community is linked, to distinct habitats or ancestral territories and the natural resources therein. It may also apply to communities or groups that have lost collective attachment to distinct habitats or ancestral territories in the project area, occurring within the concerned group members' lifetime, because of forced severance, conflict, government resettlement programs, dispossession of their lands, natural disasters, or incorporation of such territories into an urban area.

PS 7 recognises that Indigenous Peoples, as social groups with identities that are distinct from dominant groups in national societies, are often among the most marginalised and vulnerable segments of the population. The term "indigenous people" is more clearly defined in the IFC Guidance Note for PS 7.

The requirements of PS 7 do not apply to the Summit M-2 project as:

- There are no impacts on lands and natural resources subject to traditional ownership or under customary use;
- The project does not entail any relocation of Indigenous Peoples from lands and natural resources subject to traditional ownership or under customary use;
- The project does not entail any impacts on critical cultural heritage;
- The project does not entail the use of cultural heritage, including knowledge, innovations or practices of Indigenous Peoples for commercial purposes.

PS 8: Cultural Heritage

PS 8 aims to protect the irreplaceable cultural heritage and to guide clients on protecting cultural heritage in the course of their business operations. In addition, the requirements of this PS on a project's use of cultural heritage are based in part on standards set by the *Convention on Biological Diversity*.

PS 8 recognises the importance of cultural heritage with an objective to:

- Protect cultural heritage from the adverse impacts of project activities and support its preservation; and
- Promote the equitable sharing of benefits from the use of cultural heritage in business activities.

The PS requires the project proponent to comply with relevant national law on the protection of cultural heritage, including national law implementing the host country's obligations under the *Convention Concerning the Protection of the World Cultural and Natural Heritage* and other relevant international law.

The requirements of this Performance Standard do not apply to the Summit M-2 project as the land and natural resource footprints do not impact any cultural heritage sites of local, national or international significance and protection.

3.6.4 IFC Project Categorization

As part of its review of a project's expected social and environmental impacts, IFC uses a system of social and environmental categorisation. This categorisation is used to reflect the size of impacts understood as a result of the client's social and environmental assessment and to specify IFC's institutional requirements. Similar to ADB, the IFC categories are:

- *Category A* Projects: Projects with potential significant adverse social or environmental impacts that are diverse, irreversible or unprecedented;
- *Category B* Projects: Projects with potential limited adverse social or environmental impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures;
- *Category C* Projects: Projects with minimal or no adverse social or environmental impacts, including certain financial intermediary (FI) projects with minimal or no adverse risks;
- Category *FI Projects:* All FI projects excluding those that are Category C projects.

IFC therefore categorises project primarily according to the significance and nature of impacts. IFC defines the project's area of influence as the primary project site(s) and related facilities that the client (including its contractors) develops or controls; associated facilities that are not funded as part of the project (funding may be provided separately by a client or a third party including the government), and whose viability and existence depend exclusively on the project and whose goods or services are essential for the successful operation of a project; areas potentially impacted by cumulative impacts from further planned development of a project; and areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location. The area of influence does not include potential impacts that would occur without a project or independently of a project.

3.6.5 IFC EHS Guidelines

The *Environmental, Health, and Safety (EHS) General Guidelines*[1] *(April 30, 2007*) will be applicable for this Project. In addition to that, IFC's Sector specific *EHS Guidelines for Thermal Power Plants*[2] *(December 19, 2008*) will also apply.

3.6.6 Equator Principles, 2013

The Equator Principles (2013) are a set of ten (10) voluntary standards adopted by financial institutions as a framework for environmental and social risk management for project finance transactions.

The subsequent table summarises the key EP requirements and their applicability for the proposed project:

(1) [1] http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_GeneralEHS/$FILE/Final+-+General+EHS+Guidelines.pdf

(2) [2] http://www1.ifc.org/wps/wcm/connect/dfb6a60048855a21852cd76a6515bb18/FINAL_Thermal%2BPower.pdf?MOD=AJPERES&id=1323162579734

Table 3.5 Equator Principles and their Applicability for the Project

Principles	Outline	Details
Principle 1: Review and Categorization of the Project	Equator Principles Financial Institutions (EFPIs) are required to categorize projects based on the magnitude of its potential environmental and social risks based on the environmental and social screening criteria of IFC.	Projects are designated as Category A, B or C when it represents, respectively, a high, medium or low level of risk as per the following understanding: *Category A* – Projects with potential significant adverse environmental and social risks and/or impacts that are diverse, irreversible or unprecedented; *Category B* – Projects with potential limited adverse environmental and social risks and/or impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures; and *Category C* – Projects with minimal or no adverse environmental and social risks and/or impacts.
Principle 2: Environmental and Social Assessment	For projects categorized as A or B, the borrower has to conduct an ESA to appropriately address all social and environmental impacts and risks.	The assessment should also propose mitigation and management measures. The principle requires ESIA study to assess social and environmental impacts and risks due to the Category A project.
Principle 3: Applicable Environmental and Social Standards	For projects located in non-OECD countries, the assessment will refer to the applicable IFC Performance Standards and applicable industry specific EHS guidelines.	The assessment process should address compliance with the relevant host country laws, regulations, permits that pertain to social and environmental issues.
Principle 4: Environmental and Social Management System and Equator Principles Action Plan	For all Category A and Category B Projects, the borrower has to develop or maintain an Environmental and Social Management System (ESMS).	Further, an Environmental and Social Management Plan (ESMP) will be prepared by the borrower to address issues raised in the Assessment process and incorporate actions required to comply with the applicable standards. Where the applicable standards are not met to the EPFI's satisfaction, the borrower and the EPFI will agree an Equator Principles Action Plan (AP). The Equator Principles AP is intended to outline gaps and commitments to meet EPFI requirements in line with the applicable standards.
Principle 5: Stakeholder Engagement	For all Category A and Category B Projects, the EPFI will require the borrower to demonstrate effective Stakeholder Engagement as an ongoing process in a structured and culturally appropriate manner with Affected Communities and, where relevant, other stakeholders	For Projects with potentially significant adverse impacts on Affected Communities, the borrower will conduct an informed consultation and participation process. The borrower will tailor its consultation process to the risks and impacts of the Project; the Project's phase of development; the language preferences of the Affected Communities; their decision-making processes; and the needs of disadvantaged and vulnerable groups. This process should be free from external manipulation, interference, coercion and intimidation.
Principle 6: Grievance	For all Category A and where	The grievance mechanism is required to be scaled to the risks and impacts of the Project

Principles	Outline	Details
Mechanism	appropriate Category B Projects, the borrower will be required as part of the ESMS, to establish a grievance mechanism designed to receive and facilitate resolution of concerns and grievances about the Project's environmental and social performance.	and have Affected Communities as its primary user. It will seek to resolve concerns promptly, using an understandable and transparent consultative process that is culturally appropriate, readily accessible, at no cost, and without retribution to the party that originated the issue or concern. The mechanism should not impede access to judicial or administrative remedies. The mechanism will have to be informed to the affected Communities in the course of the Stakeholder Engagement process.
Principle 7: Independent Review	For all Category A and, as appropriate, Category B Projects, an Independent Environmental and Social Consultant, not directly associated with the client, will carry out an Independent Review of the Assessment Documentation including the ESMPs, the ESMS, and the Stakeholder Engagement process documentation in order to assist the EPFI's due diligence, and assess Equator Principles compliance.	The Independent Environmental and Social Consultant will also propose or opine on a suitable Equator Principles AP capable of bringing the Project into compliance with the Equator Principles, or indicate when compliance is not possible.
Principle 8: Covenants	It is important to incorporate covenants linked to compliance.	For all category A and B projects, the borrower will covenant in financing documentation a) to comply with all host country laws; b) to comply with Equator Principles; c) to provide periodic reports to the EPFIs and d) to de-commission the facilities in accordance with a decommissioning plan.
Principle 9: Independent Monitoring and Reporting	To ensure ongoing monitoring and reporting over the life of the loan.	The EPFI will, for all category A projects, and as appropriate category B projects, require an independent environmental and /or social expert, or require that the borrower retain qualified and experienced external experts to verify its monitoring information which would be shared with the EPFIs.
Principle 10: Reporting and Transparency	For all category A and category B projects as appropriate, the borrower will commit that at a minimum, a summary of the ESIA is accessible and available online.	The borrower will publicly report GHG emission levels during the operational phase for Projects emitting over 100,000 tonnes of CO_2 equivalent annually. The EPFI will report publicly, at least annually, on transactions that have reached Financial Close and on its Equator Principles implementation processes and experience, taking into account appropriate confidentiality considerations.

3.7 APPLICABLE EHS STANDARDS

The Project shall have to comply with Bangladesh environmental, health and safety laws and World Bank Group Guidelines with special attention to comply with the Bangladesh (GOB Environmental Conservation Rule 1997) and World Bank Group requirements regarding air emissions (December 2008).

Therefore, the EHS standards as stipulated in ECR 1997 and amendments thereof as well as in the IFC EHS guidelines (General and Thermal Power Plant specific) for air quality, surface and ground water quality, ambient noise levels, emissions and effluent discharge will be applicable.

The ADB SPS policy Statement 2009 (SPS) also states, "*During the design, construction, and operation of the project the borrower/client will apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines. These standards contain performance levels and measures that are normally acceptable and applicable to projects.*" For this purpose IFC EHS guidelines are recommended.

3.8 APPLICABLE ENVIRONMENTAL STANDARDS

The relevant environmental standards (national as well as international) for thermal power plants as applicable to the proposed Project are presented in the following tables:

Table 3.6 Stack Emission Limits

Parameter	Unit	Bangladesh*	World Bank**
PM_{10}	mg/Nm^3	150	50 (liquid fuel)
		-	N/A (natural gas)
SO_2		-	Use less than 0.5% sulphur fuel (liquid fuel)
		-	N/A (natural gas)
NO_x	mg/Nm^3	-	152 (74 ppm) – liquid fuel
	mg/Nm^3	40 ppm	51 (25 ppm) – natural gas
Dry Gas, Excess O_2 content	%		15 (natural gas)
	%		15 (liquid fuel)

Note:

* Schedule 11 (Standards for Gaseous Emission from Industries or Projects) of the Environmental Conservation Rules, 1997.

** Emission Guidelines for Combustion Turbines, WB/IFC EHS Guidelines for Thermal Power Plants (Source: EU (LCP Directive 2001/80/EC October 23 2001), EU (Liquid Fuel Quality Directive 1999/32/EC, 2005/33/EC), US (NSPS for Stationary Combustion Turbines, Final Rule – July 6, 2006).

Represents the standard values applicable to the Project.

Table 3.7 Ambient Air Quality Standards

Parameter	Bangladesh**	WHO***

	24 hourly (µg/m³)	Annual (µg/m³)	24 hourly (µg/m³)	Annual (µg/m³)
SPM	200	-	-	-
PM_{10}	150	50	50	20
$PM_{2.5}$	65	15	25	10
SO_2	365	80	20	-
NO_x	-	100	-	40
CO*	10,000	-	10,000	-

Note:

* CO standard is 8-hourly only.

** The Bangladesh National Ambient Air Quality Standards have been taken from the Environmental Conservation Rules, 1997 which was amended on 19th July 2005 vide S.R.O. No. 220-Law/2005.

*** WHO Ambient Air Quality Guideline Values (2005 and 2000), which are also being referred in the World Bank and IFC's General EHS Guidelines (2007)

Represents the standard values applicable to the Project.

As per the WB/IFC General EHS guidelines, ambient air quality results need to be compared with the relevant ambient air quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO air quality guidelines or other internationally recognised sources, such as the United States National Ambient Air Quality Standards and the relevant European Council Directives. *Since, Bangladesh has its own national ambient air quality standards, these local standards are considered as the applicable standard for the project.*

Table 3.8 Effluent Standards/ Guidelines

Parameter	Unit	Bangladesh*	WB/IFC**
pH	-	6-9	6-9
Total Suspended Solids (TSS)	mg/l	150	50
Oil and grease	mg/l	10	10
Total residual chlorine	mg/l	-	0.2
Chromium (total)	mg/l	0.5	0.5
Copper	mg/l	0.5	0.5
Iron	mg/l	2.0	1.0
Zinc	mg/l	5.0	1.0
Lead	mg/l	0.1	0.5
Cadmium	mg/l	0.5	0.1
Mercury	mg/l	0.01	0.005
Arsenic	mg/l	0.2	0.5
Temperature increase at the edge of the mixing zone	°C	40 (summer) 45 (winter)	Site specific requirement to be established by the EA. Elevated temperature areas due to discharge of once-through cooling water (e.g., 1 Celsius above, 2 Celsius above, 3 Celsius above ambient water temperature) should be minimized by adjusting intake and outfall design through the project specific EA depending on the sensitive aquatic ecosystems around the discharge point.

Parameter	Unit	Bangladesh*	WB/IFC**

Note:

* Schedule 10 (Standards for Waste from Industrial Units or Projects Waste) of the Environmental Conservation Rules, 1997.

** Effluent Guidelines, WB/IFC EHS Guidelines for Thermal Power Plants.

Represents the standard values applicable to the Project.

Table 3.9 Standards for Sewage Discharge

Parameter	Unit	Standard Limit (Bangladesh)*
BOD	mg/l	40
Nitrate	mg/l	250
Phosphate	mg/l	35
Suspended Solid	mg/l	100
Temperature	°C	30
Coliform	No./100 ml	1000

Notes :

(1) This limit shall be applicable to discharges into surface and inland waters bodies.

(2) Sewage shall be chlorinated before final discharge.

* Schedule 9 (Standards for Sewage Discharge) of the Environmental Conservation Rules, 1997

Table 3.10 Noise Level Standards/ Guidelines

Category of Area/ Receptor	Bangladesh*		WHO***	
	Day (dB(A))	Night (dB(A))	Day (dB(A))	Night (dB(A))
Silent Zone	45	35	55	45
Residential Area	55	45	55	45
Mixed Area	60	50	-	-
Commercial Area	70	60	70	70
Industrial Area	75	70	70	70

Note:

* The Bangladesh National Ambient Noise Standards have been taken from Schedule 4 (Standards for Sound) of the Environmental Conservation Rules, 1997.

** Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999.

*** As per IFC EHS noise level guidelines, Noise impacts should not exceed the levels presented in the above table or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

**** In Bangladesh standard day time is defined from 6.00 to 21.00 hrs and night time is from 21.00 to 6:00 hrs, whereas in WHO guidelines, day time is defined from 7.00 to 22.00 hrs and night time is from 22.00 to 7:00 hrs.

Represents the standard values applicable to the Project.

It is evident from the above tables that except noise level standards, the WB/IFC guidelines are more stringent than the local standards. The Project needs to comply with the Bangladesh environmental, health and safety laws and World Bank Group Guidelines. Hence, it is mandatory for the Project to meet the stringent standards, as per applicability.

4 ENVIRONMENTAL AND SOCIAL BASELINE CONDITIONS

4.1 INTRODUCTION

This section describes the existing environmental and social baseline of the study area which include the proposed Project site and in a 10 km radial area around the proposed project site. This includes relevant components of physical, biological and socio-economic environment.

The purposes of describing the environmental settings of the study area are:

- To understand the project needs and environmental characteristics of the area; and
- To assess the quality of the existing environment, as well as the environmental impacts of the future developments being studied.

The baseline environment and social conditions for the ESIA study was studied through information collected from secondary sources and supplemented with findings from the site reconnaissance study and field studies. In addition to that primary baseline studies were carried out as per the monitoring plan. Since the baseline monitoring and survey work was only completed by end of January 2018, some of the analysis results and reports were not available at the time of this report writing[1]. This report will be further updated based on remaining baseline monitoring data.

4.2 PROJECT INFLUENCE AREA

The Area of Influence (AOI) of the Project comprises of the Project Site and the surrounding area, where influence of the Project activities is anticipated. The areas likely to be affected by the Project and its associated activities may include:

- The project activities and facilities that are directly owned, operated or managed by the project proponent (including by contractors) and that are components of the project, such as the power plant, gas pipeline, water pipelines and transmission line to the power grid sub-station;
- Impacts from unplanned but predictable developments caused by the project that may occur later or at a related location such as increase in traffic on the approach road;
- Impacts on biodiversity or on ecosystem services upon which affected communities' livelihoods are dependent;
- Associated facilities, that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable; and

[1] Remaining primary baseline data include bio-monitoring data and fisheries study.

- Cumulative impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted i.e. existing 337 MW Duel Fuel CCPP of Summit Meghna Power Co. Ltd, , 450 MW Meghna CCPP of Power Tech, Pendekar and 100 MW Engine based Power Plant of Orion Power Meghnaghat Ltd. and proposed 750 MW CCPP of Reliance Bangladesh LNG and Power Limited.

Further to this, the AOI with respect to the environmental and social resources was considered based on the following reach[1] of impacts:

Air Quality

- Gaseous pollutants (e.g. NOx and SO_2) and fine particulate matter (PM_{10} and $PM_{2.5}$)–typically up to 2-2.5 km from operations;[2]
- Cumulative impact of air pollutants emission from existing power plants and proposed power plants at Meghnaghat Power Hub.; and
- Dust fall –typically up to 200 m from construction activities.

Noise

- Noise impact area (defined as the area over which an increase in environmental noise levels due to the project can be detected) –typically 500 m from operations and 100 m from the access roads; and
- Cumulative impact of noise generation from proposed power plant and existing power plants in Meghnaghat Power Hub.

Water

- Surface water body –typically 200 - 500 m upstream and downstream of water intake point and within 500 – 700 m upstream and downstream of discharge point.
- Other Surface water bodies within 2-2.5 km of the project footprint
- Ground water in 1-2 km radius of project footprint.

Flora and Fauna (Terrestrial and Aquatic)

- The direct footprint of the project comprising the project site.
- The areas immediately adjacent to the project footprint within which a zone of ecological disturbance is created through increased dust, human presence and project related activities (e.g., trampling, water intake/outfall, transportation). This kind of disturbance has been estimated to occur within the project footprint and surrounding areas of about 500 m to 1 km from the activity areas.

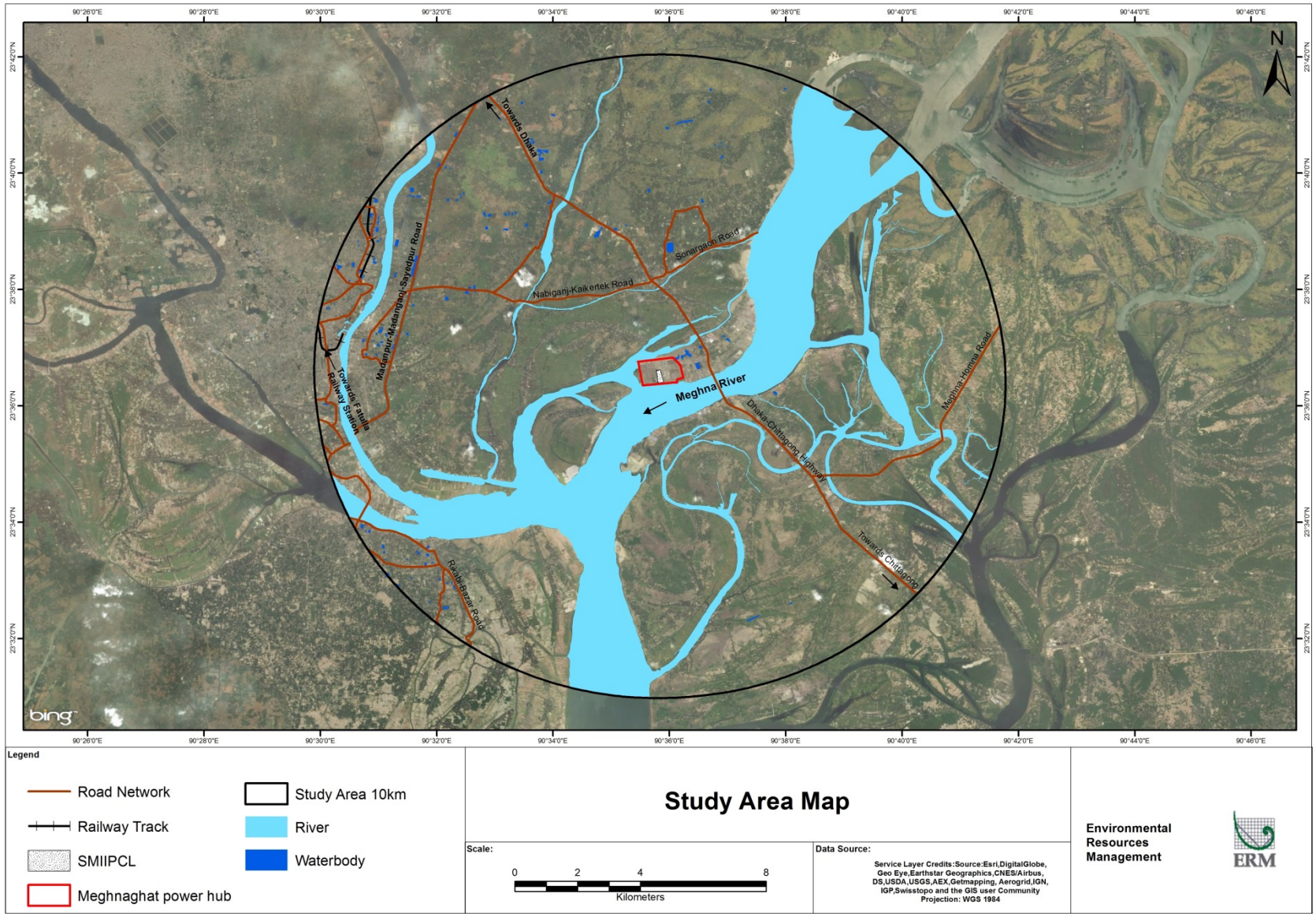
Based on the above the AOI for environmental studies is limited to 5 km from the Project site. However, as per DoE guidelines for the study area of 10 km

[1] Distance based on ERM's experience with similar projects

[2] The air quality dispersion modelling results also indicated that the maximum ground level concentration in all cases will occur between 1.5 to 2.0 km from the project site.

has been considered in this study, with focus on immediate vicinity of the Project site.

Figure 4.1 Study Area Map (10 Km Radius)



4.3 PHYSICAL ENVIRONMENT

4.3.1 Land use

Land use/cover inventories are an essential component in land resource evaluation and environmental studies. High spatial and spectral resolution satellite imageries have been widely accepted for rapid resource assessment and monitoring from the last few decades. These data sources are of immense use for decision makers and policy makers as it enables to carry out detailed forest inventories, monitoring of land use, protected area conservation and vegetation cover at various scales.

The land use study for the Summit M-2 Project and its 10 km buffer was attempted to undertaken with the following objectives:

- To study the land use/cover in the 10 km radius areas of the power plant site and provide inputs for environmental planning of the proposed plant by analysing the existing land use/land cover scenario. For this the 10 km radius was divided into 3 radial zones of 2 km, 5 km and 10 km and detailed breakups of these radial zones were analysed to get a clear understanding of the landuse/cover;
- To establish the existing baseline scenario using a GIS database for incorporation of thematic information on the different physical features including drainage and water bodies, settlements, transport networks etc.
- To identify and map the waterbodies, drainage and the streams in the study area.

Methodology

In the present study for delineation and analysis of land use / land cover, cloud free multi-temporal Satellite Imagery of SENTINAL-2 (DOP: 24-OCT-2016) has been used for Kharif seasons (August to November) of 2016. The details of the scenes, multi-spectral bands, spectral and spatial resolutions and date of pass are given in ***Table 4.1***. The date of over pass is optimum for classifying the Kharif crop / vegetation as it is in the peak of the season. Besides multi-spectral data set, reference sheets provided by the Local Government Engineering Unit, Local GIS Units and field surveys were used for detailed mapping of roads, railway line, etc. The LANDSAT-ETM satellite data (Path/Row: 137/044; DOP: 16-OCT-2017) is used for Geo-referencing of the other reference maps/imageries.

All the data sets were processed using the ARC GIS software (version 10.4.1) and ERDAS IMAGINE 2013. In this GIS environment with minimum errors and high accuracy all vectors are prepared with the following projection parameters:

- Projection Type: Transverse Mercator
- Spheroid Name: WGS 84
- Datum: WGS 84
- Zone: 46N

The satellite data is converted in the standard false colour composite by assigning blue, green and red to green, red and near infra-red band respectively. Image enhancement has been done by the technique called histogram stretching. For better accuracy, land use /cover analysis was carried out using on screen visual interpretation technique in 1: 10,000 scale using hybrid digital classification technique. The area has good coverage of homestead vegetation which shows great mixing in digital classification. Separation of settlements and ponds from the patched of the homestead plantation was difficult. Therefore, the rural settlement and the plantation class are clubbed together and classified as "homestead plantation + settlement" and put in a separate class as "Other class". Still there may be some scope of increase in the area of waterbody class in the landuse classification of that area. Different landuse classes were digitized as vector layer keeping the imagery on the back drop. These landuse vectors were stored separately, corrected topologically and assigned codes for individual landuse class. Area calculation done using the calculate geometry tool.

Table 4.1 Details of Satellite Data used in the Study

Satellite and Sensor	**Orbit/row**	**Date of Pass**	**Spatial Resolution (meters)**	**No. of bands and Band width (Microns)**
Landsat 8(OLI)	LC08_L1TP_137044_20171016_20171024_01_T1	16.10.2017	15	Coastal/Aerosol :0.433 - 0.453 B : 0.450 - 0.515 G: 0.525 - 0.600 R: 0.630 - 0.680 IR: 0.845 - 0.885 SWI : 1.560 - 1.660 SWI: 2.100 - 2.300 PAN: 0.500 - 0.680 Cirrus : 1.360 - 1.390
Sentinel-2	S2A_OPER_MTD_L1C_DS_MTI__20161024T095904_S20161024T043605	24.10.2016	10	(Central Wavelength) Coastal aerosol: 0.44 Blue: 0.490 Green: 0.560 Red: 0.665 Vegetation Red Edge: 0.705 Vegetation Red Edge: 0.740 Vegetation Red Edge: 0.783 NIR: 0.842 Narrow NIR: 0.865 Water vapour: 0.945 Cirrus: 1.375 SWIR: 1.610 SWIR: 2.190

Landuse Interpretation of the Study Area

The evaluation of the existing environmental status of the study area was divided into 3 radial zones of 0-2km, 0-5 km and 0-10 km around the Project site. This revealed that the land use/cover consists mainly of agricultural

land, built-up, water bodies, and homestead plantation including settlement on Level-I classification. A further detailed classification into Level II and Level-III was also carried out and the statistics for all the 3 zones and level classifications are presented in ***Table 4.2***. ***Figure 4.2*** gives the Land use/cover map for the study area.

Brief descriptions of the land uses/covers assessed in the AOI are given below:

Built-up Land[1]

It is defined as an area of human habitation development due to intensive non-agricultural use. They appear in dark bluish green in core built-up area and bluish in the periphery irregular and discontinuous in appearance in satellite imageries. These areas are classified and mapped using satellite data. Due to plenty of homestead plantations, the settlements are not clearly visible in the satellite imageries. The major categories discernible on the satellite data within the study area include several rural residential areas and the urban settlements of Narayanganj, Munchiganj and Sonargaon. Rural settlement patches are scattered. In the island areas settlement patches are visible adjacent to the Riverbed cultivated areas.

Some industrial activities are also seen within the study area mainly in the Narayanganj & Munchiganj area. Along the river of Sitalakhya lots of industrial areas are observed. The proposed project site is also included under this class. Several brick kilns are also seen within the AOI.

The Built up area including the Urban and Industrial area acquired land covers 38.11 sq. Km (11.71%) of the 10 km buffer area around the proposed site.

Agricultural Land

Agricultural landuse by and large is dependent on agro-climatic condition prevalent in the area. Cropped areas appear in bright red in colour with varying shape and size in a contiguous to non-contiguous pattern. Due to the non-availability of the cloud free data, only the Kharif season satellite data is analysed and the single crop (Kharif only) is classified and mapped. The riverbed cultivation areas were found to be confined to the areas around the Meghna river and other natural drains and streams.

Agricultural land is the major land use class in the study area as agriculture is the main source of livelihood in the area. The total agriculture area is 148.94 sq.km (45.77%) comprising of Kharif crop lands, River bed cultivation and fallow lands. Fallow land observed is 65.84 sq. km (20.23%) lying vacant during this cropping season of the total land cover.

[1]Rural settlement areas are very much associated with homestead plantation and village ponds. So, for better accuracy and understanding these 3 landuse classes are clubbed and classified under a new landuse class ""homestead plantation+settlement".

Wasteland

Wasteland is described as 'degraded land' which can be brought under vegetative cover with reasonable effort and which is currently under-utilized for the lack of appropriate water and soil management or on account of natural causes. In the study area existent wasteland classes are those sandy areas of Meghna River as well as the scrub lands near the river sides. The width of the Meghna River is large and therefore sedimentation and siltation occur on the river banks. Those areas covered under sedimentation and river sand are unused landuse of the study area buffer. These areas are barren and with high reflectance and easily marked in the imagery. Area under sand cover is categorised as waste land within the project buffer.

Wasteland category has covered very less area within the study buffer. Total area under wasteland is recorded as 3.87 Sq Km (1.19%) of the total geographical area of the studied 10 km buffer zone.

Water bodies

River/streams, tanks are the important waterbodies seen in the study area. The major river in the study area is Meghna river. The proposed site is located to the north of the embankment along north bank of the river Meghna. Slightly southwest and downstream of the Project Site, the Meghna River converges with the Dhaleswari (Kaliganga) river within the 10 km buffer extent. Sitalakhya River is another important waterbody of the region. All the rivers are used for navigation purpose also. At some places drainages break and develop some waterbodies. As October month imagery is used for the landuse study, the maximum extent of river submergence is captured. In some places dark patches of water like signature were observed but interestingly those places are under cultivation classified as riverbed cultivation. Water bodies cover 83.29 Sq Km (25.59%) of the total geographical area of the 10 km buffer zone. Significantly, various waterbodies are observed all along the routes of the main roads of the region. Lots of very small sized waterbodies are observed within the study area. Waterbodies with considerable size were only counted as otherwise the whole map gives a salt pepper effect.

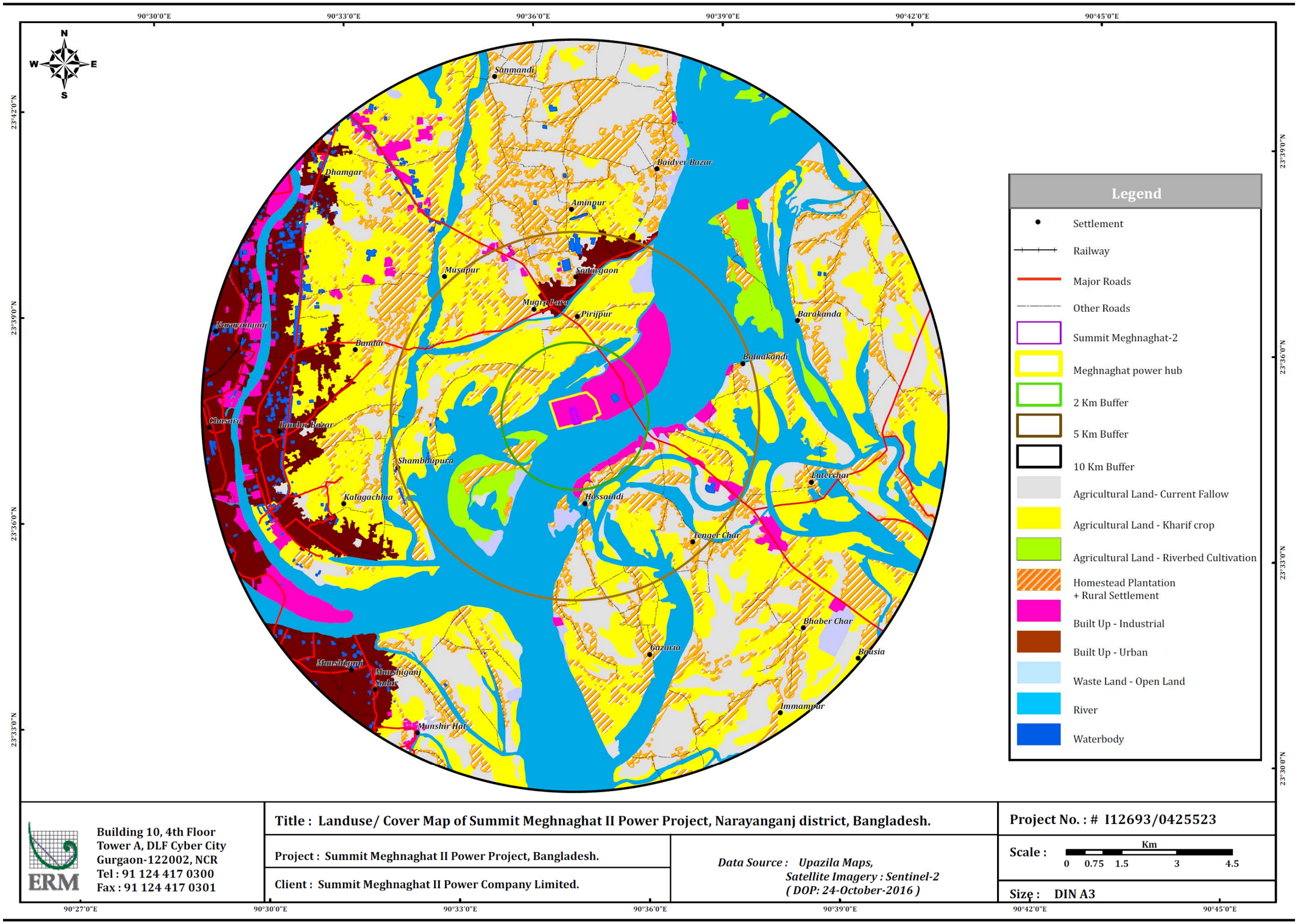
Others

Homestead Plantation + Settlement is an important class observed in the study area. Scattered patches of homestead plantation with different sizes are observed. Due to these homestead plantations, the settlement areas are not visible properly in the satellite imageries. Homestead plantation is also visible in the isolated river bars along with the settlements. Homestead plantation covers 51.24 Sq. Km (15.74 %) of the study area.

Table 4.2 Landuse/Land cover statistics of the Project AOI

Level –I	Level –II	Level –III	2 km Radial Zone		5 km Radial Zone		10 km Radial Zone	
			Area (sq. km)	% of Area	Area (sq. km)	% of Area	Area (sq. km)	% of Area
Built up	Built-up	Industrial	2.90	23.04	5.40	6.88	11.68	3.59
		Urban	0.00	0.00	1.63	2.08	26.43	8.12
		Sub- Total	***2.90***	***23.04***	***7.03***	***8.95***	***38.11***	***11.71***
Agricultural	Cropland	Kharif Crop	1.46	11.65	17.65	22.48	76.80	23.60
		Riverbed Cultivation	0.36	2.88	2.56	3.26	6.30	1.94
	Fallow Land	Current Fallow	0.37	2.98	9.13	11.62	65.84	20.23
		Sub- Total	***2.20***	***17.52***	***29.34***	***37.35***	***148.94***	***45.77***
Wasteland	Wastelands-Scrub land	Open Land	0.01	0.11	1.86	2.37	3.87	1.19
		Sub- Total	***0.01***	***0.11***	***1.86***	***2.37***	***3.87***	***1.19***
Water bodies	Waterbody	Waterbodies-Kharif Extent	0.03	0.26	0.26	0.33	2.01	0.62
		Waterbodies-River/Stream	5.85	46.53	28.96	36.88	81.28	24.98
		Sub- Total	***5.88***	***46.79***	***29.22***	***37.21***	***83.29***	***25.59***
Other	Other	Homestead Plantation + Rural settlement	1.57	12.53	11.09	14.12	51.24	15.74
		Sub- Total	***1.57***	***12.53***	***11.09***	***14.12***	***51.24***	***15.74***
		Total	***12.57***	***100.00***	***78.54***	***100.00***	***325.44***	***100.00***

Figure 4.2 *Land use / Land cover Map of Study Area*



ERM
Building 10, 4th Floor
Tower A, DLF Cyber City
Gurgaon-122002, NCR
Tel : 91 124 417 0300
Fax : 91 124 417 0301

Title : Landuse/ Cover Map of Summit Meghnaghat II Power Project, Narayanganj district, Bangladesh.

Project No. : # I12693/0425523

Project : Summit Meghnaghat II Power Project, Bangladesh.

Client : Summit Meghnaghat II Power Company Limited.

Data Source : Upazila Maps, Satellite Imagery : Sentinel-2 (DOP: 24-October-2016)

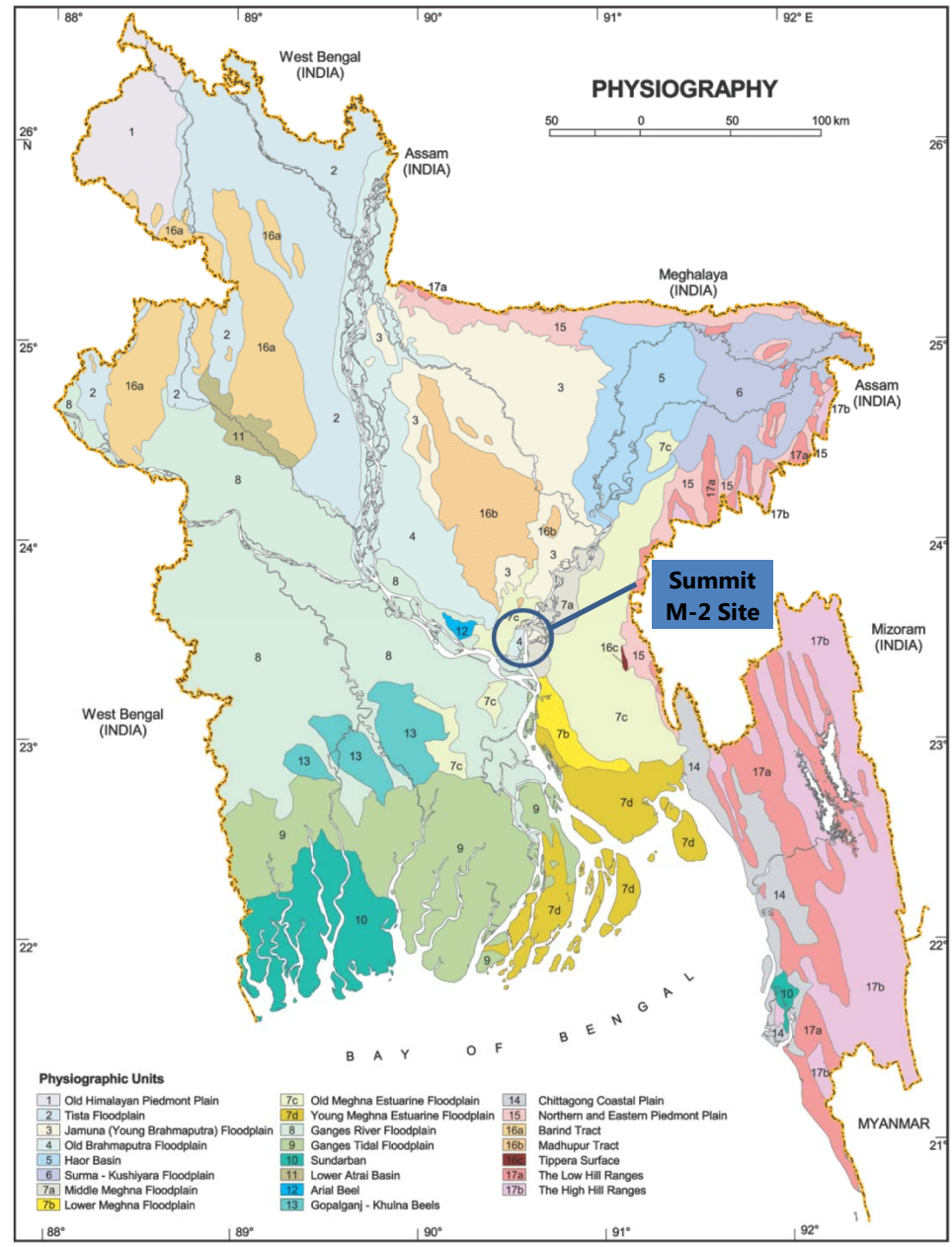
Scale : Km 0 0.75 1.5 3 4.5

Size : DIN A3

4.3.2 *Physiography*

Proposed project site belongs to the Old Brahmaputra Floodplain area of the National Classification. Soils of the area are grey, loamy on the ridges and grey to dark grey clayey in the basins. Grey sands to loamy sands with compact silty topsoil, occupying areas of old Brahmaputra char. Dominant general type is Non calcareous Grey Floodplain soils. The physiographic map of Bangladesh is presented in ***Figure 4.3***.

Figure 4.3 Physiographic Map of Bangladesh



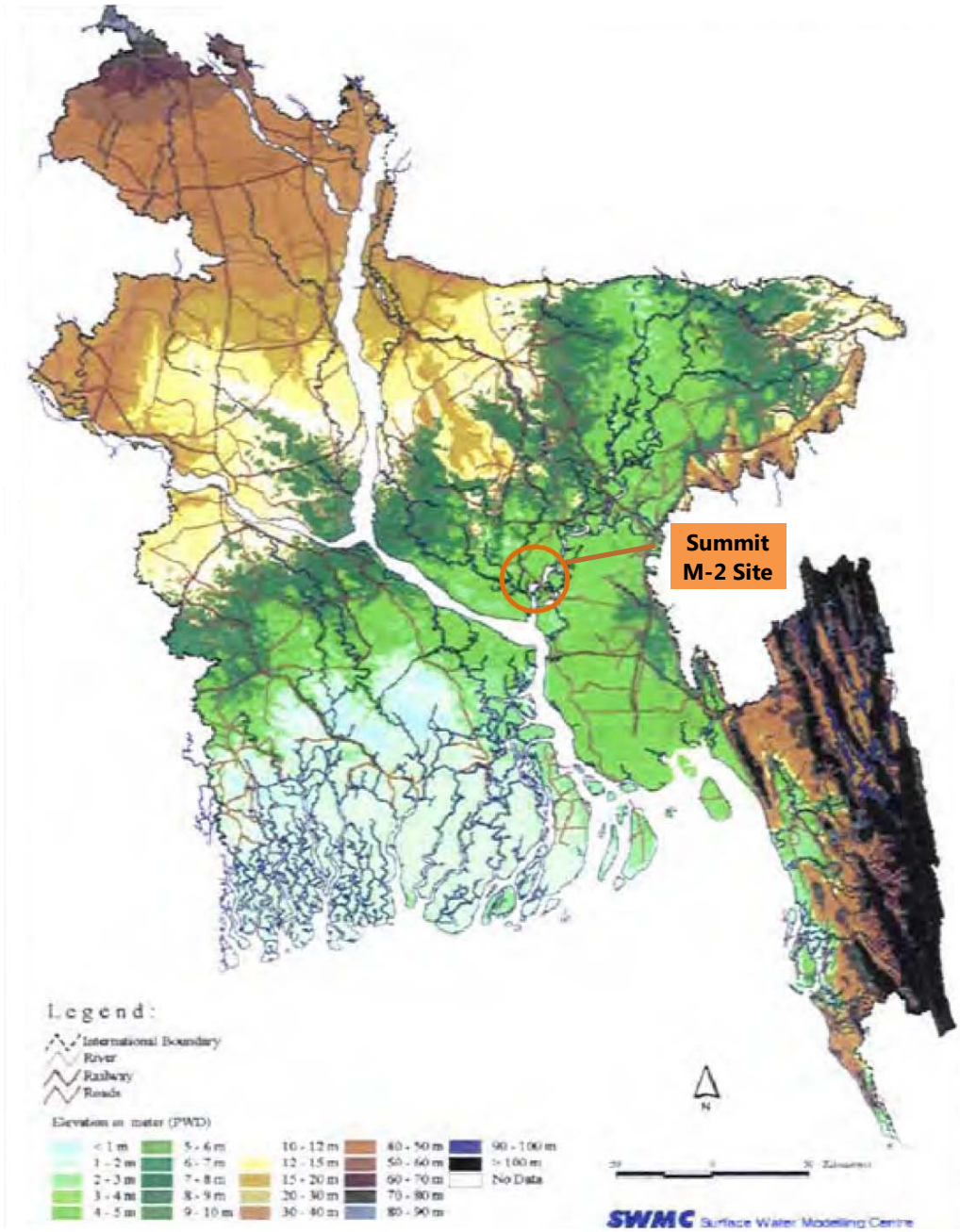
Source: Soil Research Development Institute (SRDI), 1997

4.3.3 *Topography*

The proposed project and study area (10km around the proposed project site) is predominantly a flat terrain with elevation of 5 m above mean sea level. The proposed project site is also a flat terrain and its gentle slope is towards east;

i.e. towards Meghna River. The topography map of Bangladesh is presented in ***Figure 4.4***.

Figure 4.4 Topography Map of the Bangladesh



Source: Surface Water Monitoring Center

4.3.4 Geology

The landforms of Bangladesh can be divided into three major classes: (i) the northern and eastern hills, (ii) the Pleistocene terraces, and (iii) the Holocene floodplains. The Holocene floodplain deposits cover most of the surface area of present-day Bangladesh. According to geographic and geomorphic distribution, the Holocene floodplains are divided in four classes: (a) piedmont plains, (b) meander floodplains, (c) tidal floodplains, and (d)

estuarine floodplains. The proposed project site is located in meander floodplains.

The proposed project site was developed by fill material to raise the site elevation to a point approximately one meter above the 200-year flood line. The site is underlain by several hundred meters of alluvial sediments. The surface is covered by two metres of alluvial silt, which is underlain by approximately 0.3 meters of silty sand and sand. This surface material lies above horizontally bedded clay and sand (MEP, 1997).

4.3.5 Soil Quality

The soil quality of the proposed project site and project influence area is assessed through the primary monitoring as well as reviewing the secondary soil quality monitoring data (*Ref: ESIA Report for Reliance Meghnaghat 750 MW CCPP, 2016*).

Secondary Monitoring Data

As part of this study, soil quality was monitored in four (4) locations, including the vacant land of Meghnaghat Power Hub. Other locations were Mugrapara (northern side of the Power Hub- approx. 3 km); Jamaldi (southern side of Power Hub- approx. 2.5 km) and Char Balaki (south-eastern side - approx. 2.5 km from Power Hub).

The soils in the area are slightly basic in nature with pH values ranging from 7.22-7.33; except Jamaldi, -the soil is slightly acidic (pH: 6.95). Electrical conductivity values in the samples varied from 12.5 to 225.2µS/cm. Nitrates in all the four soil samples were found to be from 2.11 (Power Hub area) to 12.45 (Jamaldi) mg/kg. The Manganese ranged from 8.55 (Char Balaki) – 375.5 (Mograpara) mg/kg. Phosphate levels were observed to be 43.21 - 147.37 mg/kg. The concentration of iron was varied from 0.083 to 1.58%.

Concentration of Lead ranges from untraceable in Char Balakito 11.0 in Mograpara. The other heavy metals like Cadmium and Chromium were found to be untraceable and ranging from 2.6 (in Char Balaki) to 29.6 (in Jamaldi) respectively. The Cation exchange capacity of soil samples ranges from 0.92 to 11.0meq/100gm. Arsenic found in the soil sample ranges from 0.29 to 2.56 mg/kg.

Primary Monitoring Data

Primary soil quality monitoring was conducted in two locations- at site and nearby open land. The monitoring details are presented in Table 4.3 and Figure 4.5.

Table 4.3 Soil Quality Monitoring Locations Details

Location Code	Location	Geographical Coordinates	Selection Criteria

Location Code	Location	Geographical Coordinates	Selection Criteria
SQ-1	Within the proposed site	23°36'32.81"N 90°35'48.74"E	Understand the existing soil quality and assess potential impacts on soil quality due to construction and operation of the plant.
SQ-2	Open area in Meghnaghat Power Hub	23°36'43.52"N 90°35'45.86"E	

Figure 4.5 Soil Quality Monitoring Location (Primary & Secondary) Map

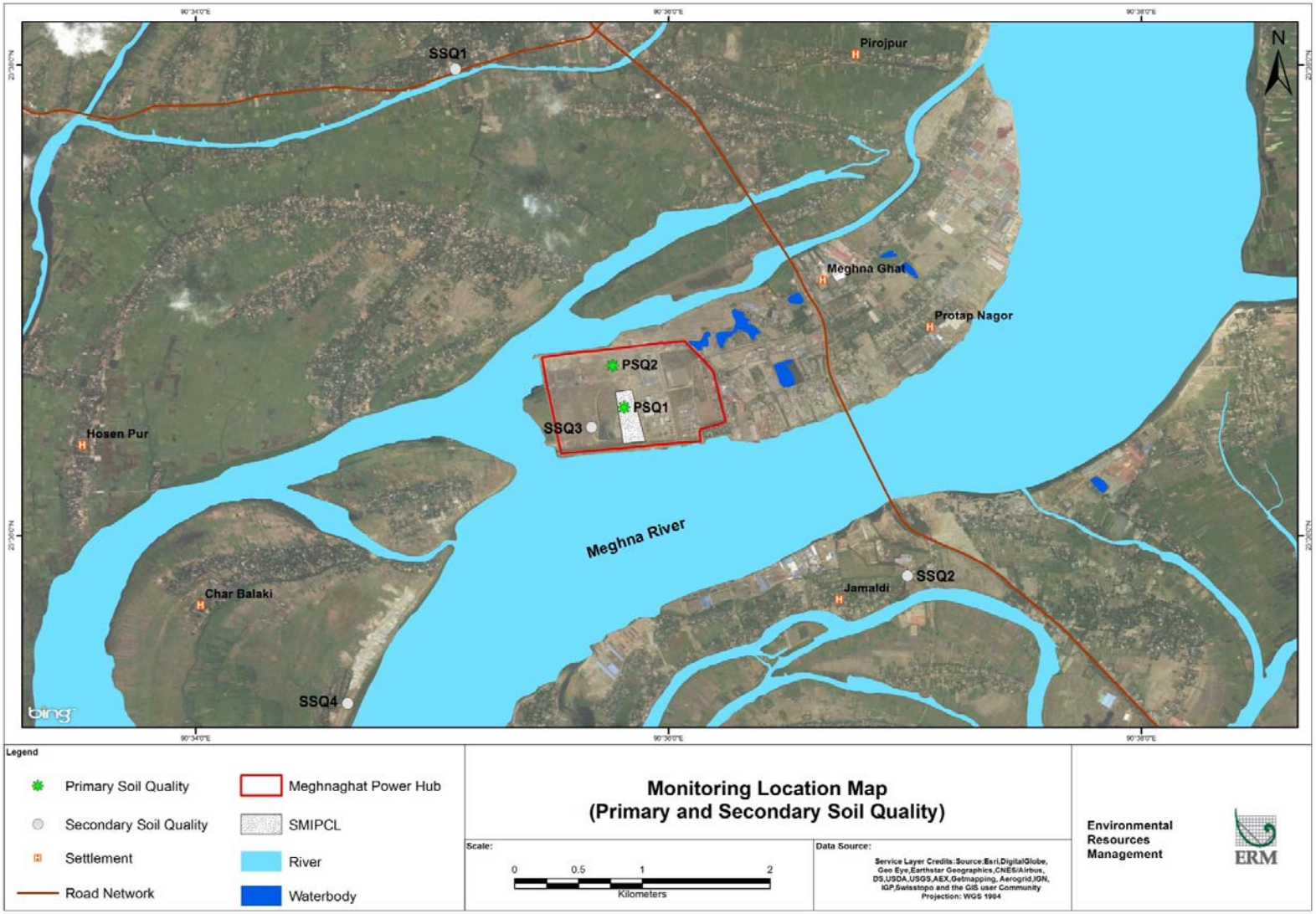


Figure 4.6 Photographs of Soil Sample Collection



Soil Sampling at proposed site



Soil sampling at nearby open area

The soil quality monitoring results is presented in Table 4.4.

Table 4.4 Soil Quality Monitoring Results in the study area

Sl. No.	Parameters	Unit	SQ-1	SQ-2
1	Acidity	mg/kg	nil	nil
2	Alkalinity (as CaCO3)	mg/kg	18	24
3	Boron (as B)	mg/kg	<0.25	<0.25
4	Bulk Density	gm/cc	1.43	1.25
5	Calcium (as Ca)	mg/kg	400	70
6	Carbonate	mg/kg	nil	nil
7	Cation Exchange Capacity	meq/100 gm	11.6	15.4
8	Chloride (as Cl)	mg/kg	20	30
9	Copper (as Cu)	mg/kg	<2.0	<2.0
10	Electrical conductivity	us/cm	40	47
11	Iron (as Fe)	mg/kg	<5.0	17
12	Magnesium (as Mg)	mg/kg	120	180
13	Moisture	%	4.2	9.6
14	Nitrogen (as N)	mg/kg	59	110
15	Particle Size Distribution	%	sand 82.7, silt 7.1, clay 10.2	sand 48.7, silt 11.8, clay 39.5
16	Permeability	Cm/hr	4.8	0.11
17	Phosphorus (as P)	mg/kg	<3	6.4
18	Porosity	%	45	43
19	Potassium (as K)	mg/kg	23	27
20	Sodium (as Na)	mg/kg	22	31
21	Sodium Adsorption Ration (as SAR)	"---	0.18	0.21
22	Specific gravity	"---	2.6	2.2
23	Sulphate (as SO4)	mg/kg	<15	<15
24	Texture	"---	loamy sand	sandy clay
25	Water Holding capacity	%	26	39
26	Zinc (as Zn)	mg/kg	11	14
27	pH value	"---	5.33 at 25 deg c(1:2.5)	6.20 at 25 deg c(1:2.5)

- pH: The pH level in soil samples varies in between 5.33 to 6.20 indicating slightly acidic soils as per standard soil classification.
- Texture: The texture of soil samples was found to be sandy to sandy clay in nature.
- EC: The values ranged between 40.0 micro Siemens/cm and 47.0 micro Siemens/cm.
- Nitrogen content: The available nitrogen content varied between 59 to 110 mg/kg.
- Phosphorus content: The available phosphorus content ranged between <3 to 6.4 mg/kg.
- Potassium content: The available potassium content ranged between 23 to 27 mg/kg.
- Sodium Absorption Ratio (SAR): The SAR values in the soil samples collected from agricultural lands were ranged from 0.18 to 0.21.
- Heavy Metals: The levels of iron level in the soil samples ranged between <5.0 mg/kg to 17 mg/kg, copper ranged between <2.0 mg/kg, zinc was ranged between 11 mg/kg to 14 mg/kg. The results were compared with the Dutch Standards[1] [2] and found well within the intervention values.

4.3.6 Sediment Quality

Meghnaghat industrial area is a more recent development in last 10-15 years' time. A host of industrial activities like discharge of effluents from industrial, spillage and leakage of oil from oil depots vessel, urban discharge etc. stand to impact quality in the rivers. To assess the sediment quality in the river primary monitoring was carried out in six representative locations in Meghna Minor Channel and Meghna River (Refer sediment sampling locations in Table 4.5 and Figure 4.7**)**.

Table 4.5 Sediment Monitoring Location

Location Code	Location	Geographical Coordinates	Selection Criteria
SD-1	Upstream of Meghna Minor Channel	23°36′52.2′′ N 90°35′35.4′′E	Understand the existing sediment quality and assess any impacts from upstream industries in Meghnaghat industrial area.
SD-2	Downstream of Summit Existing Discharge Point	23°36'43.44"N 90°35'23.19"E	Understand the existing sediment quality and assess the impacts due to discharge from Summit M1 plant.
SD-3	Downstream of Orion Power Jetty	23°36'33.43"N 90°35'20.11"E	Understand the existing sediment quality and assess the impacts due to operation of Orion Jetty and discharge from plant

[1] The assessment of potential impacts to soil and sediment has been considered as per the Dutch Standard as Bangladesh does not have any local standards for soil or sediment quality.

[2] Dutch Target and Intervention Values (Soil remediation Circular 2013), https://rwsenvironment.eu/subjects/soil/legislation-and/soil-remediation/

Location Code	Location	Geographical Coordinates	Selection Criteria
SD-4	Downstream of Meghnaghat Power Plant Discharge Point	23°36'19.19"N 90°35'25.90"E	Understand the existing sediment quality and assess impacts due to discharge of Meghna Power Plant and assess the impact due to proposed Summit M2 plant.
SD-5	Near Meghnaghat Power Plant Intake Point	23°36'19.92"N 90°35'54.55"E	Understand the existing sediment quality and assess impacts due to upstream industries in Meghnaghat industrial area.
SD-6	Downstream of Meghna River, Char Balaki	23°36'2.10"N 90°35'16.69"E	Understand the existing sediment quality and assess impacts due to upstream industries in Meghnaghat industrial area and proposed Summit M2 project.

Analysis of Results

Toxic Metal: The concentration of Chromium and Cadmium in all the monitoring locations were observed <2.0 mg/kg. The concentration of Arsenic in all the monitoring locations were observed <0.25 mg/kg. The concentration of Cr, Cd and Pb were well below the Dutch intervention values for these metals (Dutch intervention value: Cd 13 mg/kg, Cr(III)- 180 mg/kg, Cr (VI)-78 mg/Kg, Pb- 530 mg/kg).

The concentration of Cobalt varies from <4.0 mg/kg (SD-4 & SD-5) to 7.0 mg/kg (SD-1). The concentration of copper varies from <2.0 mg/kg (SD-5) to 19 mg/kg (SD-1). The concentration of nickel varies from 9.0 mg/kg (SD-4) to 21 mg/kg (SD-1). The concentration of zinc varies from 15 mg/kg (SD-4) to 36 mg/kg (SD-1). It was found that concentration of Co, Cu, Ni and Zn were well below the Dutch intervention values for these metals. (Dutch targeted and intervention value: Co - 190 mg/kg, Cu- 190 mg/kg, Ni-100 mg/kg, Zn- 720 mg/kg).

It was observed that concentration of toxic metals in the Meghna River minor channel was higher than other location (downstream of Power Plant discharge locations and main Meghna River). The higher concentration in the Meghna minor channel may be due to industrial discharges in the upstream of the channel and lower flow.

Figure 4.7 Sediment Sampling Locations in the Study Area

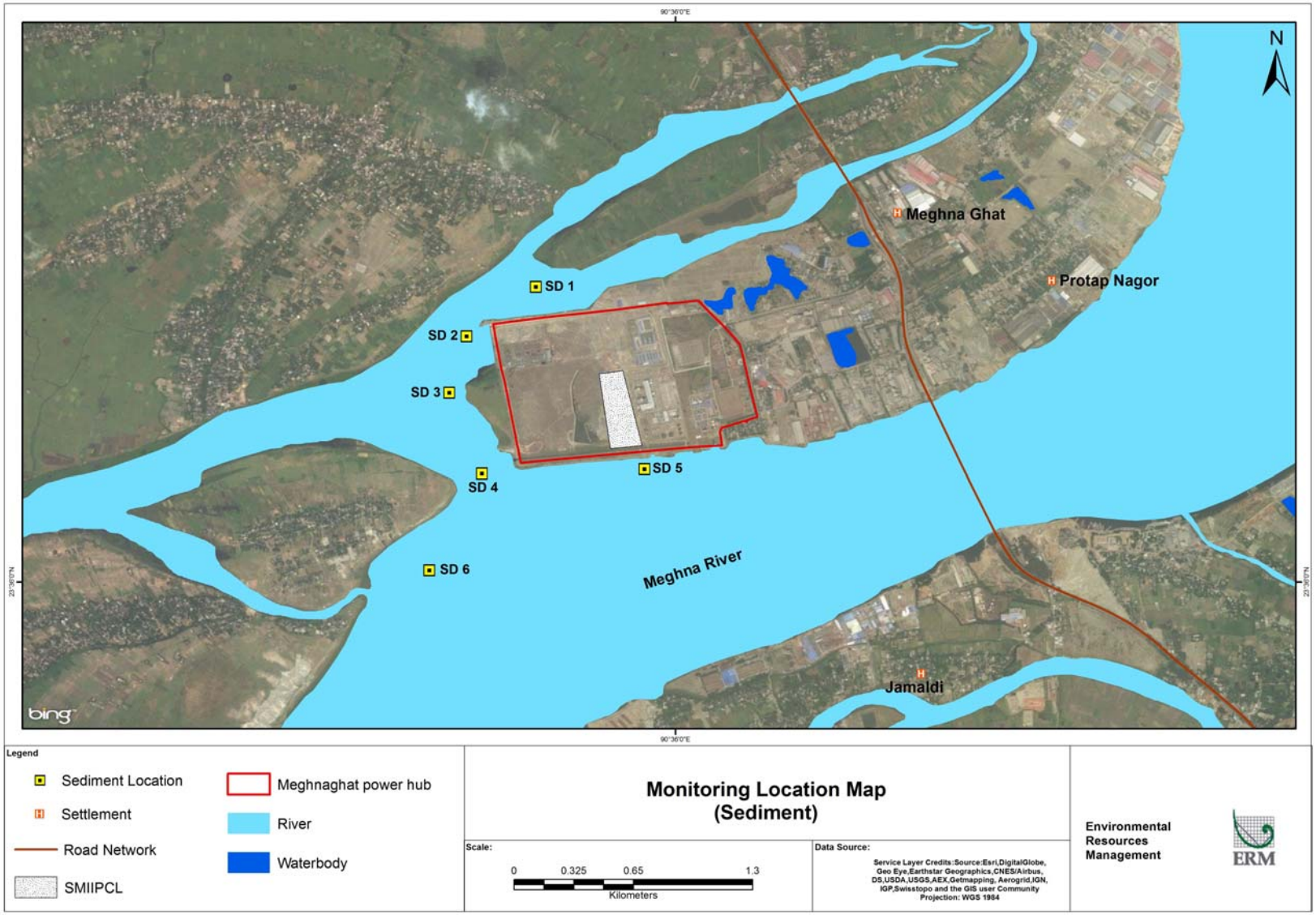


Table 4.6 Sediment Quality Monitoring Results in the Study Area

Sl. No.	Parameters	Unit	SD-1	SD-2	SD-3	SD-4	SD-5	SD-6
1	Acidity	mg/kg	nil	nil	nil	nil	nil	nil
2	Alkalinity (as CaCO3)	mg/kg	12	18	24	12	24	12
3	Arsenic	mg/kg	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
4	Cadmium (as Cd)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
5	Cation Exchange Capacity	meq/100 gm	28	32	20	19	14.9	23
6	Cobalt (as Co)	mg/kg	7	5	5	<4.0	<4.0	6
7	Copper (as Cu)	mg/kg	19	17	8	3.0	<2.0	12
8	Electrical conductivity	us/cm	247	460	132	130	158	154
9	Hexavalent Chromium (as Cr+6)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
10	Hg (inorganic)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
11	Hg (organic)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
12	Lead (as Pb)	mg/kg	9	8	<5.0	<5.0	<5.0	6
13	Manganese (as Mn)	mg/kg	248	163	266	81	236	327
14	Nickel (as Ni)	mg/kg	21	17	16	9	15	18
15	Silica (as SiO2)	%	16	20	14	17	19	21
16	Texture	---	CLAY	clay	clay	clay	clay	clay
17	Total Organic Carbon	%	0.77	0.94	0.59	0.54	0.65	0.38
18	Zinc (as Zn)	mg/kg	36	32	25	15	18	24
19	pH value	---	5.89 AT 25 DEG C (1:2.5)	6.19 at 25 geg c(1:2.5)	6.21 at 25 deg c (1:2.5)	5.10 at 25 deg c(1:2.5)	6.34 at 25 deg c (1:2.5)	5.66 at 25 deg c

4.3.7 Hydrology, Drainage and Flooding

Hydrology

The Meghna River originates inside Bangladesh by joining of the Surma and Kushiyara rivers originating from the hilly regions of eastern India. The name is properly applied to a channel of the Old Brahmaputra downstream from Bhairab Bazar, after it has received the Surma (Barak) River. Flowing almost due south, the Meghna receives the combined waters of the Padma and Jamuna (the name of the Brahmaputra in Bangladesh) rivers near Chandpur. Down to Chandpur, Meghna is hydrographically referred to as the Upper Meghna and after the Padma joins, it is referred to as the Lower Meghna. Flowing a course of about 260 km it enters the Bay of Bengal by four principal mouths—Tetulia, Shahbazpur, Hatia, and Bamni rivers. The proposed site is about 30 km North of Chandipur, in the upper Meghna zone.

Drainage in the Study Area

The study area falls within the watershed of Meghna River. The main channel of Meghna River flows northeast to south west within the study area at a nearest distance of 0.5 km south of the proposed site. The minor channel of Meghna River flows north-east to south-west at a distance of 0.25 km towards north of the proposed site. The proposed site has flat terrain; however, the gentle slope of the site is towards west, i.e. Meghna minor channel. Drainage map of the study area is presented in following figure.

Water Resource & Availability

The river water in the Meghnaghat Industrial Area is used for industrial cooling and process water. The rivers serve as a sink for treated effluents from industries including thermal discharges from power plants which mostly have once through cooling systems.

Figure 4.8 Geological Map of Bangladesh

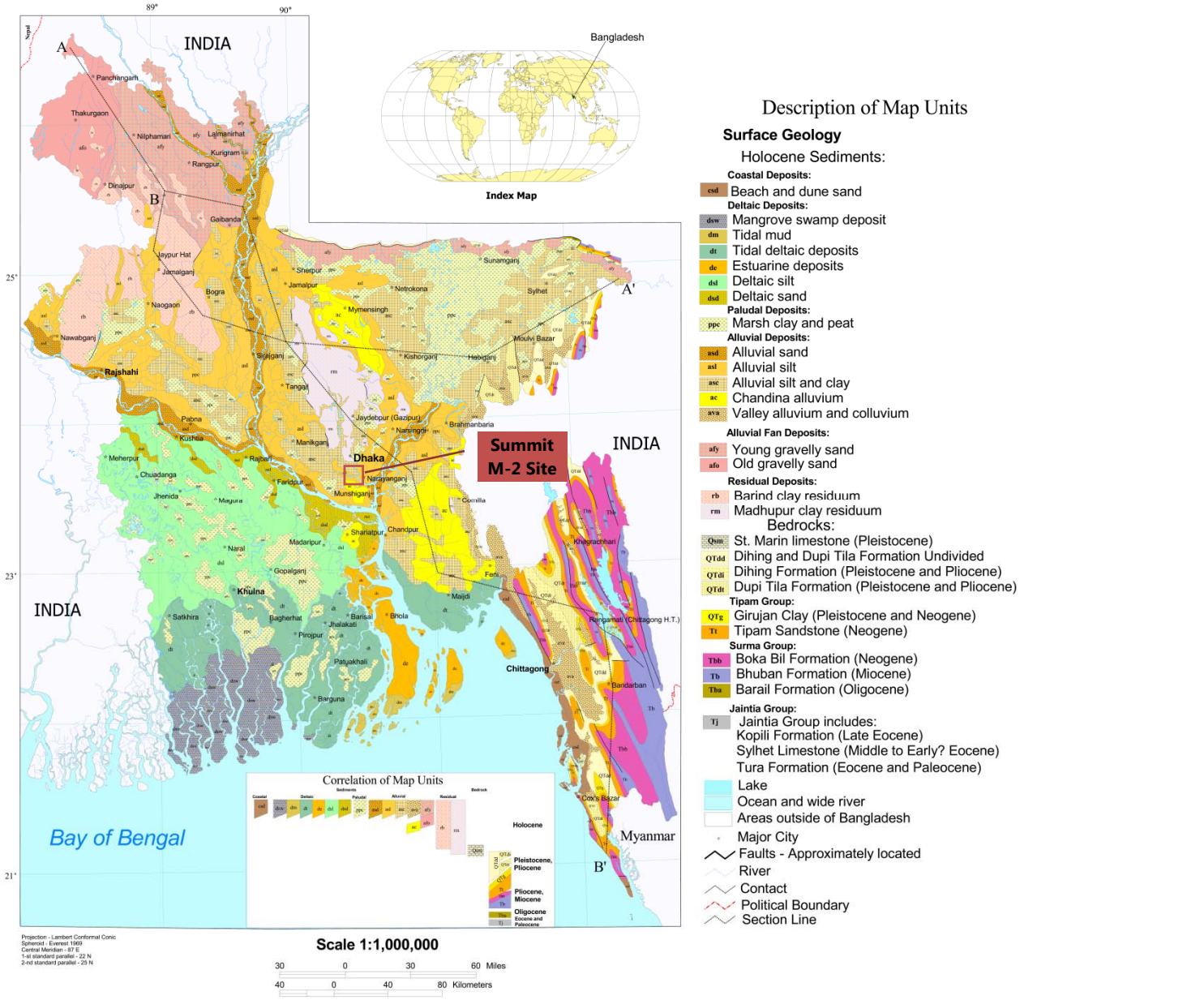
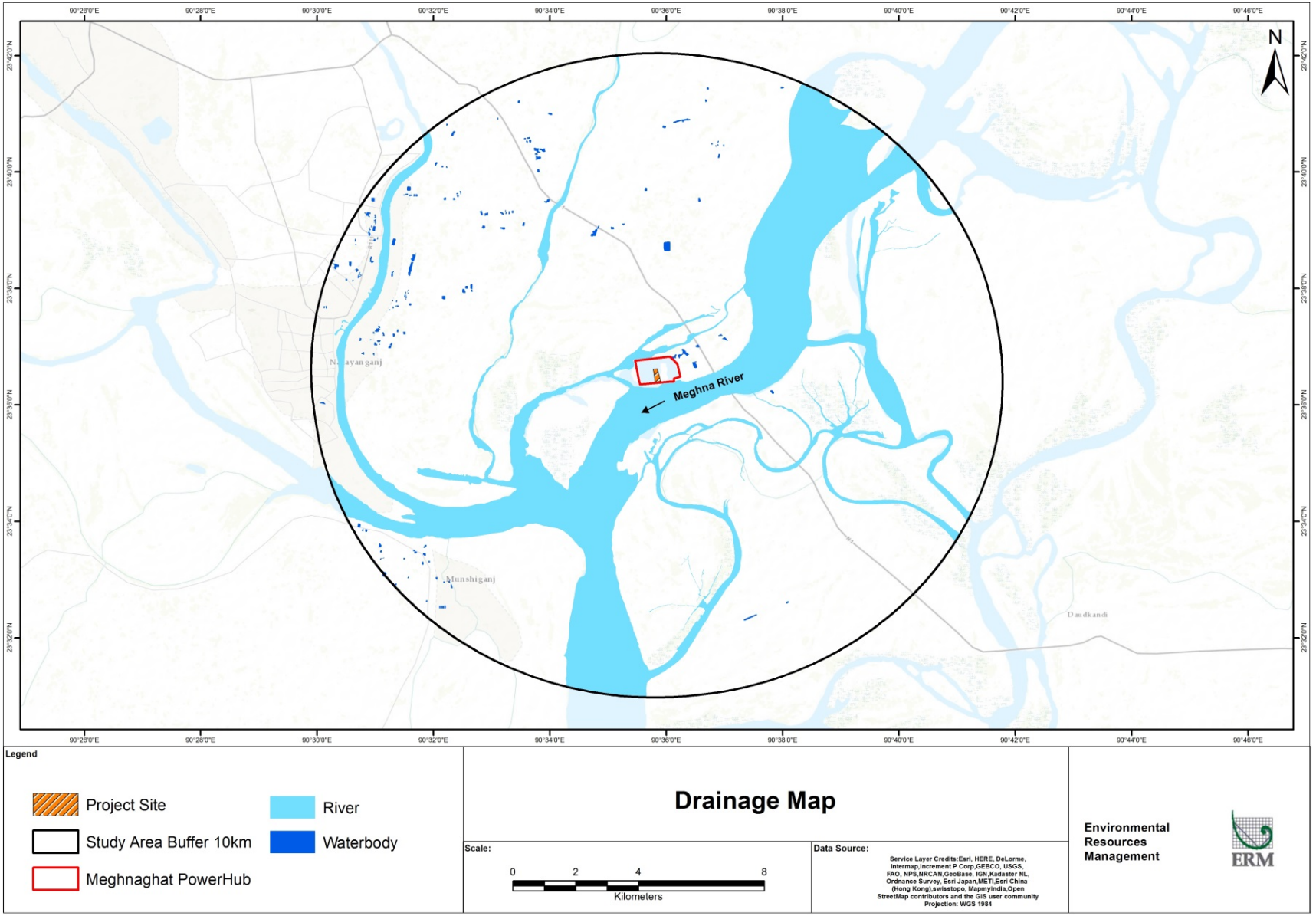


Figure 4.9 Drainage Map of the Study Area



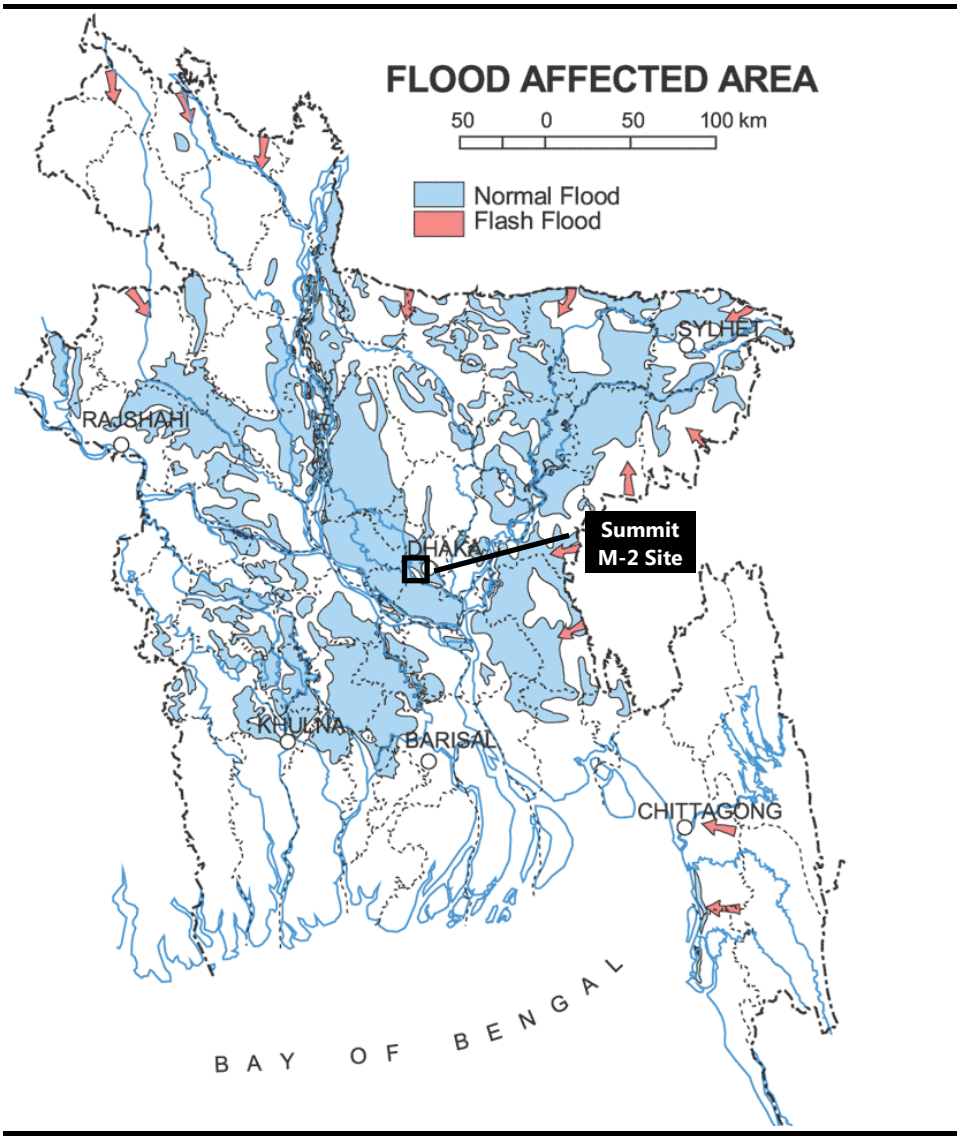
The river is also used for transport of raw material and finished products and construction material. The river supports aquatic ecosystem and fish propagation.

Flooding

The maximum discharge of Meghna River at Bhairab Bazar Station was observed as 13400 m^3/sec in 1995 and 10572 m^3/sec in 2004. There has been a declining trend in the maximum discharge levels over the years, though the minimum discharge has remained almost same. Meghna is a wide river and water is available throughout the year for consumptive uses of industry as well as for river transport and fish propagation.

Every year near about one-fifth of Bangladesh undergoes flood during the monsoon season. A flood season in Bangladesh may start as early as May and can continue until November. Five floods during the last fifty years were extensive and devastating and these are the floods of 1955, 1974, 1987, 1988, and 1998. The flood affected area of Bangladesh is presented in **Figure 4.10.**

Figure 4.10 Flood Affected Areas of Bangladesh



Meghna carries huge amount of water from the precipitation over large area of the Ganga-Brahmaputra-Meghna (GBM) basin. About 80% of the annual rainfall of Bangladesh occurs during monsoon season between June to September. The major cause of the monsoon flood relies on the intensity, duration and magnitude of the rainfall in the GBM basin.

A comparison of floods in major rivers in 2007 with other major floods of recent past in 2004, 1998 and 1988 was conducted. Water level data from Bhariab Bazar gauge station in the Meghna River is presented in following table.

Table 4.7 Summary of Flood study (2007, 2004, 1998 and 1988) in Meghna Rover

Parameter	2007	2004	1998	1988
Danger Level in meters above PWD datum	6.25	6.25	6.25	6.25
Date of crossing Danger Level at rising stage	30.07.07 & 12.09.07	11.07.04	20.07.98	06.07.88 & 14.08.88
Date of crossing Danger Level at falling stage	21.08.07 & 25.09.07	18.08.04	25.09.98	05.08.88 & 27.09.88
Height of peak flood level in meter above Danger Level	0.69	1.53	1.08	1.41
Duration of flood in days above Danger Level	37	38	67	75

The magnitude of water level above danger level in the Meghna River during 2007 was almost half of it during 2004. The most severe flood in terms of magnitude occurred in this basin during 1988 and 2004. Also, during 1998 the magnitude of the peak flood in this basin was much higher than that of 2007. In 2007 and 1988, the first flood wave entered into Meghna basin in the last week of July. In 1988 and 2007, flood was observed in the Meghna river basin of Bangladesh much earlier (at the beginning of July) than in 2007, while in 1998, the first flood wave was observed in the middle of July. Duration of floods in the Meghna river basin of Bangladesh in 2007 is similar to that of 2004. Although the long lasting flood was observed in this basin in 1988 and it was twice the duration of flood in 2007. In 1998, the duration of flood in the Meghna river basin of Bangladesh was less than 1988 but has much higher than in 2007 and 2004. In general the Meghna River basin more affected due to flood during the month of July based on the past flood level data.

BPDB had developed the Meghnaghat Power Hub; the site was elevated to one meter above the 200 year highest flood level (HFL), which is +8.0 m Public Works Datum (PWD) or +7.54 m above the mean sea level (MSL). The highest flood levels in the project area were recorded at the Meghna Ferryghat gauge station (1.5 kilometres south-east of the project site) during the monsoons of 1998, 1988, and 1974 when flood elevations of +6.76 metres, +6.55 metres, and +6.19 metres PWD were respectively noted (*EIA, Meghnaghat Power Project, 2001*).

4.3.8 Surface Water Quality

Pollution of surface waters is considered as one of the most serious problems in industrial and urban areas. The water quality of the river is of particular importance not only for ecological and commercial reasons but also for concerns regarding safe drinking water supply and suitability for industrial use and domestic use. The quality of surface water was assessed through primary monitoring and collection of secondary data from various sources.

Secondary Data

Surface water quality data was collected during January 2016 and March 2016 for CEIA study[1] was analysed in the following section.

Ambient water temperature: The ambient water temperature varied from 19.8°C to 24.4°C (during January 2016) and 25.3°C to 28°C (during March 2016) along the industrial zone of the Meghna river. Higher temperatures were observed at a minor channel of the Meghna River during both winter and early summer. Major temperature difference was not observed in the cooling water outfall points of the thermal plants.

Dissolved Oxygen (DO): DO varied from 5.9 to 6.5 mg/L (during January 2016) and 1.6 to 6.4 mg/L (during March 2016) along the industrial zone of Meghna river. The DO level at the sampling locations is much above the critical level of 4 mg/L.

Biochemical oxygen demand (BOD): BOD level at all sampling location was <2 mg/L in both the season, except for in minor channel of Meghna river, where it was recorded as 142 mg/L and 89 mg/L during winter and early summer respectively ; possibly due to discharge of industrial effluents from paper mills in the minor stream. The BOD level at all the sampling locations are much below the standard for Class 'D' water (< 6 mg/l Country Standard for Class D Waters – used by fisheries)

Toxic Metal (Pb, Cr & Cd): Cd (<0.001 mg/L), Cr (<0.01 mg/L) and Pb (<0.005 mg/L) was recorded in low concentration all the sampling locations.

Primary Monitoring Results

Surface water was monitored at six different locations from the study area. Samples were collected to understand the existing water quality of the river and assess the potential impact due to proposed project activities. The sampling location details are presented in Table 4.8 and ***Figure 4.11***.

[1] Cumulative Environmental Impact Assessment (CEIA) Study Report for Siddhirganj and Meghnaghat Power Hubs, prepared by ERM for Power Cell, Power Division, Government of Bangladesh, September 2016

Figure 4.11 Surface Water, Ground Water & Sediment Quality Monitoring Location Map

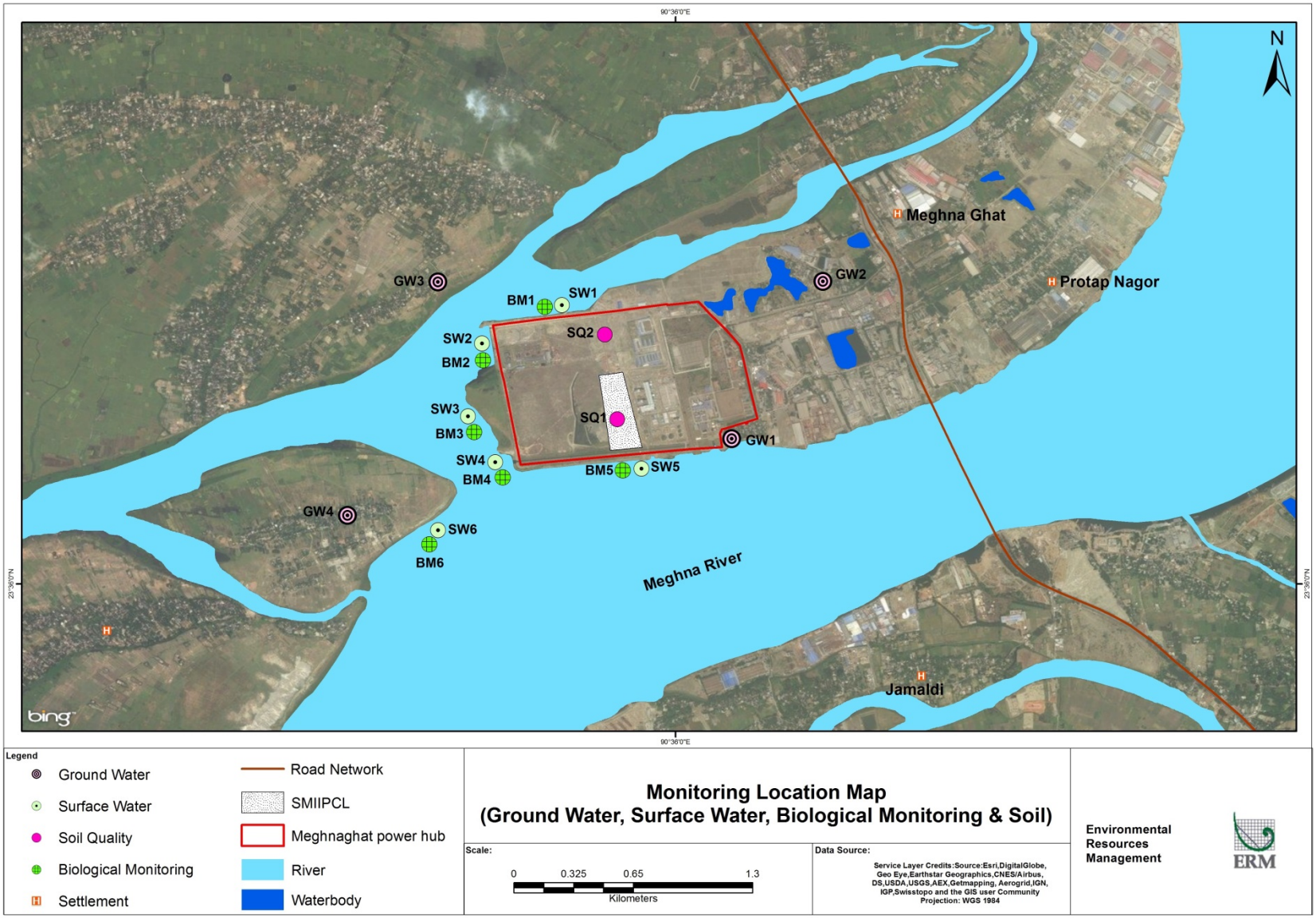


Table 4.8 Surface Water Quality Monitoring Location Details

Location Code	Location	Geographical Coordinates	Selection Criteria
SW-1	Upstream of Meghna Minor Channel	23°36′52.2′′ N 90°35′35.4′′E	Understand the existing water surface quality and assess any impacts from upstream industries in Meghnaghat industrial area.
SW-2	Downstream of Summit Existing Discharge Point	23°36'43.44"N 90°35'23.19"E	Understand the existing water surface quality and assess the impacts due to discharge from Summit M1 plant.
SW-3	Downstream of Orion Power Jetty	23°36'33.43"N 90°35'20.11"E	Understand the existing water surface quality and assess the impacts due to operation of Orion Jetty and discharge from plant
SW-4	Downstream of Meghaghat Power Plant Discharge Point	23°36'19.19"N 90°35'25.90"E	Understand the existing water surface quality and assess impacts due to discharge of Meghna Power Plant and assess the impact due to proposed Summit M2 plant.
SW-5	Near Meghanaghat Power Plant Intake Point	23°36'19.92"N 90°35'54.55"E	Understand the existing water surface quality and assess impacts due to upstream industries in Meghnaghat industrial area.
SW-6	Downstream of Meghna River, Char Balaki	23°36'2.10"N 90°35'16.69"E	Understand the existing water surface quality and assess impacts due to upstream industries in Meghnaghat industrial area and proposed Summit M2 project.

Surface water quality analysis results are presented in Table 4.9.

Interpretation of Surface Water Quality Results

Temperature of the surface water samples varied from 26°C (SW-1) to 29°C; the difference of temperature may be due to increase of air temperature during sampling period. The pH of the surface water samples varied from 5.92 (SW-6) to 6.8 (SW-1). The DO levels at all locations exhibited values ranging from 5.7 mg/l (SW-6) to 6.6 mg/l (SW-3), indicating favourable conditions for the growth and reproduction fish and other aquatic organisms in these water bodies. Biochemical Oxygen Demand (BOD) values of the sample varied from <2.0 mg/l to 2.9 mg/l (SW-1). Such low BOD values confirmed the presence of low concentrations of biologically oxidizable organic matter in the receiving water bodies. Chemical Oxygen Demand (COD) values of the samples varied from 5 mg/l (SW-3) to 21 mg/l (SW-1); the higher COD level in SW-1 (minor channel of Meghna river) may be due to discharge of effluent from paper mills and chemical plant in the upstream of Meghnaghat industrial area.

Presence of contaminants in the form of total petroleum hydrocarbon (TPH) in all surface water samples was found to be negligible (<0.001 mg/l).

The total Coliform count of the surface water samples found between 78 MPN/100 ml (SW-2) to 920 MPN/100 ml (SW-6).

Concentrations of heavy metal like lead (<0.005 mg/l), total chromium (<0.01 mg/l), and cadmium (<0.001 mg/l), mercury (0.001 mg/l), nickel (<0.02 mg/l) were found to be below detection limits in the surface water sample.

Water from the surface water bodies in the study area is used for (i) Source of drinking water for supply after conventional treatment (Best Practice based classification- C), (ii) Water usable by fisheries (Best Practice based classification- D), (ii) Water usable by various process and cooling industries (Best Practice based classification- E). The results of surface water analysis indicated compliance to Class C, D and E.

Surface Water quality Trends

Comparative analysis of monitoring data, BWDB data (2001-2009) and other scientific research data recorded in Meghna River is shown in Table 4.10.

Table 4.9 Surface Water Quality Monitoring Results in the Study Area

Sl. No.	Parameters	Unit	SW-1	SW-2	SW3	SW4	SW5	SW6
1	Aluminium (as Al)	---	<0.01	0.19	<0.01	0.29	0.33	0.33
2	Arsenic(as As)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
3	Barium (as Ba)	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
4	Biochemical Oxygen Demand (as BOD)	mg/l	2.9	<2.0	<2.0	<2.0	<2.0	2.2
5	Cadmium (as Cd)	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
6	Chemical Oxygen Demand (COD)	mg/l	21	11	5	10	<4.0	16
7	Colour	Hazen	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
8	Copper (as Cu)	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
9	Dissolved Oxygen	mg/l	5.9	6.4	6.6	6.2	6.4	5.7
10	Iron (as Fe)	mg/l	0.4	0.8	0.5	1	1.3	0.65
11	Lead (as Pb)	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
12	Magnesium (as Mg)	mg/l	1.92	3.8	4.8	4.8	4.8	8.6
13	Mercury (as Hg)	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
14	Nickel (as Ni)	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
15	Odour	---	unobjectionable	unobjectionable	unobjectionable	unobjectionable	unobjectionable	unobjectionable
16	Oil and Grease	mg/l	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4
17	Salinity	---	0.12	0.11	0.08	0.08	0.08	0.08
18	Temperature	Deg C	26	27	27	28	28	29
19	Total Chromium (as Cr)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
20	Total Nitrogen (as N)	mg/l	1.3	1	0.3	<0.3	0.4	<0.3
21	Total Petroleum Hydrocarbon (as TPH)	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
22	Total Phosphorus	mg/l	0.24	<0.05	<0.05	<0.05	0.16	<0.05
23	Total Suspended Solid (as TSS)	mg/l	53	19	21	20	26	28
24	Turbidity	N.T.U.	46	20	32	30	35	23
25	Vanadium as V	mg/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
26	Zinc (as Zn)	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
27	pH value	---	6.8 at 26 deg C	6.31 at 27 deg C	6.40 at 27 deg C	6.36 at 28 deg C	6.65 at 28 deg C	5.92 at 29 deg C
28	Total coliform	MPN/100ml	79	7.8	540	79	110	920

[Source: primary monitoring December 2017]

Table 4.10 Comparative Analysis of Surface Water Data of Meghna River

Parameters	Meghna River CEIA Study, 2016 (Summer)[#1]	Meghna River CEIA Study, 2016 (Winter)[#1]	ESIA for CCPP at Meghnaghat, (2012)[#2]	ESIA Reliance Meghnaghat 750 MW, 2016[#3]	Regular Monitoring by Summit Power, April 2016	ESIA Study for Summit M2, Dec 2017
Temperature (^{o}C)	25.3-28.0	19.8 to 24.4	31.8 to 32.5	27.3 to 27.5		26 to 29
pH	6.3-6.8	6.77 to 6.82	6.5 to 6.7	7.8 to7.26	6.96	5.92 to 6.8
DO (mg/L)	1.6-6.4	5.9 to 6.5	5.9 to 6.6	5.0 to 8.0	3.52	5.7 to 6.6
TDS (mg/L)	118-615	86 to 120	54 - 72	37 to 38	83.2	-
COD (mg/L)	<4-293.6	<4	< 5 to 5.7	21.8to 33.2	23.5	5.0 to 21.0

Source:

#1 – Cumulative Environmental Impact Assessment (CEIA) Study Report for Siddhirganj and Meghnaghat Power Hubs, prepared by ERM for Power Cell, Power Division Government of Bangladesh, September 2016
#2 ESIA Study Report for 305-350MW Dual Fuel Combined Cycle Power Plant Project at Meghnaghat, Narayanganj, prepared by SGS India Private Limited for Summit Meghnaghat Power Company Limited
#3 - ESIA Study Report for Reliance Meghnaghat 750 MW Combined Cycle Power Plant, prepared by Adroit Environment Consultants, Bangladesh for Reliance Bangladesh LNG and Power Limited, March 2017

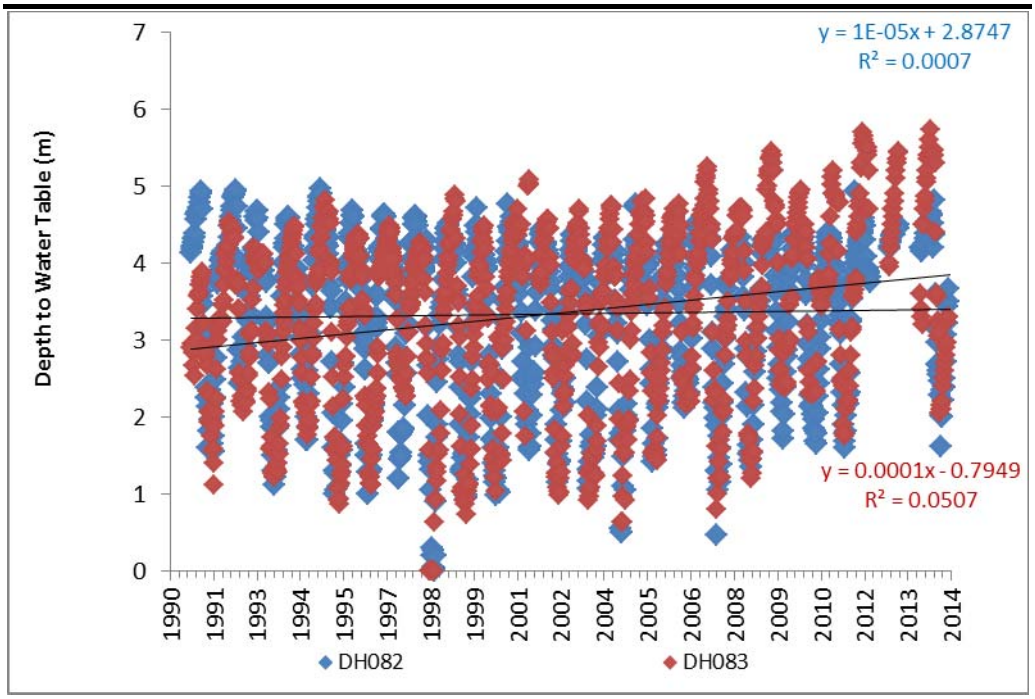
4.3.9 Ground Water Resource

Groundwater is abundant in Bangladesh and the aquifers are highly productive. Water tables vary across the country but are typically shallow at around 1–10 m below the ground surface. These factors have made groundwater an attractive and easily accessible resource. Over abstraction of ground water in the industrial area is causing unusual declining of ground water level.

Ground Water Level in the Study Area

The Bangladesh Water Development Board (BWDB) has ground water monitoring wells in Sonargaon Upazilas. The monitored data is graphically represented in ***Figure 4.12.***

Figure 4.12 Water Table Variations in Sonargaon Upazila Monitoring Wells

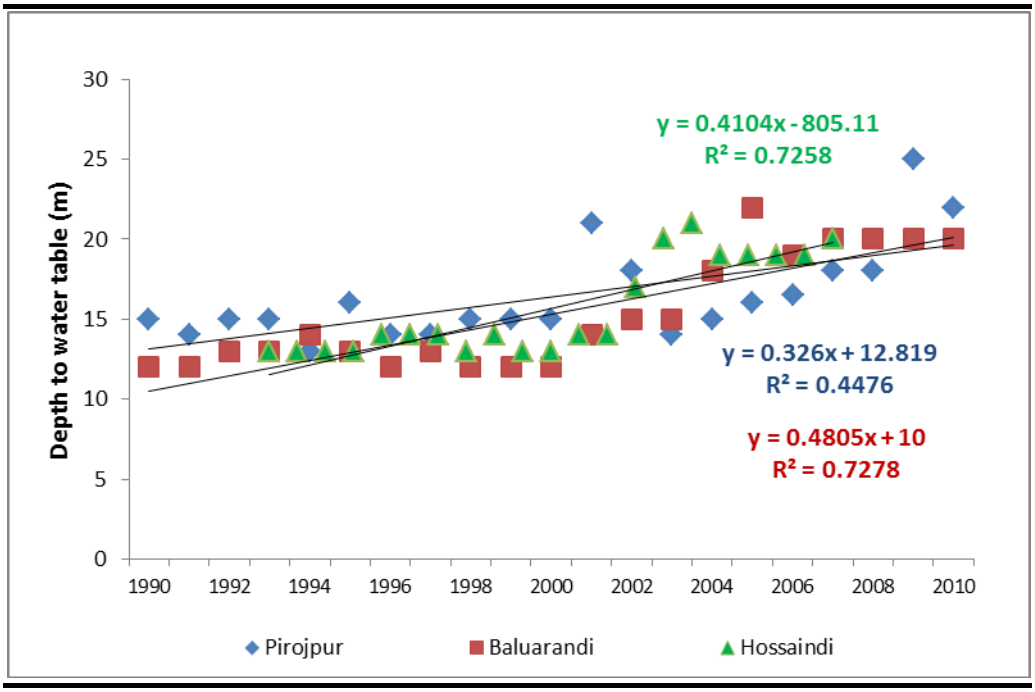


Source: Plotted from BWDB data for station id DH082 and DH083 for Sonargaon Upazila

From the analysis of the graphs it is evident that there is seasonal variation in the water table and the water table decreases in the dry months of December to April. From equations it is evident that the water table has gradually gone deeper over the years in Upazila.

Further in this regard, more specific information for locations within Meghnaghat industrial areas was obtained from Department of Public Health Engineering (DPHE). The data collected from their permanent monitoring wells over a period spanning well over two decades (1989-2011) is graphically represented in **Figure 4.13.**

Figure 4.13 Water Table Variations in Monitoring Wells of DPHE in Meghnaghat Area



Source: Plotted from DPHE data for Monitoring Wells in Meghnaghat Area

Analysis of the comprehensive data set collected from BWDB and DPHE for Meghnaghat industrial area, presents a clear trend of a gradual decline in the water table over the years. The declining water tables can be attributed to the increasing utilisation of ground water by industries as well as domestic use.

4.3.10 *Ground Water Quality*

The ground water quality was considered important in order to understand the probable impacts of the proposed project activities on the sub surface aquifers. The quality of surface water was assessed through primary monitoring and collection of secondary data from various sources.

Secondary Data

Ground water samples were collected from eight (8) locations in Meghnaghat Industrial area and targeted parameters were monitored in CEIA study.

Reference was also made to few EIA studies namely *EIA Study of the 330-335 MW CCPP project at Meghnaghat in 2012* carried out in the Meghnaghat industrial area for referring to previous data ground water quality.

Comparative analysis of secondary data monitoring data is presented in **Table 4.11**

Table 4.11 Comparative Analysis and Inferences – Meghnaghat

Parameters	Units	CEIA Study, 2016 (Meghnaghat Area) #1	ESIA for 300-350 MW Dual Fuel CCPP at Meghnaghat, 2012 #2	Regular Monitoring, Summit Power, April 2016	Standards - ECR 97

Parameters	Units	CEIA Study, 2016 (Meghnaghat Area) #1	ESIA for 300-350 MW Dual Fuel CCPP at Meghnaghat, 2012 #2	Regular Monitoring, Summit Power, April 2016	Standards - ECR 97
Colour	Hazen	<10	10-20	-	15
Odour	---	Unobjectionable	Odourless	-	Odourless
pH at 25°C	---	6.63 – 6.95	7.2 – 7.4	8.2	6.5 -8.5
Turbidity	N.T.U.	<10 -16.4	0.89 – 4.52	0.23	10
Total Dissolved Solids	mg/l	394 - 590	296 - 508	560.25	1000
Fluoride (as F)	mg/l	0.64 -0.79	0.32 – 0.48	-	1.0
Iron (as Fe)	mg/l	<0.05 – 2.91	0.15 – 0.40	ND	0.3
Nitrate (as NO_3)	mg/l	<0.5 – 3.04	1.07 – 3.42	ND	10
Cadmium (as Cd)	mg/l	<0.001	<0.005	-	0.005
Lead (as Pb)	mg/l	<0.005	0.02 - 0.04	ND	0.05
Arsenic (as As)	mg/l	<0.01	<0.005 – 0.11	0.0076	0.05
Total Chromium (as Cr)	mg/l	<0.01	< 0.01	-	0.05
Faecal Coliform	/100ml	Absent	-	-	-
Total Coliform Organism	MPN/ 100 ml	<1.8 - 94	-	-	-

Source:
#1 – Cumulative Environmental Impact Assessment (CEIA) Study Report for Siddhirganj and Meghnaghat Power Hubs, prepared by ERM for Power Cell, Power Division Government of Bangladesh, September 2016
#2 ESIA Study Report for 305-350MW Dual Fuel Combined Cycle Power Plant Project at Meghnaghat, Narayanganj, prepared by SGS India Private Limited for Summit Meghnaghat Power Company Limited

From Table 4.11, it can be observed that all the parameters are within the standard values of ECR 97 and it can be assumed that the ground water quality was satisfactory for drinking.

Primary Monitoring

Groundwater samples were collected from 4 different locations. Groundwater was collected from shallow tube wells of the study area. Refer ***Figure 4.11*** and Table 4.12.

Table 4.12 Ground Water Monitoring Location

Location Code	Location	Geographical Coordinates	Distance & Direction from Summit M2 boundary	Selection Criteria
GW-1	Ganganagar	23°36'52.03"N; 90°36'26.07"E	1.2 km; NE	To understand the existing baseline and potential impact from plant
GW-2	Ialampur	23°36'26.89"N; 90°36'11.30"E	0.6 km; SE	To understand the existing baseline and potential impact from plant
GW-3	Mongoler Gaon	23°36'50.70"N; 90°35'11.88"E	1.2 km; NW	To understand the existing baseline
GW-4	Char Balaki	23°36'12.27"N; 90°35'0.33"E	1.5 km, SW	To understand the existing baseline

The detailed results of physicochemical characteristics of groundwater within the study area are presented in Table 4.13.

Interpretation of Ground Water Quality Results

pH of the groundwater samples were found in the range of 6.75 to 7.2; were found to be within drinking water standard (6.5-8.5).

DO of the groundwater samples were found in the range of 4.3 mg/l to 5.2 mg/l; were found to be below the drinking water standard (6 mg/l).

BOD of the groundwater samples were found in the range of <2.0 mg/l to 2.9 mg/l; were found to be above the drinking water standard (0.2 mg/l).

COD of the groundwater samples were found in the range of <4.0 mg/l to 20 mg/l; were found to be above the drinking water standard (4.0 mg/l), except GW-3.

The concentration of total suspended solids (TSS) in ground water were found in range of <2.5 mg/l to 49.0 mg/l. The TSS values in all the sampling locations were within the permissible limit (10 mg/l), except GW-2 (Islampur).

Arsenic, barium, copper, mercury, cadmium, nickel, zinc and vanadium contents in all ground water samples were found to be below detection limits and in compliance to the drinking water standard.

Iron is considered to be an important ground water parameter since at higher concentration it interferes with laundering operations and imparts objectionable stains. Concentration iron in ground water sample ranged from 0.1 mg/l to 16 mg/l. Iron concentration in all the samples were in compliance to the acceptable limit (0.3-1.0 mg/l) of drinking water standards excepting the sample collected from Islampur village (16 mg/l).

Organic pollutants like Total Petroleum Hydrocarbon (as TPH) contents were found to be below detection limit for all the samples.

Coliform are indicators of contamination from sewage and faecal matter. Total coliforms contents of all the samples were found to be <1.8 MPN/100 ml.

Table 4.13 Ground water monitoring results in the study area

Sl. No.	Parameters	Unit	Ganga Nagar	Islampur	Mongoler Gaon	Char Balaki
1	Aluminium (as Al)	mg/l	<0.01	<0.01	<0.01	<0.01
2	Arsenic(as As)	mg/l	<0.01	<0.01	<0.01	<0.01
3	Barium (as Ba)	mg/l	<0.05	<0.05	<0.05	<0.05
4	Biochemical Oxygen Demand (as BOD)	mg/l	<2.0	2.9	<2.0	<2.0
5	Cadmium (as Cd)	mg/l	<0.001	<0.001	<0.001	<0.001
6	Chemical Oxygen Demand (COD)	mg/l	6	20	<4.0	6
7	Colour	Hazen	<1.0	<1.0	<1.0	<1.0
8	Copper (as Cu)	mg/l	<0.02	<0.02	<0.02	<0.02
9	Dissolved Oxygen	mg/l	4.4	4.3	5.2	4.8
10	Iron (as Fe)	mg/l	1.0	16	0.1	0.1
11	Mercury (as Hg)	mg/l	<0.001	<0.001	<0.001	<0.001
12	Nickel (as Ni)	mg/l	<0.02	<0.02	<0.02	<0.02
13	Odour	---	unobjectionable	unobjectionable	unobjectionable	unobjectionable
14	Oil and Grease	mg/l	<1.4	<1.4	<1.4	<1.4
15	Salinity	---	0.72	0.28	0.41	0.76
16	Temperature	Deg C	23	24	24.8	25.4
17	Total Chromium (as Cr)	mg/l	<0.01	<0.01	<0.01	<0.01
18	Total Nitrogen (as N)	mg/l	0.7	8.4	1.7	3.6
19	Total Petroleum Hydrocarbon (as TPH)	mg/l	<0.001	<0.001	<0.001	<0.001
20	Total Phosphorus	mg/l	<0.05	0.37	<0.05	<0.05
21	Total Suspended Solid (as TSS)	mg/l	7	49	<2.5	2.8
22	Turbidity	N.T.U.	19	125	<1	6
23	Vanadium as V	mg/l	<0.2	<0.2	0.2	<0.2
24	Zinc (as Zn)	mg/l	0.08	0.012	0.03	0.07
25	pH value	---	6.8 at 23 deg c	7.1 at 24 deg c	6.75 at 24.8 deg c	7.2 at 25.4 deg c
26	Total coliform	MPN/100ml	< 1.8	< 1.8	< 1.8	1600

[Source: Primary Monitoring December 2017]

4.3.11 Climate and Meteorology

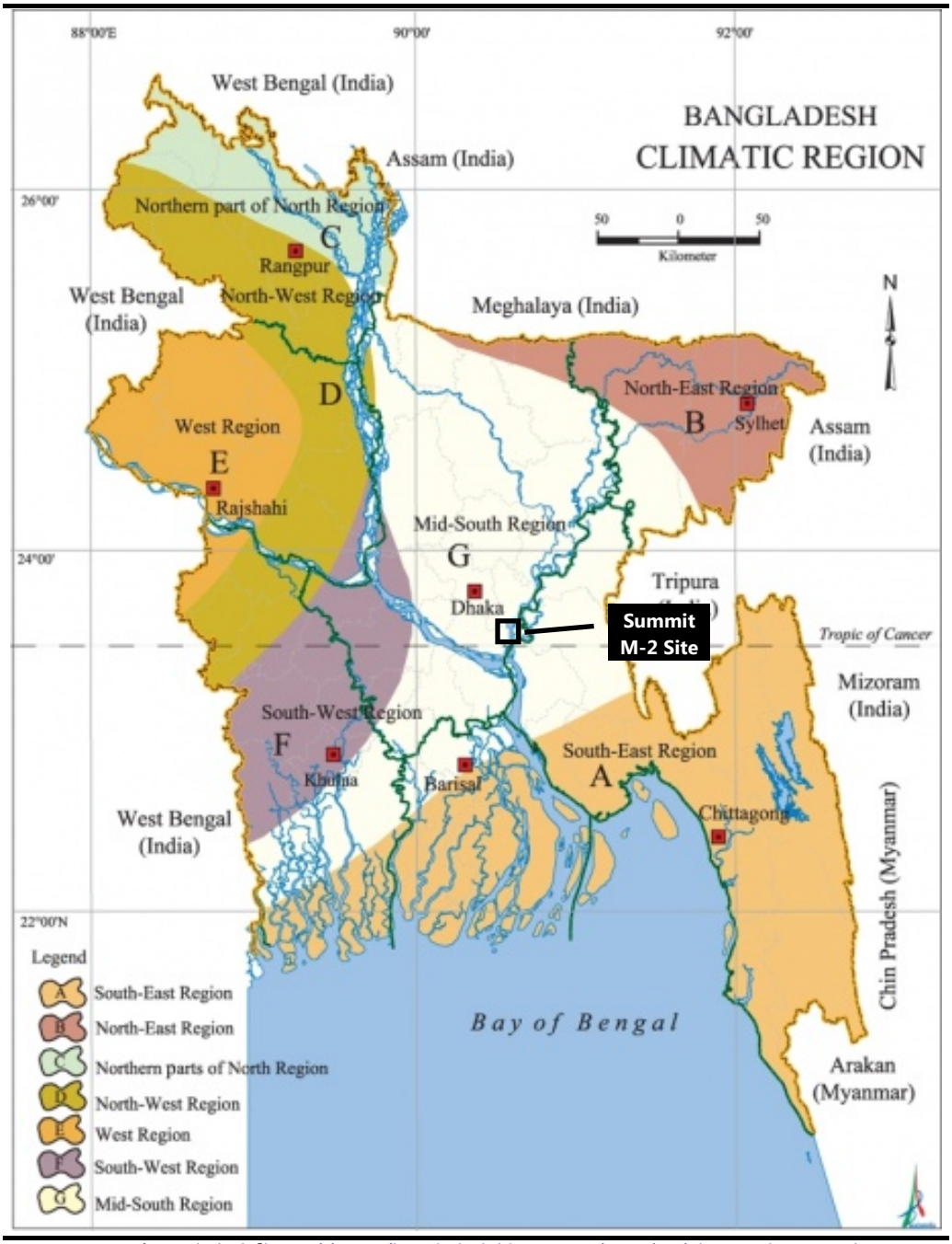
Climate

Bangladesh is located in the sub-tropical monsoon region and its climate is characterised by high temperature, heavy rainfall, often excessive humidity, and fairly marked seasonal variations. From the climatic point of view, three distinct seasons can be recognised in Bangladesh - the cool dry season from November through February, the pre-monsoon hot season from March through May, and the rainy monsoon season from May to October. January is the coolest month with temperatures averaging near 26°C and April the warmest with temperatures from 33 to 36°C. Most places receive more than 1,525 mm of rain a year, and areas near the hills receive 5,080 mm. Most rains occur during the monsoon (June-September) and little in winter (November-February). Moderate rains also reported in the months of March, April and October.

Climatic sub-regions of Bangladesh are presented in ***Figure 4.14*** and as per the same, the Narayanganj District falls in the Mid-South Zone. The nearest Bangladesh Meteorological Department (BMD) [1] meteorological station is at Dhaka City, which is about 25 km north of the Project site. The climatic conditions as recorded at Dhaka therefore can be considered applicable for the Project. To assess the climatic conditions of the area, climatology data has been obtained from Bangladesh Meteorological Department (BMD) for the period 1966 – 2011.

(1) [1] Bangladesh Meteorological Department is the authorised Government organisation for all meteorological activities in Bangladesh. It maintains a network of surface and upper air observatories, radar and satellite stations, agro-meteorological observatories, geomagnetic and seismological observatories and meteorological telecommunication system.

Figure 4.14 Climatic Sub-regions of Bangladesh

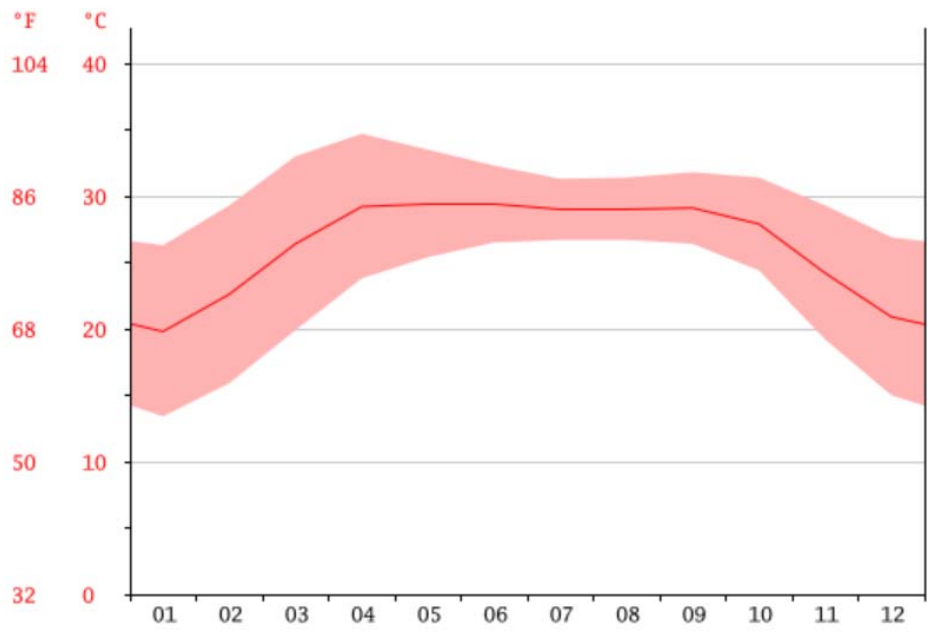


Source: Maps of Bangladesh [https://mapofbangladesh.blogspot.in/2012/01/climate-climatic-sub-regions.html]

Temperature

The mean monthly maximum and mean monthly minimum recorded over a period of 1961 to 2016 shows that mean monthly maximum temperature is experienced in May (29.4°C) and the mean monthly minimum temperature is experienced in January (19.8°C). The monthly temperature is presented in **Table 4.14** and **Figure 4.15.**

Figure 4.15 Graphical Representation - Temperature, Humidity & Rainfall at Dhaka



[Source: Bangladesh Meteorological Department, Dhaka Station]

Table 4.14 Climatic Data of the Dhaka Station (2016)

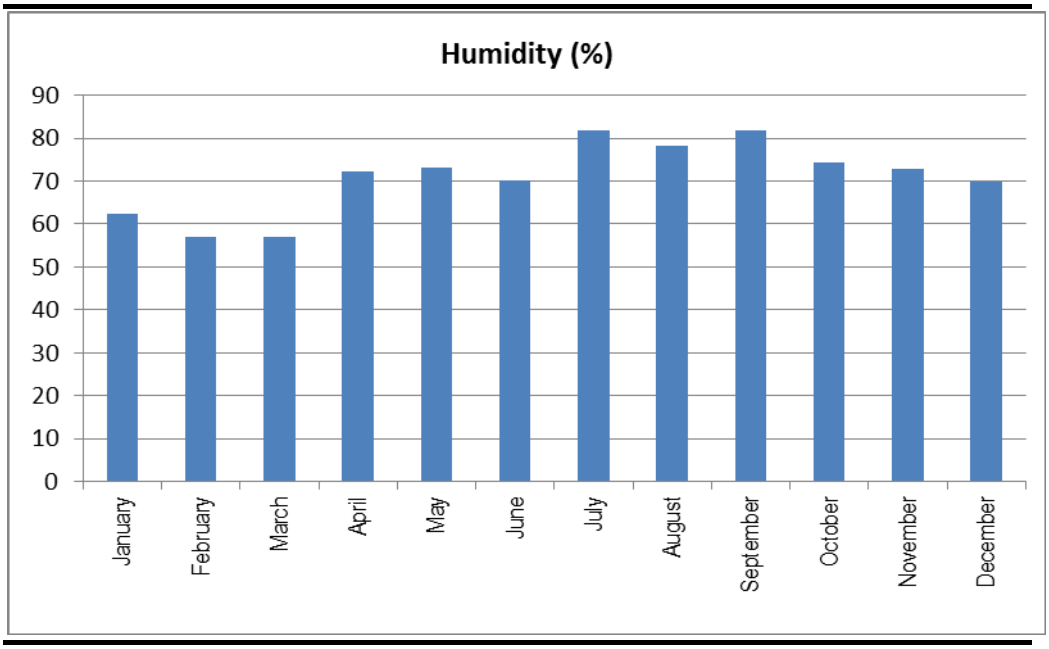
Month	Avg. Temperature (°C)	Rainfall (mm)	Humidity (%)	Wind Speed (km/h)
January	19.8	9	62.4	1.7
February	22.6	20	57.0	1.2
March	26.4	54	56.9	3.7
April	29.2	149	72.1	4.4
May	29.4	245	73.2	3.8
June	29.4	373	70.3	3.1
July	29.0	374	81.7	2.4
August	29.0	335	78.1	2.1
September	29.1	253	81.9	0.9
October	27.9	153	74.3	0.9
November	24.2	34	72.8	0.9
December	20.9	5	70.0	1.2

[Source: Bangladesh Meteorological Department, *Dhaka* Station]

Humidity

The relative average humidity varied between 56.9% (March) to 81.9% (September). The monthly relative humidity is presented in **Table 4.14.**

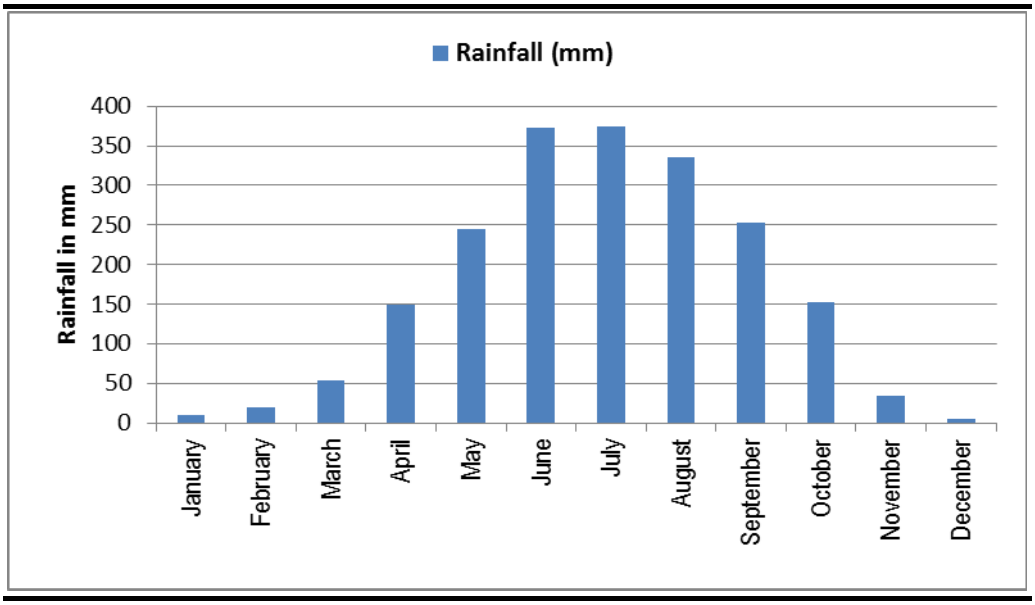
Figure 4.16 Monthly Humidity



Rainfall

Average annual rainfall in the Narayanganj district is about 2000 mm. January-March and November-December received very little rainfall. Rainfall was highest in June and July (373 and 374 mm respectively), followed by August (335.1mm), May (245 mm) and September (253 mm). The average monthly variation of rainfall is presented in **Figure 4.17.**

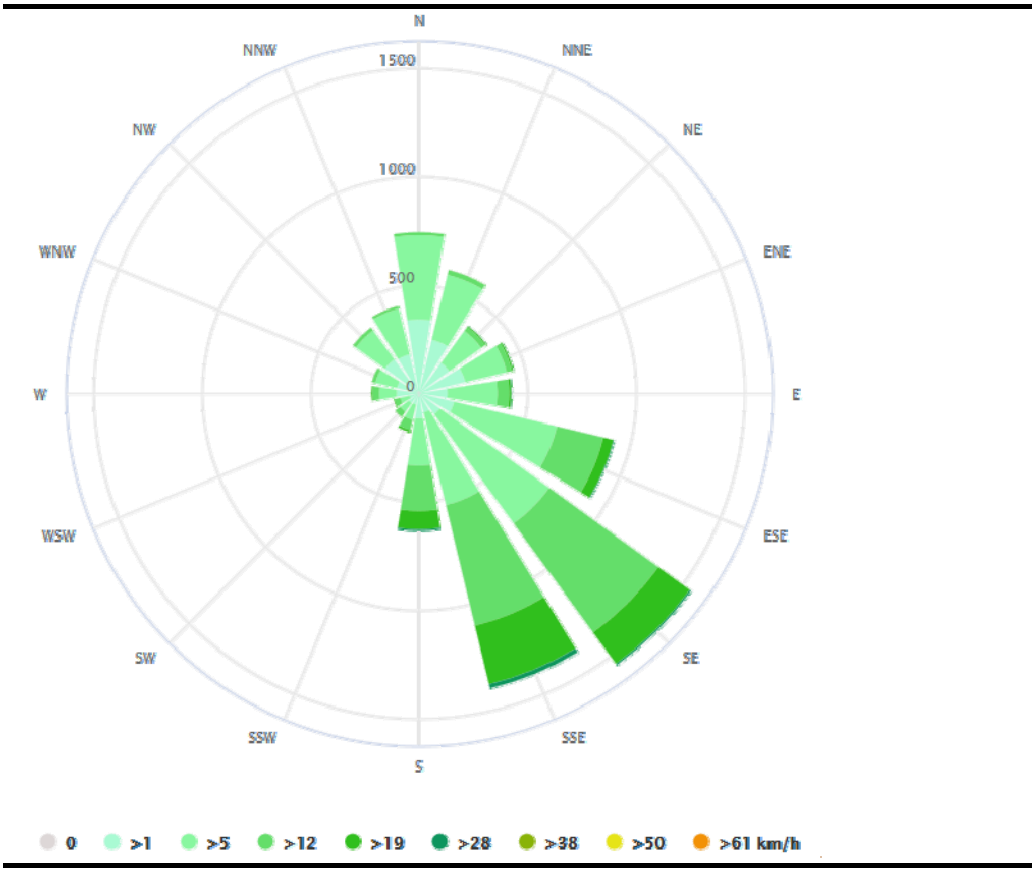
Figure 4.17 Monthly Rainfall



Wind Speed and Direction

The wind speed varied from 0.9 km/hr to 4.4 km/hr. The average wind speed during the period was 2.2 km/hr. The predominant wind direction of the study period is from south-east. Windrose diagram is presented in ***Figure 4.14***.

Figure 4.18 Wind Rose of Dhaka Station



Site Specific Meteorology

Site-specific micro-meteorological data has been collected for the study period (from December 2017 to January 2018), using an automatic weather monitoring station. The automatic weather monitoring station was installed at the rooftop of the fire station building of the Summit M1 plant at a height of about 10 m above the ground level, ensuring that there were no obstructions to the free flow of winds.

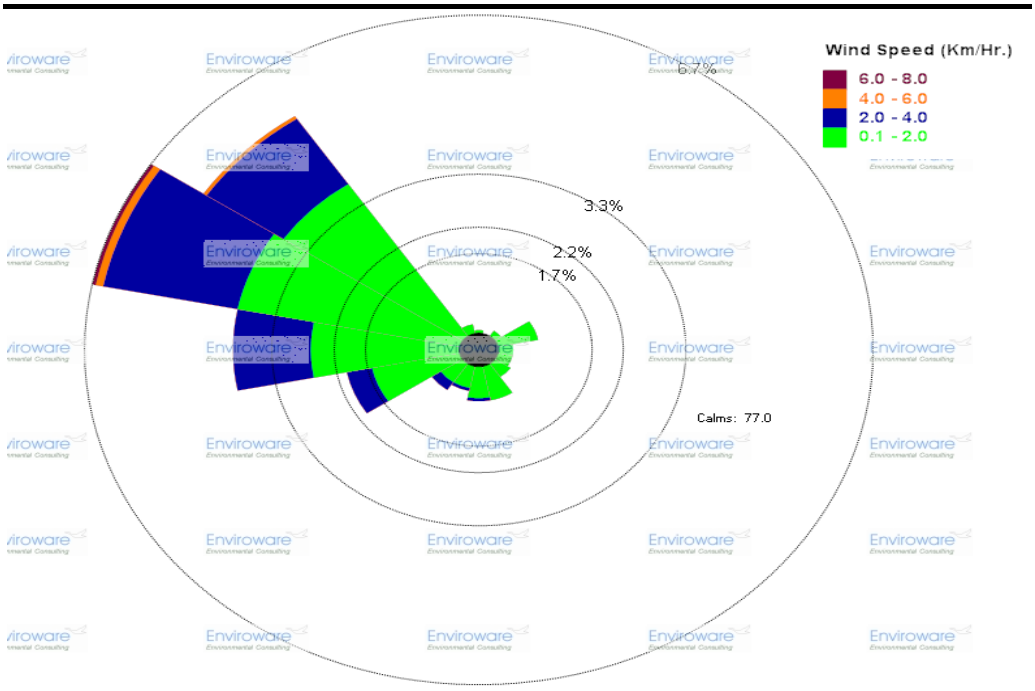
Summary of site specific meteorological observations during monitoring period (December 2017 – January 2018) are presented in Table 4.15 and wind rose diagram of the site during same period is shown in Figure 4.19. It is to be noted that during the winter season, majority of the time the wind is calm, which also results into poor dispersion conditions for air pollutants.

Table 4.15 Summary of Primary Meteorological Data Collected at Site

S. No.	Parameter	Maximum	Minimum	Average
1	Wind Speed	8 km/hr	0	0.4 km/hr
2	Temperature	28.8 °C	7.6 °C	18.9 °C
3	Humidity	99.8%	29.7%	78.8%
4	Precipitation	6 mm/hr	0 mm/hr	63.2 mm [1]

[1] Total rainfall during monitoring period

Figure 4.19 Windrose Diagram - Primary Baseline Monitoring Period



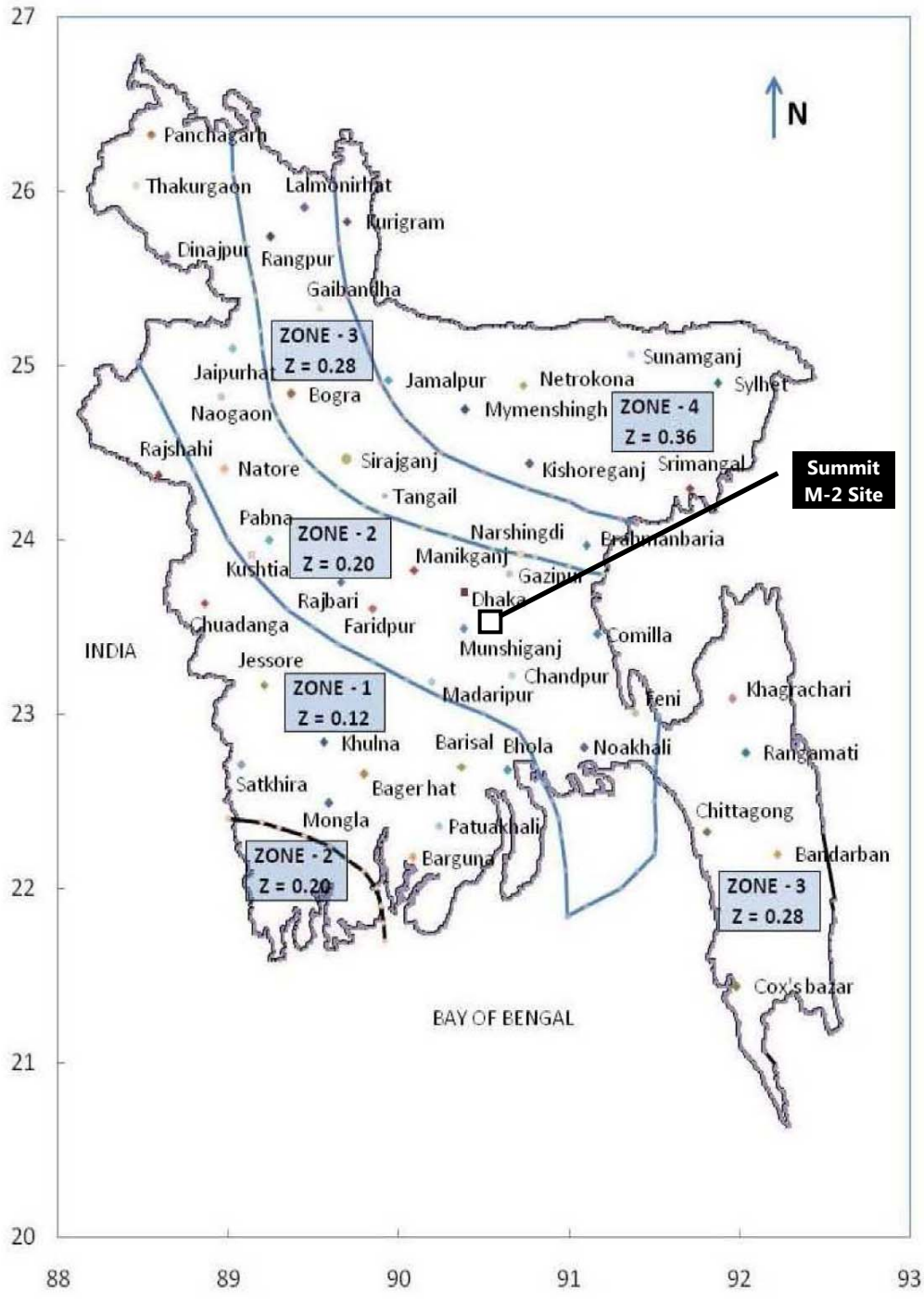
Source: Primary baseline during December 2017 and January 2018

4.3.12 *Natural Hazards*

Earthquakes

As per the Seismic Zoning Map of Bangladesh, the country is divided into four seismic zones and the design strength of buildings is stipulated in each seismic zone. The project site and study area is located in Seismic Zone II resulting in a basic seismic coefficient z of 0.20 (***Figure 4.20***). The Zone-II includes the greater districts of Dinajpur, Bogra, Dhaka, Narayanganj and Chittagong, where earthquake shock of maximum intensity of VIII of the Modified Mercalli Scale is possible.

Figure 4.20 Earthquake Zone Map of Bangladesh



Source: Geological Survey of Bangladesh (GSB) and Bangladesh National Building Code, 2015, prepared by Housing and Building Research Institute

Cyclones

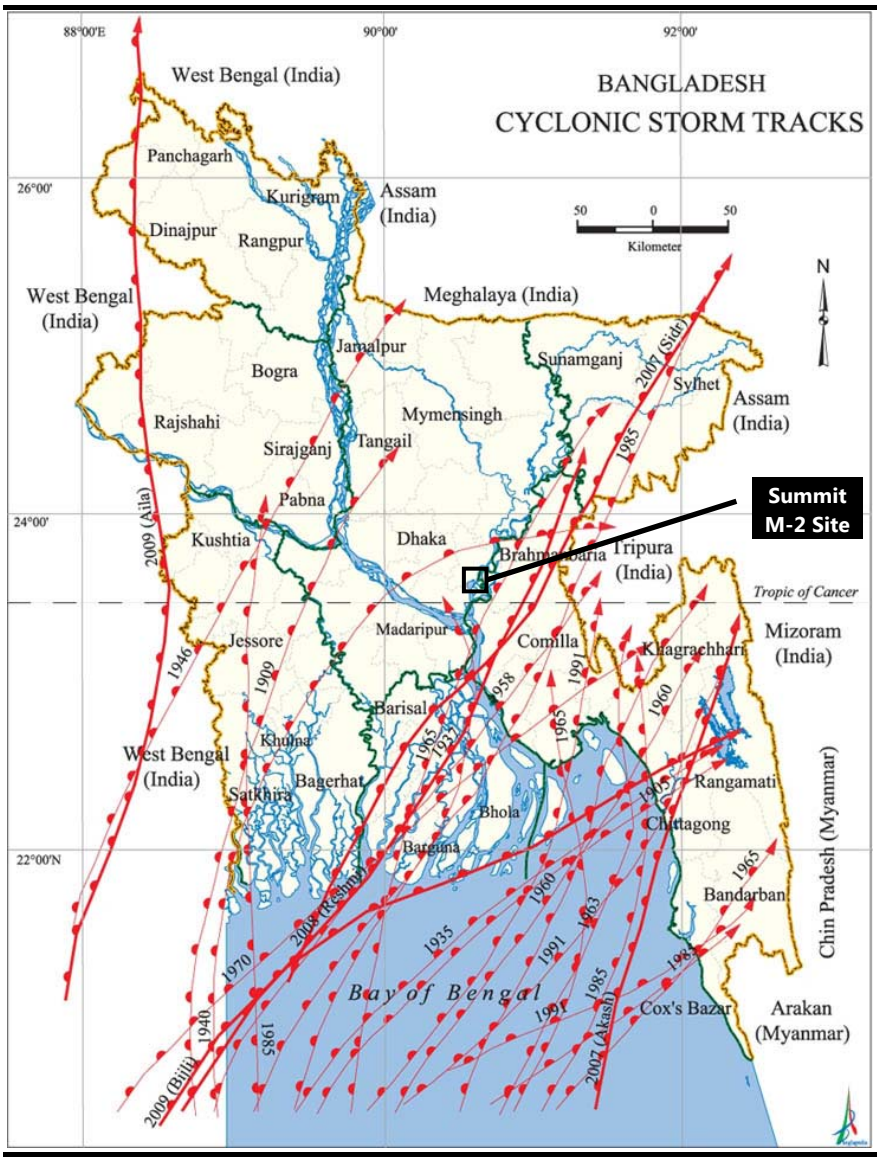
Devastating cyclones hit the coastal areas of Bangladesh almost every year usually accompanied by high-speed winds, sometimes reaching 250 km/hr or more and 3-10m high waves, causing extensive damage to life, property and livestock. Because of the funnel shaped coast, Bangladesh repeatedly becomes the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

the monsoon. The cyclonic storm tracks in Bangladesh have been shown in ***Figure 4.21***. The proposed project site is away from coastal area and cyclonic risk is very less.

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

- depression (winds upto 62 km/hr);
- cyclonic storm (winds from 63 to 87 km/hr);
- severe cyclonic storm (winds from 88 to 118 km/hr); and
- very severe cyclonic storm of hurricane intensity (winds above 118 km/hr).

Figure 4.21 Cyclonic Storm Tracks in Bangladesh

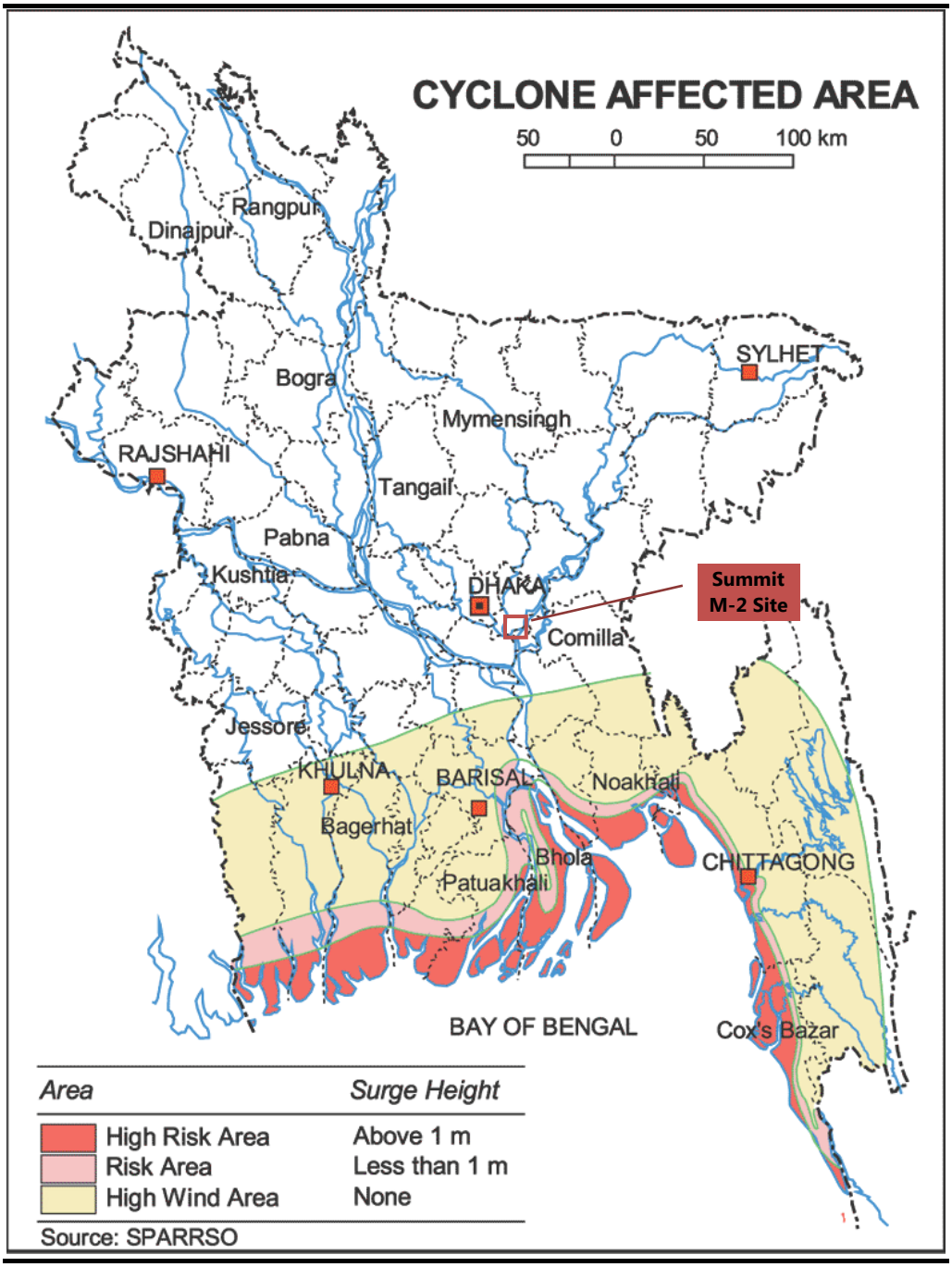


Source: Banglapedia [http://en.banglapedia.org/index.php?title=Cyclone]

Storm Surge

Figure 4.22 shows cyclone affected areas of Bangladesh. From the figure it is very clear that Meghnaghat area has no risk of storm surge.

Figure 4.22 Cyclone Affected Area Map of Bangladesh



Source: Bangladesh Space Research and Remote Sensing Organisation (SPARRSO)
Maps of Bangladesh
[https://mapofbangladesh.blogspot.in/2011/10/cyclone-affected-area-bangladesh.html]

Floods

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

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

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

Figure 4.10 shows the flood affected areas of Bangladesh. The Meghnaghat industrial area is not prone to flooding. The Project site is also not affected by flood waters. In order to avoid any flooding event, BPDB had developed the Meghnaghat Power Hub; the site was elevated to one meter above the 200 year highest flood level (HFL), which is +8.0 m Public Works Datum (PWD) or +7.54 m above the mean sea level (MSL). The highest flood levels in the project area were recorded at the Meghna Ferryghat gauge station (1.5 kilometres south-east of the project site) during the monsoons of 1998, 1988, and 1974 when flood elevations of +6.76 metres, +6.55 metres, and +6.19 metres PWD were respectively noted (EIA, Meghnaghat Power Project, 2001).

4.3.13 Air Environment

To understand the present condition in the Meghnaghat area, primary air quality monitoring as well as secondary data on air quality was collected.

Secondary Data

Ambient air quality monitoring results of various studies representing different seasons are presented below:

ESIA Study of Reliance Power Project, Meghnaghat

Ambient air quality monitoring was conducted from September to December 2016 at six locations, which are shown in Figure 4.23. The results indicated that almost all the parameters were within the national limits except the $PM_{2.5}$ and PM_{10} crossed the national standard on 23rd and 24th of November 2016 at 2 monitoring locations (Gowal Gaon and Vati Balaki). It was an exception and may be occurred due to any incidental reason. NOx was measured within a range of 3-17 µg/m^3 in different locations throughout the monitoring period.

Figure 4.23 Ambient Air Quality Monitoring Locations of Reliance Power Project

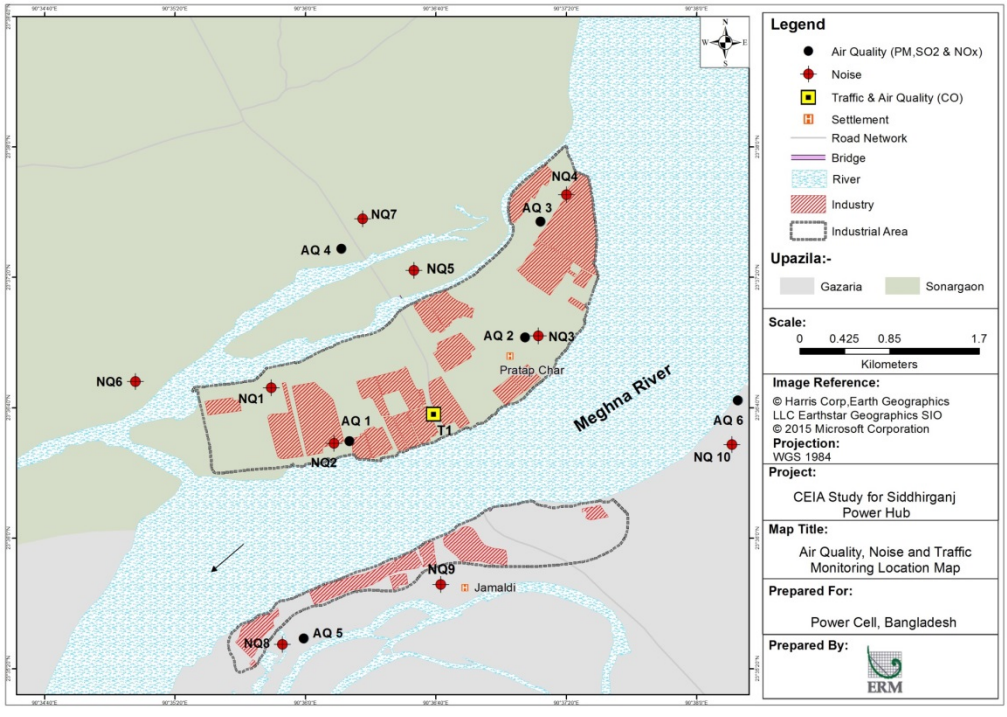


Source: ESIA Study of Reliance Power Project at Meghnaghat (2017)

CEIA Study of Meghnaghat Industrial Area

Ambient air quality monitoring was conducted from February to March 2016 at six locations, which are shown in Figure 4.24.

Figure 4.24 Map showing AQ Monitoring Locations - CEIA Study of Meghnaghat Region

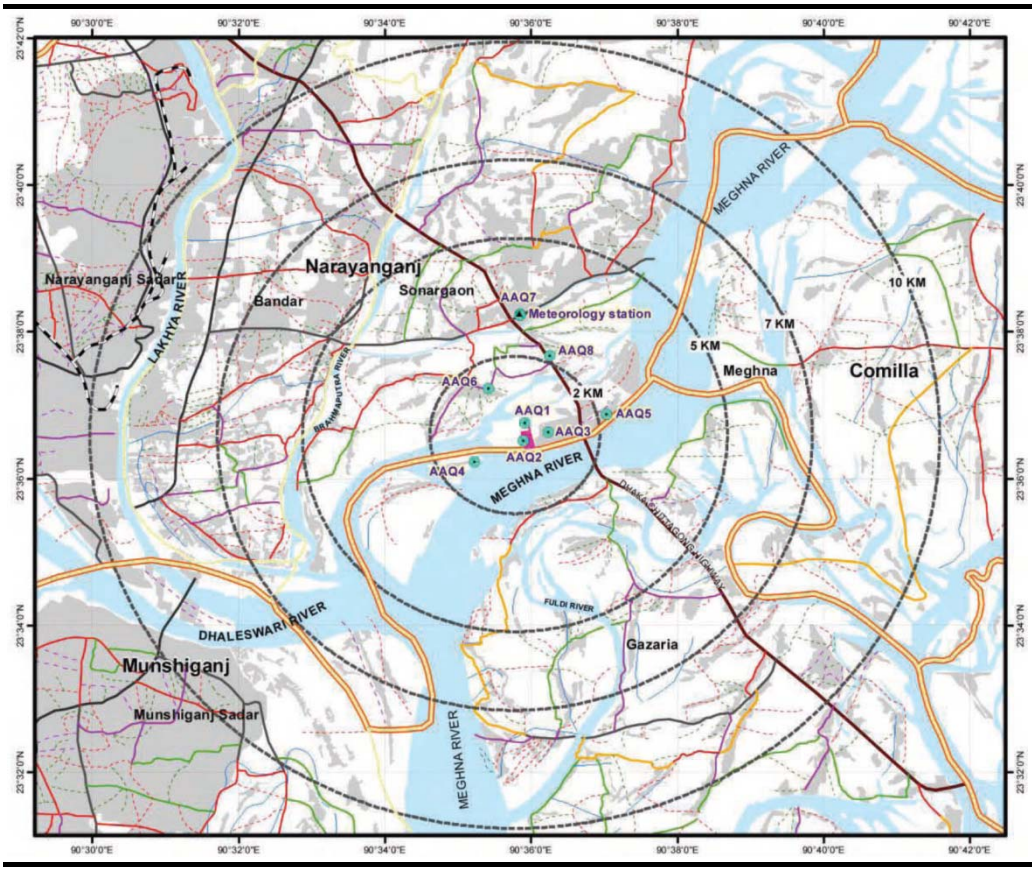


Source: CEIA Study of Meghnaghat Industrial Area (2016)

Particulate Matter (PM_{10} and $PM_{2.5}$): The PM concentrations in Meghnaghat Industrial area were well within the NAAQS. The concentration of $PM_{2.5}$ and PM_{10} varied from 20.5 µg/m³ to 58.3µg/m³ and 38.5 µg/m³ to 185.3 µg/m³ respectively; only at one of the locations (Islampur), the concentration of PM_{10}

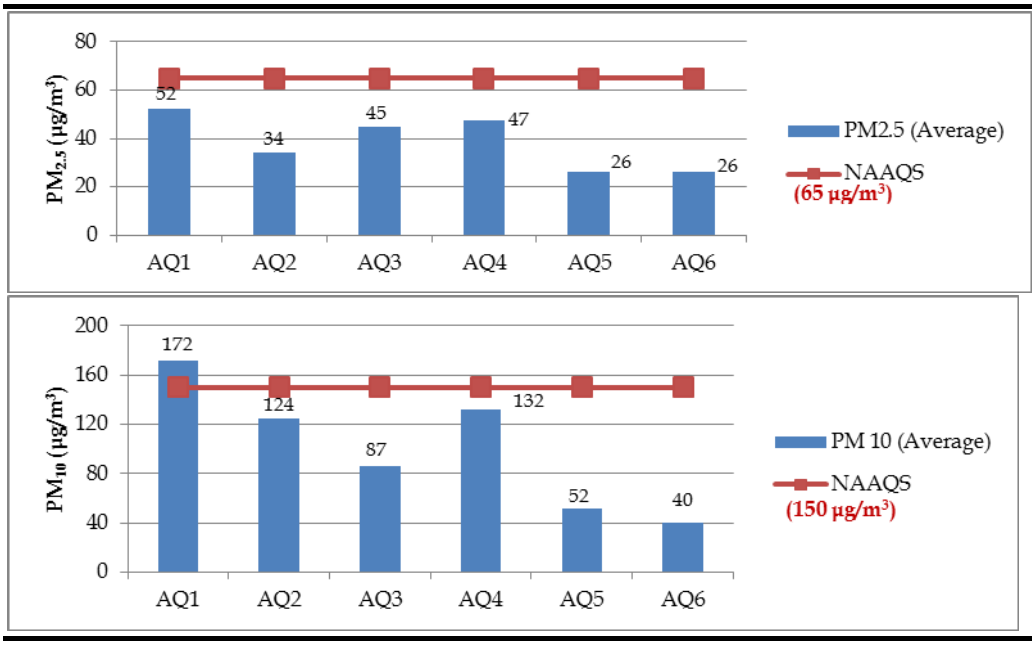
was higher than NAAQS, indicative of localised contribution from cement plant and other external factors like traffic. The station wise average PM concentration is presented in ***Figure 4.26***.

Figure 4.25 AQ Monitoring Network - ESIA Study of Summit M1 Project



Source: ESIA Study Report of Summit M1 Project (2012)

Figure 4.26 Station wise PM $_{2.5}$ and PM$_{10}$ Concentrations in Meghnaghat Industrial Area

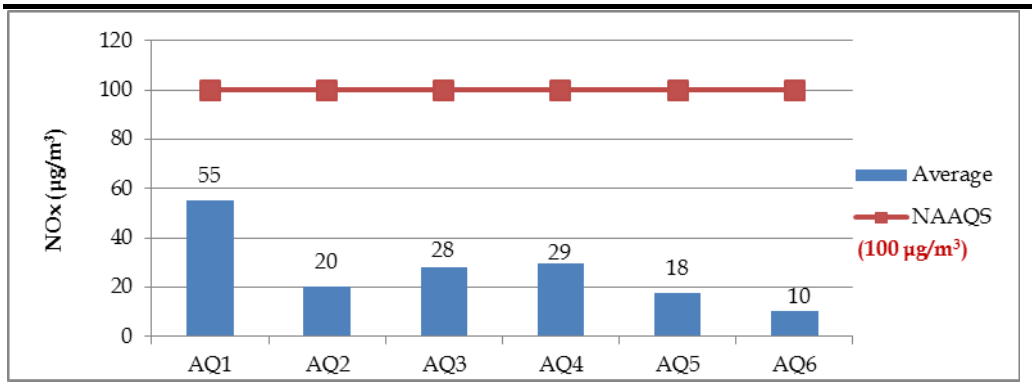


Trend of PM Concentration: The ambient air quality data monitored during 2012 in Meghnaghat Industrial area (*Source: ESIA of 305-350MW Dual Fuel Combined Cycle Power Plant Project at Meghnaghat)* reveals that PM_{10} concentrations were well below the NAAQS; i.e. less than 50 µg/m³, except for at one location near the Power Hub. The general trend clearly shows that PM concentration over the period has been increased.

NOx: The concentration of NOx in Meghnaghat industrial region varied from 9.4 µg/m³ to 52.3 µg/m³. In general, the NOx concentrations were not exceeding the NAAQS, however, at only one location (Islampur, close to the Meghnaghat Power Hub) NOx concentration were found to be higher in comparison to other locations (primarily due to contribution from the Meghnaghat Power hub). The location wise average NOx concentrations for the Meghnaghat area are presented in ***Figure 4.27.***

Trend of NOx Concentration: The ambient air quality data monitored in this region during 2012 (Source: ESIA of 305-350 MW Dual Fuel CCPP at Meghnaghat) indicates that that NOx concentration was well below the NAAQS; i.e. less than 100 µg/m³ (annual average). The general trend clearly shows that NOx concentration over the period has increased.

Figure 4.27 ***Location wise NOx Concentrations in the Meghnaghat Industrial Area***



SO_2: The concentration of SO_2 was varied from 3.5 µg/m³ to 23.59 µg/m³. The Concentration of SO_2 at all locations was observed to be within the prescribed NAAQS limits of 365µg/m³.

Primary Air Quality Monitoring

Ambient Air quality was monitored at 8 locations across the study area. The parameters studied were Suspended Particulate Matter (SPM), Particulate Matter (PM_{10} and $PM_{2.5}$), Oxides of Nitrogen (NOx), Sulfur dioxide (SO_2), Carbon Monoxide (CO), and Ozone (O_3) for once a week for eight weeks. Air quality monitoring locations were selected based on the following aspects covered in field survey plan developed prior to the field work:

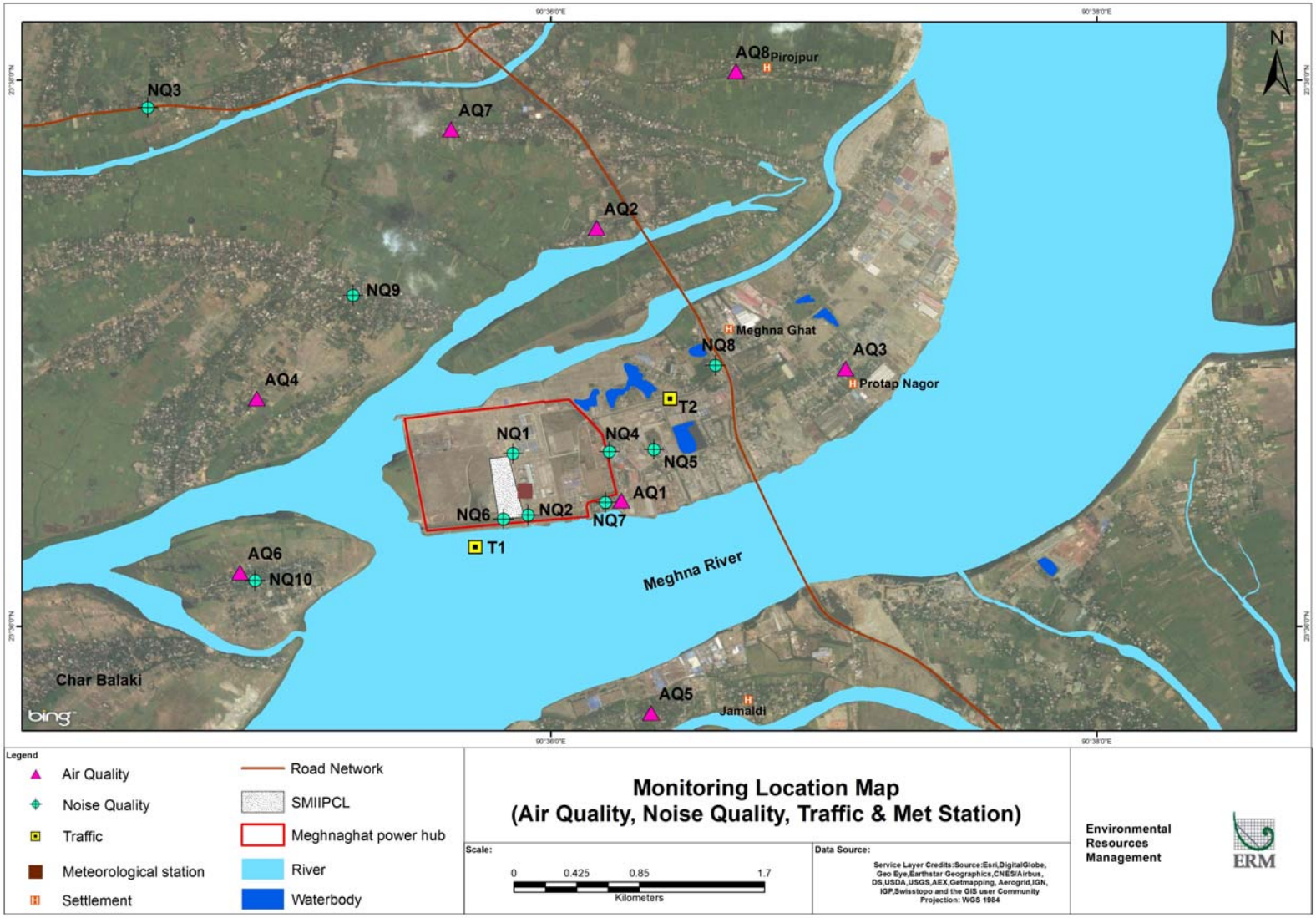
- Meteorological conditions of the area;
- Topography of the study area; and
- Location of sensitive receptors such as major settlements;

The justification for selection of the monitoring locations is given in Table 4.16. The location of ambient air quality monitoring station is presented in Figure 4.28.

Table 4.16 Air Monitoring Locations

Sl No	Location Number	Monitoring location Name	Geo-coordinates	Distance from Project site & Direction	Rationale for selection
1.	AAQ1	Islampur	23°36'27.52"N 90°36'11.07"E	0.65km; SE	Upwind direction. To understand the existing air quality of the Meghnaghat Power Hub area.
2.	AAQ2	Nayagoan	23°37'4.63"N 90°35'28.21"E	1.1 km; N	Downwind: To understand the existing air quality and assess the potential impact from proposed expansion project
3.	AAQ3	Pratapnagar	23°37'0.80"N 90°37'10.56"E	2.5 km; E	Crosswind: To understand the existing air quality
4.	AAQ4	Mongoler Gaon/ Dudhghat	23°36'46.28"N 90°34'46.93"E	1.8 km, NW	Crosswind: To understand the existing air quality
5.	AAQ5	Loshkordi-Husendi	23°35'36.66"N 90°36'23.33"E	2.0 km, South	Upwind direction. To understand the existing air quality of the Meghnaghat South Industrial Area.
6.	AAQ6	Char Balaki	23°36'7.27"N 90°34'47.51"E	1.8 km; W	Crosswind: To understand the existing air quality
7.	AAQ7	Mograpara	23°37'48.82"N 90°35'55.05"E	2.4 km; N	Downwind: To understand the existing air quality and assess the potential impact from proposed expansion
8.	AAQ8	Pirozpur	23°37'40.01"N 90°36'46.01"E	2.7 km, NE	Downwind: To understand the existing air quality and assess the potential impact from proposed expansion

Figure 4.28 Air, Noise Quality, Traffic Monitoring Location Map (Primary)

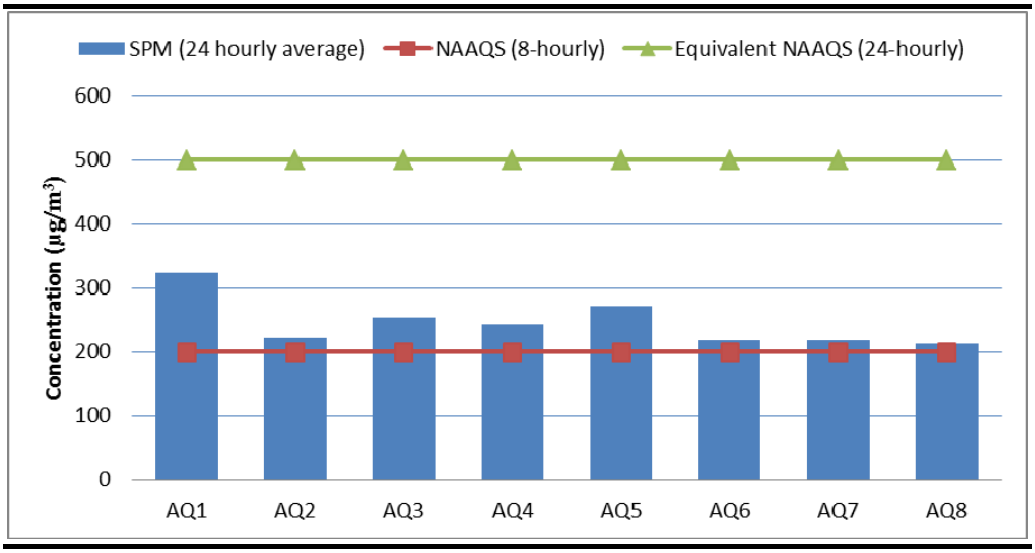


Interpretation of Monitoring Results

The monitoring results were compared with the National Ambient Air Quality Standards (NAAQS) and the interpretation is discussed in the following subsections. The summary of ambient air quality monitoring results is presented in Table 4.17.

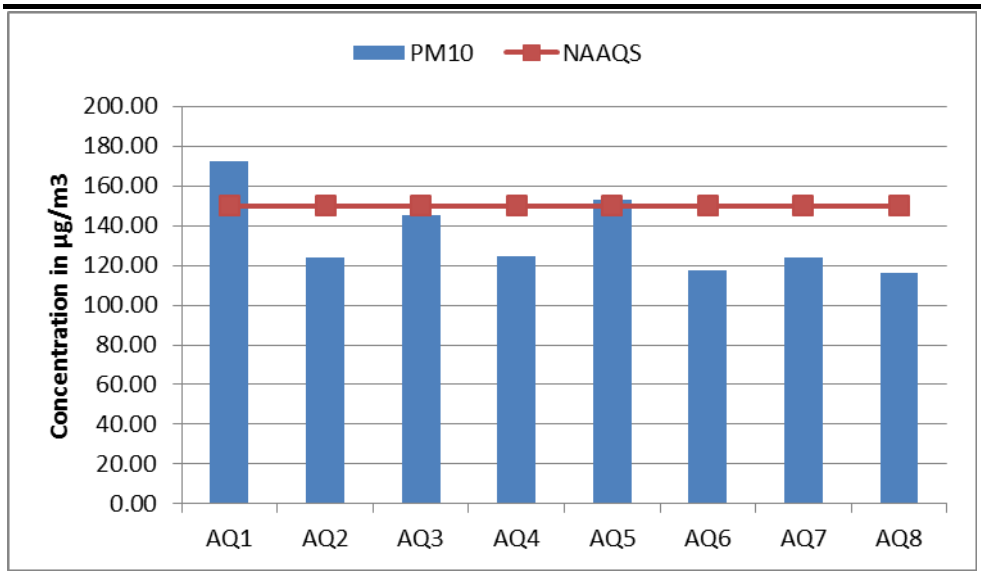
Suspended Particulate Matter (SPM): The 24 hourly average SPM concentrations in the monitoring locations ranged from 212.13 µg/m^3 (Pirozpur) to 323.13 µg/m^3 (Islampur). The average concentrations of SPM were observed well within the equivalent NAAQS (500 µg/m^3-24 hourly average) in all the monitoring locations. The higher concentration of SPM may due to emissions from industries (especially cement plants), construction activities and fugitive emission from degraded road network and vehicular emission in the study area. The variation of SPM is shown below in Figure 4.29.

Figure 4.29 Concentration of SPM in Study Area



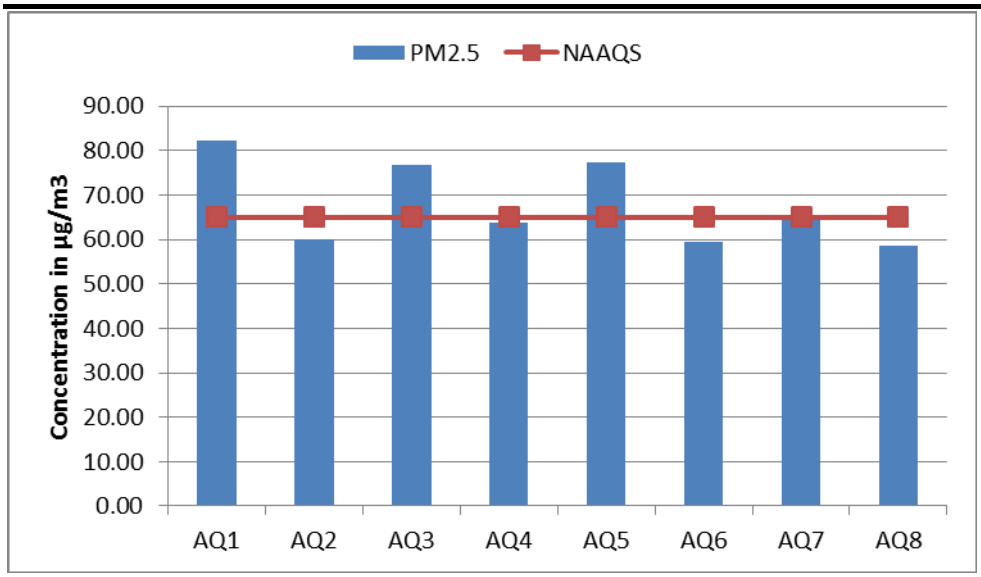
Particulate Matter (PM_{10}): The average PM_{10} concentration in the monitoring locations ranged from 117.25 µg/m^3 (Char Balaki) to 172.63 µg/m^3 (Islampur). The average concentration of PM_{10} was within the NAAQS (150 µg/m^3-24 hourly average) in all the monitoring locations except Islampur and Loshkordi-Husendi villages. The higher concentration of PM_{10} are mostly due to emissions from other industries (especially cement plants), and construction activities and fugitive emission from degraded road network and vehicular emission in the study area. The variation of PM_{10} is shown below in Figure 4.30.

Figure 4.30 Concentration of PM_{10} in Study Area



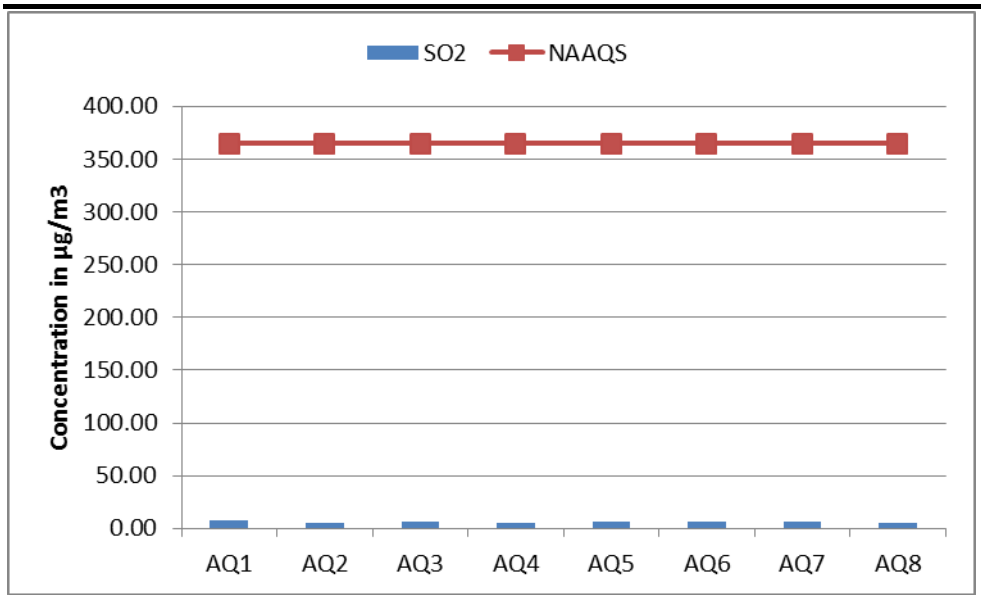
Particulate Matter ($PM_{2.5}$): The average $PM_{2.5}$ concentration in the monitoring locations ranged from 58.75 µg/m³ (Pirozpur) to 82.38 µg/m³ (Islampur). The average concentration of $PM_{2.5}$ was within the NAAQS (65 µg/m³-24 hourly average) in all the monitoring locations except Pratapnagar, Islampur, and Loshkordi-Husendi villages. The higher concentration of PM_{10} may due to emissions from industries (especially cement plants), construction activities and fugitive emission from degraded road network and vehicular emission in the study area. The variation of $PM_{2.5}$ is shown below in Figure 4.31.

Figure 4.31 Concentration of $PM_{2.5}$ in Study Area



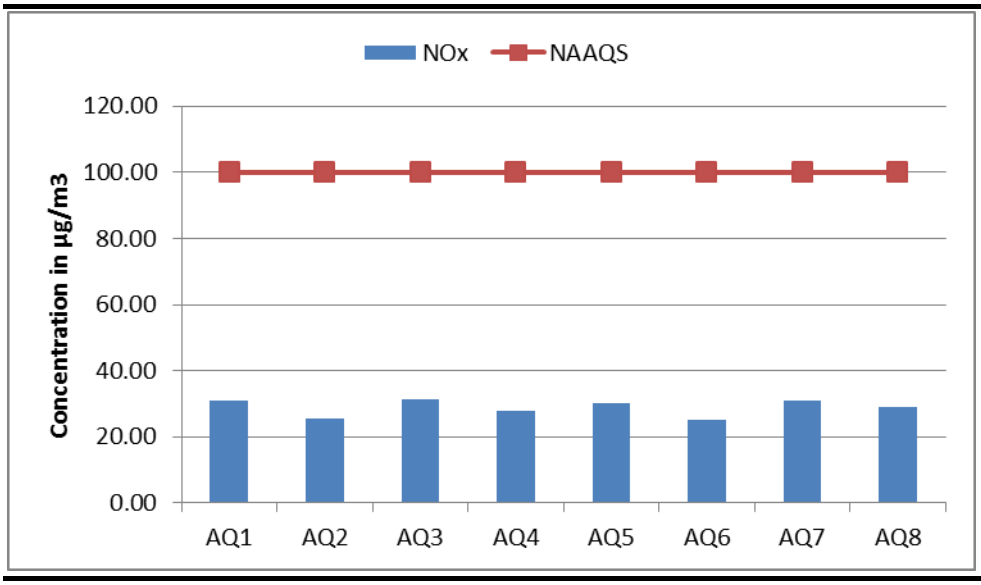
Sulphur Di-oxide (SO_2): The average SO_2 concentration in the monitoring locations ranged from 5.63 µg/m³ (Nayagoan) to 7.24 µg/m³ (Islampur). The average concentration of SO_2 was within the NAAQS (365 µg/m³-24 hourly average) in all the monitoring locations. The variation of SO_2 is shown below in Figure 4.32.

Figure 4.32 Concentration of SO_2 in Study Area



Oxides of Nitrogen (NOx): The average NOx concentration in the monitoring locations ranged from 25.09 µg/m³ (Nayagoan) to 31.34 µg/m³ (Pratapnagar). The average concentration of NOx was within the NAAQS (100 µg/m³-annual average) in all the monitoring locations. The variation of NOx is shown below in Figure 4.33.

Figure 4.33 Concentration of NOx in Study Area



Carbon Mono-oxides (CO): The average CO concentration in the monitoring locations ranged from 360 µg/m³ (Nayagoan and Char Balaki) to 724 µg/m³ (Islampur). The average concentration of CO was within the NAAQS (10,000 µg/m³-8 hourly average) in all the monitoring locations.

Ozone (O_3): The average **O_3** concentration in the monitoring locations ranged from 19.65 µg/m³ (Pirozpur) to 21.72 µg/m³ (Loshkordi-Husendi). The

average concentration of O_3 was within the NAAQS (157 µg/m^3-8 hourly average) in all the monitoring locations.

Table 4.17 Summary of Ambient Air Quality Monitoring Results

	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8
SPM in µg/m^3								
Maximum	485.00	254.00	385.00	345.00	388.00	269.00	320.00	275.00
Minimum	168.00	185.00	198.00	148.00	142.00	175.00	112.00	130.00
Average	323.13	221.13	253.25	243.50	271.50	218.13	218.50	212.13
98 Percentile	479.40	252.74	376.60	336.88	384.78	266.06	314.82	274.30
NAAQS (8-hourly)	***200***	***200***	***200***	***200***	***200***	***200***	***200***	***200***
Equivalent NAAQS (24-hourly)	***500***	***500***	***500***	***500***	***500***	***500***	***500***	***500***
PM_{10} in µg/m^3								
Maximum	275.00	149.00	230.00	152.00	216.00	143.00	183.00	143.00
Minimum	74.00	89.00	98.00	87.00	76.00	89.00	53.00	61.00
Average	172.63	123.75	145.38	124.75	153.25	117.25	124.25	116.00
98 Percentile	267.72	148.86	222.02	151.44	213.76	142.02	178.80	142.86
NAAQS	***150***	***150***	***150***	***150***	***150***	***150***	***150***	***150***
$PM_{2.5}$ in µg/m^3								
Maximum	124.00	72.00	116.00	79.00	111.00	68.00	100.00	75.00
Minimum	36.00	44.00	50.00	46.00	43.00	46.00	35.00	27.00
Average	82.38	60.13	76.88	63.75	77.38	59.50	64.88	58.75
98 Percentile	122.32	71.44	114.04	78.30	108.62	67.86	96.64	74.58
NAAQS	***65***	***65***	***65***	***65***	***65***	***65***	***65***	***65***
NO_2 in µg/m^3								
Maximum	37.50	33.00	38.70	35.20	37.50	31.20	38.60	36.60
Minimum	24.50	18.50	25.20	16.60	23.30	18.50	20.20	19.60
Average	31.05	25.39	31.34	28.01	30.01	25.09	30.98	29.11
98 Percentile	37.23	32.61	38.11	34.78	36.76	31.06	38.32	36.26
NAAQS	***100***	***100***	***100***	***100***	***100***	***100***	***100***	***100***
SO_2 in µg/m^3								
Maximum	9.20	7.20	8.20	7.20	8.50	7.20	8.50	7.60
Minimum	6.00	4.50	4.50	4.20	4.50	4.20	4.20	4.50
Average	7.24	5.63	6.36	5.68	6.41	6.06	6.00	5.65
98 Percentile	9.06	7.12	8.10	7.07	8.43	7.20	8.32	7.42
NAAQS	***365***	***365***	***365***	***365***	***365***	***365***	***365***	***365***
CO in mg/m^3								
Maximum	0.85	0.66	0.77	0.62	0.67	0.58	0.78	0.66
Minimum	0.32	0.15	0.26	0.25	0.42	0.21	0.33	0.25
Average	0.57	0.36	0.51	0.47	0.54	0.36	0.58	0.47
98 Percentile	0.85	0.65	0.75	0.62	0.67	0.57	0.77	0.65
NAAQS	***10***	***10***	***10***	***10***	***10***	***10***	***10***	***10***
Ozone in µg/m^3								
Maximum	24.20	25.50	23.20	23.30	26.60	23.30	21.20	24.20
Minimum	15.50	17.80	18.50	16.60	18.50	16.60	19.60	16.60
Average	20.17	20.63	20.00	20.58	21.72	20.37	20.13	19.65
98 Percentile	24.11	25.22	22.98	23.30	26.36	23.22	21.14	24.02
NAAQS	***157***	***157***	***157***	***157***	***157***	***157***	***157***	***157***

[Source: Primary Monitoring, December 2017-January 2018]

Note: SPM results presented here are 24 hourly averages, whereas the applicable standard is for 8 hourly averages. Therefore, equivalent NAAQS for 24 hourly average has been considered as 500 µg/m^3.

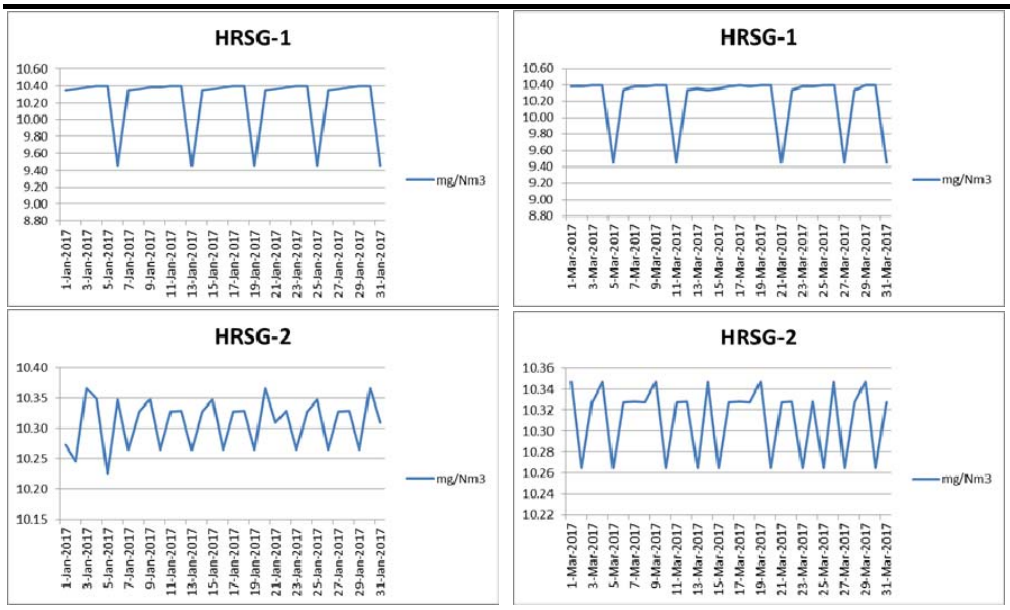
Table 4.18 Comparative Analysis of Air Quality in Meghnaghat Area

Parameter	ESIA of Summit M2: (Dec. 2017)	Regular Monitoring carried out by Summit, Jan 2017	Reliance Power, ESIA Study (Sep – Dec 2016)	CEIA Study, 2016 (Meghnaghat Area)	ESIA Study of Summit M1 Project (Mar – Jun 2012)	National Standards (ECR, 97)
PM_{10} (µg /m^3)	117.25-172.63	21.3 to 118.8	28.6 – 197	34.1 - 167	9.1 – 280.1	150 (24-hr)
$PM_{2.5}$ (µg /m^3)	58.75-82.38	14.8 to 55.9	17 – 90.2	22.7 – 41.1	7.3 – 40.1	65 (24-hr)
SOx (µg /m^3)	5.63-7.24	2.0 to 25.0	4.1 – 13.1	3.5 – 23.59	<4.0 – 10.7	365 (24-hr)
NOx (µg /m^3)	25.09-31.34	4.0 to 50.3	4.8 – 15.7	9.4 – 52.30	4.9 – 34.8	100 (Annual)

The results clearly indicate that the airshed is non-degraded for gaseous pollutants but degraded for particulate matters. Most of the pollutants [except particulate matter at few locations (AQ1, AQ3 and AQ5) close to the industrial sources like cement plants and other industries as well as near the roads with heavy traffic and poor road conditions, which result into resuspension of dust] were observed meeting the applicable national standards.

Summit M-2 project is primarily based in RLNG as fuel, which will be having very low particulate emission. However, secondary fuel is HSD and guaranteed emissions for that are of the order of 50 mg/Nm^3. In order to check the trend of PM emission from Summit M-1 project, which is currently running with HSD as fuel and have guaranteed emission as 50 mg/Nm3, previous third party stack monitoring reports as well as CEMS emission data was reviewed. The analysis of CEMS data as presented in Figure 4.34 and third party stack monitoring data indicated that the PM emissions are always below 11 mg/Nm^3 from both the stacks connected with HRSG 1 and 2. Considering that Summit M-2 project will use same HSD fuel, the emission levels can be maintained below 30 mg/Nm^3 during plant operations with 60% or higher load.

Figure 4.34 PM Emission Monitoring Data of Summit M-1 Project (with HSD as fuel)



4.3.14 *Noise Environment*

The major noise generating sources in the study area have been identified as industrial activities, commercial and anthropogenic activities and traffic plying along transport corridors. Industries generating high noise levels include power plants, cement plants, etc. For such industries the noise generation sources are generally housed within industrial buildings and equipped with acoustic control measures. Other industries like shipyards act as noise generation sources from open work areas. In addition the noise from the traffic plying on the major arterial roads (like Dhaka Chittagong Highway) and other internal roads is also contributing to the overall noise in the region.

To understand the baseline noise level in the study area, primary noise quality monitoring as well as secondary data on noise quality was collected.

Secondary Data

CEIA Study

During the CEIA study the noise level was assessed through 24 hourly noise data was collected in ten (10) locations. In addition hourly noise data was also collected from (20) locations in Meghnaghat Industrial area. Details of noise monitoring locations within the study area are shown in ***Figure 4.35***.

The day time level varies from 51.9 dB(A) to 61.8 dB(A), which was well within National Ambient Noise Standard for industrial area 75 dB(A). The night time level varied from 44.8 dB(A) to 56.5 dB(A), which also well within National Standard for industrial area 70 dB(A).

However, on comparison with Ambient Noise Standards for Mixed Zone, at three locations the monitored noise levels were found to exceed both Day

Time [60 dB(A)] whereas at six locations the noise levels were found to exceed the Night Time [50 dB(A)] Noise Standards.

The hourly noise level during day time was 45.2 to 61.3 dB(A) and night time noise level was 50.3 to 68.2 dB(A).

Primary Noise Quality

The primary noise quality was monitored in 10 locations. The monitoring location details is presented in Table 4.19 and Figure 4.28. The 24-hour baseline noise monitoring was conducted by using the portable sound meter (Lutron, SL-0423SD, unit: dB(A)). Noise level (LAeq) were measured and recorded at a ten-minute interval and averaged at an hourly and daily (i.e. 24-hour) interval using the following formula:

LAeq = 10*Log $_{10}$(Average (10^ ((X)/10))) where X is measured noise in dB(A).

Figure 4.35 Noise Quality Monitoring Location during CEIA Study

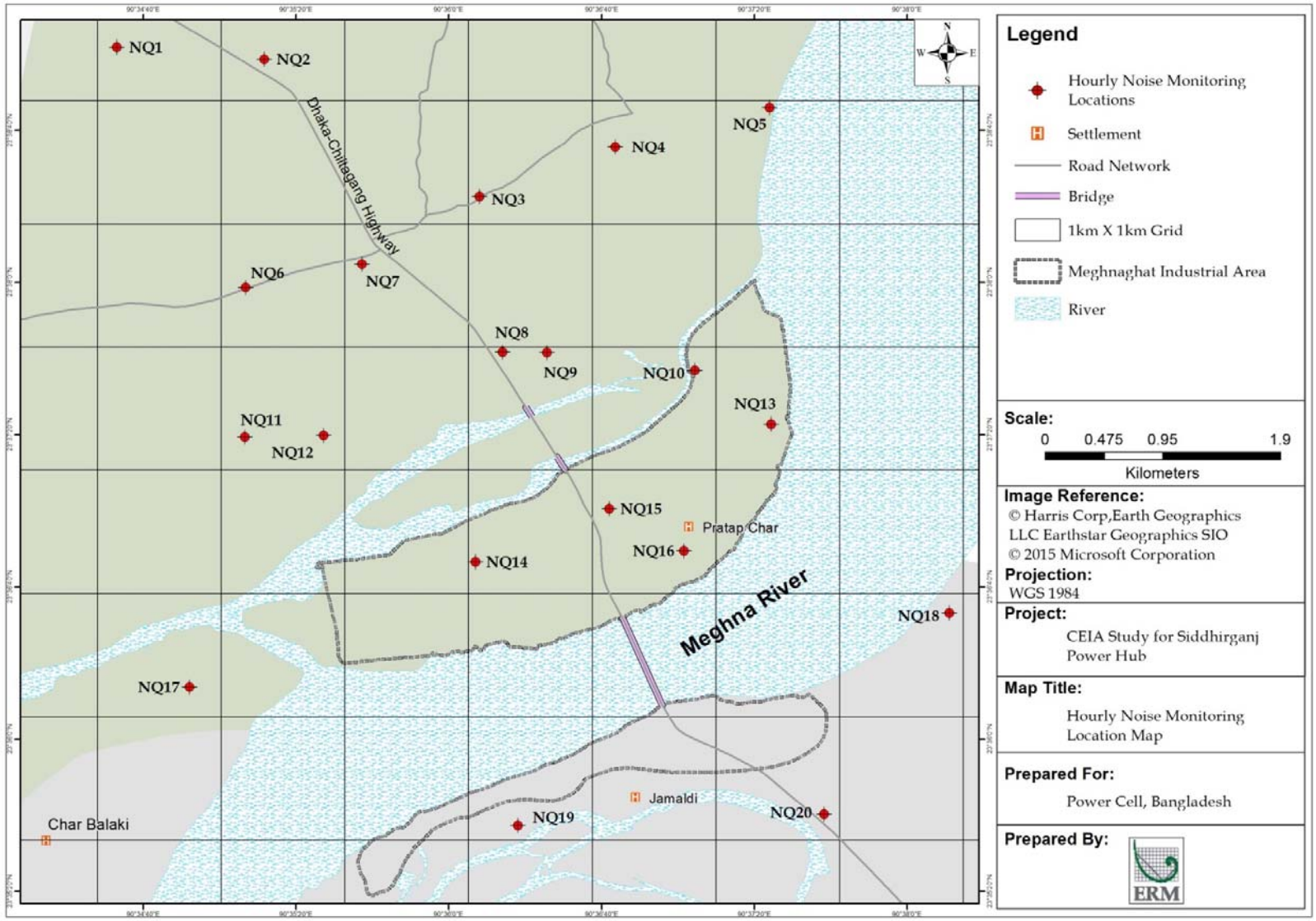


Table 4.19 Primary Noise Monitoring Locations

Stn. Code	Sampling location	Category of Area/ Receptor	Geo-coordinates	Selection Criteria
NQ1	Northern side of Project Area; near GTCL	Industrial	23°36'37.9"N 90°35'51.7"E	Baseline noise level and assess the potential impact during construction and operational phase.
NQ2	Northern side of Project Area; Near Summit Watch Tower	Industrial	23°36'24.5"N 90°35'55.0"E	Baseline noise level and assess the potential impact during construction and operational phase.
NQ3	Mugrapara	Residential	23°37'54.0"N 90°34'31.4"E	Baseline noise level and assess the potential impact from plant.
NQ4	Ganganagar	Industrial	23°36'38.3"N 90°36'12.9"E	Baseline noise level and assess the potential impact during construction and operational phase.
NQ5	Eastern side of Power Hub	Industrial	23°36'38.8"N 90°36'22.7"E	Baseline noise level and assess the potential impact during construction and operational phase.
NQ6	Southern Side of the Power Hub	Industrial	23°36'23.6"N 90°35'49.6"E	Baseline noise level and assess the potential impact during construction and operational phase.
NQ7	Islampur Village*	Mixed Zone	23°36'27.3"N 90°36'12.0"E	Baseline noise level and assess the potential impact during construction and operational phase.
NQ8	New Town*	Mixed Zone	23°36'57.3"N 90°36'36.2"E	Baseline noise level and assess the potential impact from plant and traffic
NQ-9	Mongoler Gaon/ Dudhghata	Residential	23°37'12.7"N 90°35'16.5"E	Baseline noise level.
NQ-10	Charbalaki village	Residential	23°36'10.1"N 90°34'55.0"E	Baseline noise level.

* Both Islampur and New Town are the residential areas well within the Meghnaghat Industrial Area as well as other commercial activities and therefore these are considered under mixed zone category.

Noise Monitoring Results

Power Hub & Meghnaghat Industrial Area:

The daytime equivalent noise levels monitored at different locations in Meghnaghat Power Hub ranged between 59.4 to 71.2 dB(A) and the night time equivalent noise levels ranged between 53.4 to 64.6 dB(A). The day and night time equivalent noise levels at all the monitored locations in the industrial zone were in compliance to the National Ambient Noise Standard day time and night time noise standards [75dB(A) and 70 dB(A) respectively] for industrial area.

Mixed Zone

The daytime equivalent noise levels in the mixed zone were found to be 61.3 dB(A) and 69.8 dB(A). The nigh time equivalent noise levels in the mixed zone were found to be 49.7 dB(A) and 60.9 dB(A). The higher noise level in New Town area may be due to traffic in the NH. The day time and night time equivalent noise levels at the station was in compliance to the National Ambient Noise Standard day time and night time noise standards [60dB(A) and 50 dB(A) respectively] for mixed zone.

Residential Area:

The daytime equivalent noise levels in the residential area were found to be 57.5 dB(A) and 59.5 dB(A). The nigh time equivalent noise levels in the residential area were found to be 46.9 dB(A) and 48.9 dB(A). The day time and night time equivalent noise levels at the station was higher in compliance to the National Ambient Noise Standard day time and night time noise standards [50dB(A) and 40 dB(A) respectively] for residential area.

The station wise day time and night time noise is presented in Table 4.20.

Table 4.20 Ambient Noise Quality in the Study Area

Stn Code	Sampling Location	Leq Day (dBA)	Leq Night (dBA)	Applicable Standard Leq (dBA)	
				Day	Night
NQ1	Northern side of Project Area; near GTCL	66.1	58.0	75	70
NQ2	Northern side of Project Area; Near Summit Watch Tower	71.2	64.6	75	70
NQ3	Mugrapara	57.5	48.3	55	45
NQ4	Ganganagar	58.2	48.7	75	70
NQ5	Eastern side of Power Hub	59.4	53.4	75	70
NQ6	Southern Side of the Power Hub	65.5	59.8	75	70
NQ7	Islampur Village	61.3	49.7	60	50
NQ8	New Town	69.8	60.9	60	50
NQ-9	Mongoler Gaon/ Dudhghata	59.5	46.9	55	45
NQ-10	Charbalaki village	57.8	48.3	55	45

[Source: Primary Monitoring December 2017 & January 2018]

4.3.15 Road & Traffic

Meghnaghat industrial area can be accessed through Dhaka-Chittagong Highway. Meghna Rivers are important waterways for this industrial area. The Meghnaghat Power Hub is connected with Dhaka-Chittagong Highway through a dedicated road to Power hub. This road is also used by residence of Ganganagar village.

To understand the traffic load and emissions from the road/water way traffic, a survey was conducted at Power Hub Access Road and Meghna River near South-Western side of the Power Hub. To understand the traffic load of Dhaka-Chittagong Highway secondary data also compared from CEIA study traffic monitoring data collected near Tool Plaza.

Present Condition of Traffic Load

The traffic survey was conducted continuously for 24 hours, once during the study period. The traffic survey was conducted for both way movement of vehicles and categorized as heavy vehicles (heavy truck/ trailer/ container/8 or more axels), medium vehicle (small truck, big bus, mini bus, micro bus), light vehicle (car, auto rickshaw, utility, motor cycle). A summary of traffic survey results is presented in Table 4.21.

Table 4.21 Status of Road and River Traffic

Description	Power Hub Access Road	Dhaka-Chittagong Highway	River Traffic- Meghna River	
Heavy Motor Vehicle (Truck, Bus, Dumper, Tanker, Trailer)	190	-	Goods Ship, Oil Tanker. Big Cargo	90
Light Motor Vehicles (Car, Jeep, Van, Metador, Tractor, Tempo, Mini Bus)	241	-	Mini Ship, Big Troller, Small Cargo	96
Two/Three Wheelers (Scooter, Motor Cycle, Auto, Moped)	1103	-	Speed Boat, Public Transport Boat, Small Troller,	124
Non-Motorised Vehicles (Bicycle, Tricycle)	263	-	Non-Motorized (Hand Puller Fishing Boat)	122
Total traffic volume	1797	19588*	Total	432
Total PCU (Nos.)/24 Hours (To & From)	1841			
Average PCU Flow/Hr	77	816*		18
Max PCU (Nos)/Hr	194	1658*		34
Min PCU (Nos)/Hr	0	91*		0
Minimum PCU Hours	00.00 to 04.00	04.00-05.00		01.00 to 02.00
Maximum PCU Hours	14.00 to 15.00	15.00-16.00		11.00 to 12.00

[* traffic volume]

Interpretation of Traffic Survey Results

Road Traffic

Total 1841 PCU was recorded at the traffic monitoring station. As per observation made for traffic density, on an average 77 PCU was recorded at this location. It was also noticed that major contributor (47.9%) of the vehicular traffic was two/three wheelers followed by Heavy motor vehicles (36.12%). Light vehicles contributed 13.09% of the total density while contribution of non-motorizes vehicle like bicycle, tricycle etc. towards total vehicular traffic was fewer.

River Traffic

The river traffic survey was conducted continuously for 24 hours, one time during the study period at one location along the Meghna river. The river

traffic survey was done for both way movement of vessels and categorized as Boat, Barge, Container Vessel and Launch. A summary of river traffic survey results is presented in Table 4.21.

4.4 ECOLOGICAL ENVIRONMENT

4.4.1 Introduction

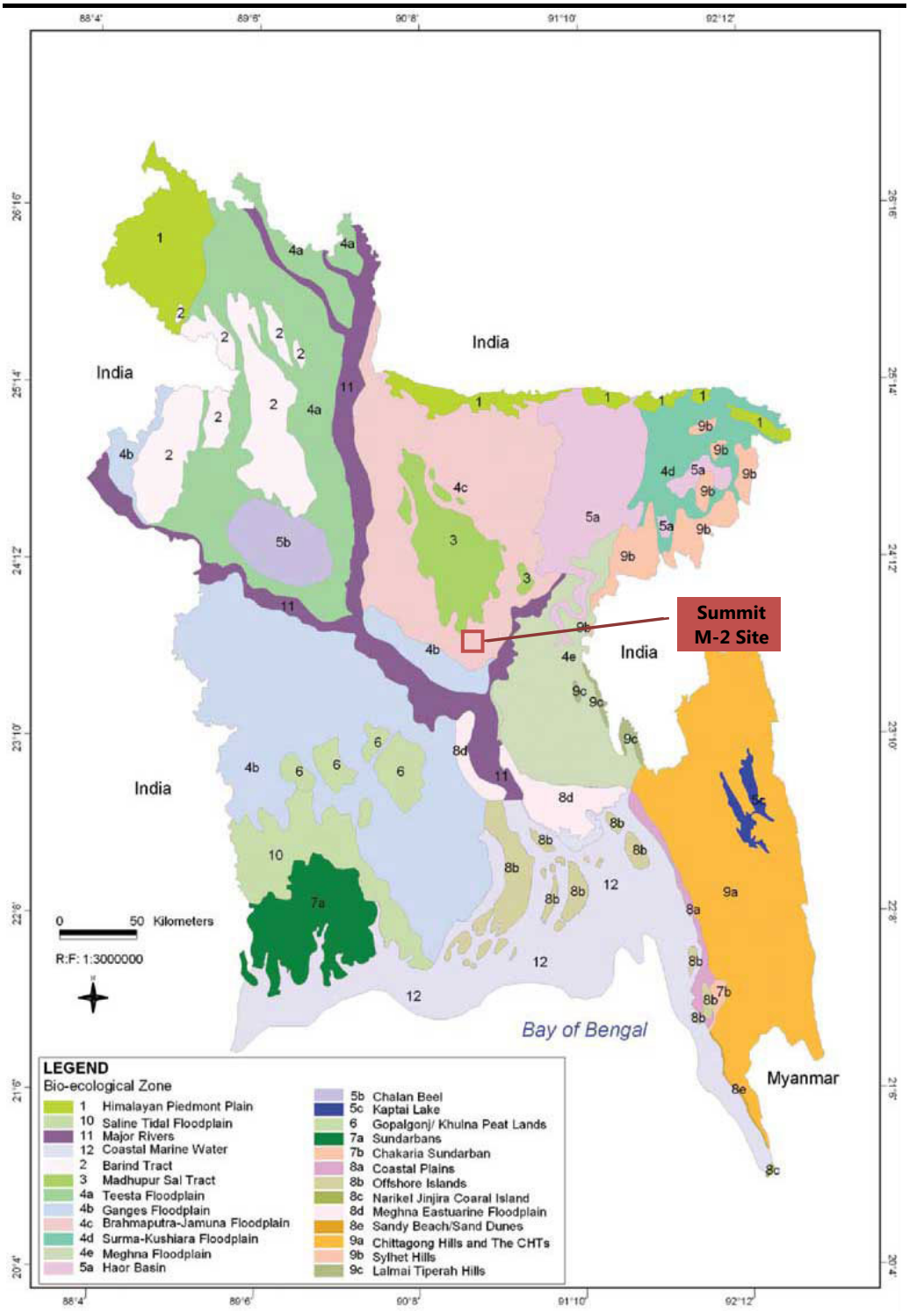
The ecological baseline survey was conducted by ERM team from 30th Nov. to 2nd Dec. 2017. The fishery survey and bio-monitoring (plankton & benthos) study was conducted by Fishery Expert and his team (Shyamal K. Barman, - Fisheries Expert and Dr. Mohammed Mahbub Iqbal,-Limnolocical Expert) from 3rd week of December to 4th week of January 2018. The objective of the survey is as follows:

- Identification of various habitat in the study area;
- Identification of floral species (terrestrial and aquatic), endangered species, if any;
- Identification of faunal species (terrestrial and aquatic), endangered species, if any;
- Identification of areas which are important or sensitive for ecological reasons; and,
- Fish diversity in the study area.

4.4.2 Classification of Study Area-Bio-ecological Zone of Bangladesh

IUCN has classified Bangladesh into 25 Bio-ecological Zones in the context of physiographic and biological diversity. The Meghnaghat Riverine Island and its study area falls under the bio-ecological zone of 'Brahmaputra-Jamuna Floodplain (4c)'.

Figure 4.36 Bio-ecological Zones of Bangladesh



4.4.3 Ecosystem within the Study Area

Available ecosystems within the study area are indicated below;

- Terrestrial Ecosystem;
- Aquatic Ecosystem

4.4.4 Terrestrial Ecosystem

The industrial zones and their adjacent areas have been significantly altered due to continued industrial development and residential area. The study area has no natural forests; it is modified habitat. The identified habitat in the terrestrial ecosystem area as follows:

Homestead Plantation

Homestead plantation was observed on marginal and fallow lands by the local villages e.g. homestead, roads and fallow agriculture land. Species observed are *Samanea saman, Acacia auriculiformis, Azadirachta indica, Eucalyptus* sp., *Pongamia pinnata, Acacia nilotica, Ziziphus mauritiana, Leucaena leucocephala, Switenia mahogani, Tectona grandis, Casia siamea, Gmelina arborea, Phoenix sylvestris, Bambusa* sp., *Cocos nucifera, Mangifera indica, Tamarindus indica, Areca catechu, Borassus flabellifer, Artocarpus heterophyllus* etc.

Agricultural Lands

Mono- cropped agricultural land are located in the study area. The major crop cultivated in the agricultural lands is paddy. The other crops are vegetable – like chilli, onion, ladies finger, long yard bean, tomato, watermelon etc. Tree species observed near agricultural lands are *Mangifera indica, Samanea saman, Azadirachta indica, Cocos nucifera, Eucalyptus* sp., *Acacia auriculiformis, Phoenix sylvestris, Bambusa* sp., *Areca catechu, Borassus flabellifer* etc.

Riparian Vegetation

The study area is enriched with open water fisheries which are available in the rivers, canals and floodplain. Riparian vegetation are present along the sides of ponds, canals etc. Main type of plant species observed is *Syzygium cumini, Samanea saman, Cocos nucifera* etc.

4.4.5 Vegetation

Proposed Project Site

The proposed project site is a developed land. There is no tree species observed during site visit. *Calotropis procera* and *Lantana camara* was recorded in the proposed project site.

Study Area

Total 80 terrestrial floral species were recorded from the study area which included 39 trees, 16 shrubs and 23 herbs and climbers. Detailed list of flora (including terrestrial and aquatic) is presented in **Annex F**.

Among the land use classes maximum number of species were recoded from homestead plantation (80 species), followed by agricultural lands (38 species), riparian vegetation (14 species).

4.4.6 Fauna

Herpetofauna

A total of 11 species of herpetofauna are reported from the study area. out of which 4 species of amphibians and 7 sepcies of reptiles ware reported from the study area. A list of herpetofaunal species is provided in following table.

Table 4.22 Herpetofaunal Species in the Study Area

S N	Scientific Name	English Name	Local Name	Conservational Status		
				IUCN BD	IUCN Global	WLPA 2012
1	*Duttaphrynus melanostictus*	Southeast Asian toad	Kono bang	LC	LC	-
2	*Euphlyctis hexadactylus*	Green Frog	Kotkoti bang	LC	LC	Schedule I
3	*Fejervarya limnocharis*	Cricket frog		LC	LC	Schedule II
4	*Hoplobatrachus tigerinus*	Bull frog	Kola bang,	LC	LC	Schedule I
5	*Calotes versicolor*	Garden Lizard	Roktochusha	LC	Not Evaluated	Schedule II
6	*Mabuya mabuya*	Skink	Achil	-	-	-
7	*Gekko gecko*	Tokay Gecko	Tokkhak	LC	Not Evaluated	Schedule II
8	*Hemidactylus frenatus*	House lizard	Pati Tiktiki	LC	LC	Schedule II
9	*Xenochrophis piscator*	Checkered keel back	Dhora sap	LC	Not Evaluated	Schedule I
10	*Naja kaouthia*	Monocled Cobra	Jati Sap	NT	LC	Schedule II
11	*Enhydris sieboldi*	Siebold's Smooth Water Snake	Sibolder Joloj Shap	Not Assessed	LC	Schedule I

Note: LC: least concern; NT: near threatened;

Avifaunal Species

The avifauna was recorded and reported from various terrestrial habitat as well (homestead plantation, agricultural land and riparian vegetation) and river and marshy area of the study area. A total of 51 species of Avifaunal species were observed in the study area. A list of species recorded and reported in the study area is provided in following table.

Table 4.23 Avifaunal Species in the Study Area

SN.	Scientific Name	English Name	Local Name	Migratory Status	Conservational Status		
					IUCN BD	IUCN Global	WLPA 2012
1	*Sterna sumatrana*	Black-naped Tern	Kalaghar Panchil	M	-	LC	I
2	*Charadrius mongolus*	Little Sand Plover	Choto Dhuljiria	M	LC	LC	I
3	*Actitis hypoleucos*	Common Sandpiper	Pati Batan	M	LC	LC	II
4	*Numenius arquata*	Eurasian Curlew	Eureshio Gulinda	M	NT	NT	I
5	*Nycticorax nycticorax*	Black-crowned Night Heron	Kalamatha Nishibok	R	LC	LC	I
6	*Sterna albifrons*	Little Tern	Choto Panchil	R	LC	LC	I
7	*Ardea cinerea*	Grey Heron	Dhupni Bok	R	LC	LC	I
8	*Ardeola grayii*	Indian Pond Heron	Deshi Kanibok	R	LC	LC	I
9	*Bubulcus ibis*	Cattle Egret	Go Boga	R	LC	LC	II
10	*Casmerodias albus*	Great Egret	Boro Boga	R	LC	LC	II
11	*Egretta intermedia*	Intermediate Egret	Majhla Boga	R	LC	LC	I
12	*Egretta garzetta*	Little Egret	Choto Boga	R	LC	LC	II
13	*Phalacrocorax niger*	Little Cormorant	Choto Pankouri	R	LC	LC	II
14	*Athene brama*	Spotted Owlet	Khuruley Pencha	R	LC	LC	I
15	*Cypsiurus balasiensis*	Asian Palm Swift	Asio Talbatashi	R	LC	LC	I
16	*Psittacula krameri*	Rose-ringed Parakeet	Shobuj Tia	R	LC	LC	II
17	*Psittacula alexandri*	Red-breasted Parakeet	Modna Tia	R	LC	NT	II
18	*Merops philippinus*	Blue-tailed Bee-eater	Neel-lej Shuichora	R	LC	LC	I
19	*Merops leschenaulti*	Chestnut-headed Bee-eater	Khoiramatha Shuichora	R	LC	LC	I
20	*Dinopium benghalense*	Lesser goldenback	Bangla kaththokra	R	LC	LC	I
21	*Upupa epops*	Eurasian Hoopoe	Pati Hoodhood	R	LC	LC	I
22	*Ceryle rudis*	Pied Kingfisher	Pakra Machranga	R	LC	LC	II
23	*Halcyon smyrnensis*	White-throated Kingfisher	Dholagoloa Machranga	R	LC	LC	II
24	*Alcedo atthis*	Common Kingfisher	Pati Machranga	R	LC	LC	II
25	*Dicrurus aeneus*	Bronzed Drongo	Fingey	R	LC	LC	I
26	*Aegithina tiphia*	Common Iora	Fatik Jal	R	LC	LC	II
27	*Zosterops palpebrosus*	Oriental White-eye	Udoi Dholachokh	R	LC	LC	I
28	*Pellorneum ruficeps*	Puff-throated Babler	Golafola Satarey	R	LC	LC	I
29	*Anthus rufulus*	Paddyfield Pipit	Dhani Tulika	R	LC	LC	II
30	*Lonchura striata*	White-rumped Munia	Dholakomor Munia	R	LC	LC	I
31	*Lonchura punctulata*	Scaly-breasted Munia	Tila Munia	R	LC	LC	I
32	*Ploceus philippinus*	Baya Weaver	Deshi Babui/Baoi	R	LC	LC	I
33	*Cinnyris asiaticus*	Purple Sunbird	Beguni Moutushi	R	LC	LC	I
34	*Leptocoma zeylonica*	Purple-rumped Sunbird	Begunikomor Moutushi	R	LC	LC	I

SN.	Scientific Name	English Name	Local Name	Migratory Status	Conservational Status		
					IUCN BD	IUCN Global	WLPA 2012
35	*Dicaeum trigonostigma*	Orange-bellied Flowerpecker	Komlapet Fuljhur	R	LC	LC	I
36	*Dendrocitta vagabunda*	Rufous Treepie	KhoiraHarichacha	R	LC	LC	II
37	*Oriolus xanthornus*	Black-hooded Oriole	Holdey Pakhi	R	LC	LC	II
38	*Corvus macrorhynchos*	Jungle Crow	Dar Kak	R	-	LC	-
39	*Corvus splendens*	House Crow	Pati Kak	R	LC	LC	-
40	*Pycnonotus cafer*	Red-vented Bulbul	Bangla Bulbul	R	LC	LC	I
41	*Treron phoenicopterus*	Yellow-footed Green Pigeon	Holdepa Horial	R	LC	LC	I
42	*Streptopelia chinensis*	Spotted Dove	Tila Ghughu	R	LC	LC	I
43	*Treron bicintus*	Orange-breasted Green Pigeon	Horikol	R	LC	LC	I
44	*Columba livia*	Common Pigeon	Jalali Kabutor	R	LC	LC	I
45	*Orthotomus sutorius*	Common Tailorbird	Pati Tuntuni	R	LC	LC	-
46	*Copsychus saularis*	Oriental Magpie-Robin	Udoi Doel	R	LC	LC	II
47	*Acridotheres fuscus*	Jungle Myna	Jhuti Sahlik	R	LC	LC	II
48	*Acridotheres tristis*	Common Myna	Bhat Shalik	R	LC	LC	II
49	*Sturnus contra*	Pied Myna	Pakra Shalik	R	LC	LC	II
50	*Dicrurus macrocercus*	Black Drongo	Kala Fingey	R	LC	LC	II
51	*Passer domesticus*	House Sparrow	Pati Chorui	R	LC	LC	II

Note: [R: resident; M: migratory; LC: least concern; NT: near threatened]

Mammalian Species

A total 11 species of mammalian species were enumerated within the study area. The species were identified based on community consultation and direct sightings. Large Indian Civet (*Viverra zibetha*) and Common otter (*Lutra lutra*) are listed as Near Threatened as per IUCN Redlist 2016.3.

Table 4.24 Mammalian Species within Study Area

SN	Species Name	English Name	Local Name	BD IUCN Status	Global IUCN Status	WLPA 2012
1	*Pipistrellus coromandra*	Indian Pipistrelle	Chamchika	LC	LC	I
2	*Rousettus leschenaultia*	Leschenault's Rousette	Kola Badur	LC	LC	I
3	*Pteropus giganteus*	Indian Flying Fox	Baro badur	LC	LC	I
4	*Rattus rattus*	House rat	Indur	LC	LC	III
5	*Bandicota indica*	Indian Mole rat	Indur	LC	LC	III
6	*Suncus murinus*	House shrew	Chika	LC	LC	-
7	*Viverra zibetha*	Large Indian Civet	Baghdas	NT	NT	I
8	*Lutra lutra*	Common otter	Ud biral	CR	NT	I
9	*Felis chaus*	Wild cat	Bon biral	NT	LC	I
10	*Herpestes edwardsii*	Indian grey mongoose	Bejji	LC	LC	I

Note: [LC: least concern; NT: near threatened; CR: critically endangered]

4.4.7 Aquatic Ecosystem

Meghna River: The aquatic habitat of the Meghna River is highly stressed but the biotic diversity is good. Consultation with local communities revealed that effluent discharged from chemical and pulp & paper industries periodically caused fish kills in the river.

Fish Species and Commercial Fishing

Meghna River: A fish study in Meghna River conducted during 2013-14[1] reported of the availability of 25 species of fishes. It was also reported that the hilsa fish occurrence has decreased in the Meghna River. About 15 endangered and threatened fish species were reported in the Meghnaghat region. These are *Notopterus Chitala (*Chital*),Labeo calbasu (*Kalbaus), *Labeo gonius* (Gonia), *Osteobrama cotio* (Dhela), *Rita rita* (Rita), *Ompok Pabda* (Pabda), *Channa Marulius* (Gajal/Gagar), *Puntius sarana* (Sarputi), *Rasbora rasbora* (Darkina), *Silonia Silondia* (Silong), *Bagarius bagarius* (Baghair), *Chaca chaca* (Chaga), *Chanda nama* (Nama chanda), *Badis badis* (Napit Koi), *Macroganthus aral* (Tara Baim)[2].

A wide range of fish species are caught here. Their variations are also season depended. Usually, late monsoon (September -October) is the peak time for fishing. In that period water starts to recede. Juvenile and adult fishes also come to main river from the adjacent floodplain areas.

[1] Fisheries Study at Meghna River (adjacent and around the power plant site) December 2013 to February 2014; Environmental Quality and Management System (EQMS)

[2] ESIA Study for 305-350MW Dual Fuel Combined Cycle Power plant project at Meghnaghat, Narayanganj

The fish species reported in the fishery study conducted by SMPCL 2016[1] were Ayre, Bele, Baim, Boal, Bujuri tengra, Batashi, Chanda, Chela, Common carp, Chapila, Garua, Hilsa, Kaski, Kalbasu, Katla, Kakila, Kholisa, Koi, Meni, Mola, Prawn, Pabda, Puti, Rui, Shorputi, Shingi, Shol, Taki, Rayek bata and Tengra

Fish and fisheries have been playing a vital role; not only in providing food security to the Bangladeshis but also in shaping the economy of Bangladesh. Consultation with local people and review of various study reports indicates towards earning opportunities in the fishery sector as well as prevalence of subsistence fishing.

Fishing: A wide range of fish species are caught from the Meghna River. Their variations are also dependent on the season. Usually, late monsoon (September-October) is the peak time for fishing. In that period water starts to recede. Juvenile and adult fishes also come to the main river from the adjacent floodplain areas. Again, fish species and their amount of catch usually differ from gear to gear. The most common fish species of this river are Rui, Katla, Ayre, Hilsa, Kalbasu, Bacha, Chewa, Gharua, Kaski, Chapila, Kajoli, Prawn, Eel, Puti, Boal, etc. Chewa, Puti, Rui, Katla, Ayre, Boal, Kaski, Bacha, Kajoli.

Fish spawning and rearing grounds

The spawning behaviour of almost all fish species depends on some specific external factors such as river water current, turbidity, seasons etc. when some fish like the soft bottom, some like the hard one while some prefer bottom with vegetation.

Except Major Carps, Pangas and Hilsa are migratory. Most of the fresh water species reported in the Meghna River and adjacent wetland are the resident species, breed more or less in any water bodies in the region. Based on breeding habitats, there are two types of fish spawning patterns in the region:

- River breeders such as the Carps, Chital, Aor, Pabda, Bacha, Shilon, etc.
- Floodplain breeders such as Boal, Gonia, Singi, Koi, Magur, Chanda etc.

Breeding of fish in the floodplains begins at the onset of monsoon flooding, when water in adjacent rivers and channels flow in to the beels. The fish move to the inundated shallow water area for spawning. Carnivorous species breed earlier than omnivorous and herbivorous species.

Breeding patterns of river breeders are more diverse than those of floodplain breeders. Ayre and Ghagot dig pits in the shallow area in the early monsoon season.

It was reported that the spawning grounds of fresh water prawns and other small indigenous fishes in the study area are (i) upstream of Meghna near the

[1] Survey report on Fisheries resources at the Meghna River within the study area of SMPCL; conducted by Sustainable Development Associates (SDA) June 2016

Meghna Bridge and (ii) Floodplains (approximately 6.5 km from proposed discharge point).

It was reported that the amount of fish breeding in the main river has drastically reduced due to the severe changes of their habitats. These habitats are being polluted frequently due to the discharge of toxic effluent of the industries, significantly increase in river navigation, indiscriminate use of illegal fishing gears to capture of brood fishes, etc. on the other hand, the adjoining canals are either being silted up or grabbed by the influential.[1]

Fish Migration Routes within the Study Area

The floodplains on the western and southern sides of Summit M-2 plant are linked with some seasonal canals. These are possible migration routes of relatively small sized fishes. These fishes normally enter during the peak monsoon season from the river for breeding and feeding.

Major carps, during this period, start upstream migration for breeding. Practically, there is no evidence that major carps use the Upper Meghna River for its migration routes flowing through the study area. However, it is believed that the fish travel miles to reach the head water for breeding.

One of the most important migrations takes place in case of Hilsa fish in all the major rivers of Bangladesh including Meghna River. The Hilsa breeding ground is far downwards (south) from the SMPCL by at least 100 Km. In this regard, the project has no direct influence on Hilsa breeding. After late 80s Hilsa catch was declining in the River drastically.

Ecological Health of the River

To understand the ecological health of the river, biomonitoring (plankton and benthos) survey data was analysed which was carried out in winter (Jan 2016) and early summer (March 2016), under CEIA study. To understand the present ecological health of the river, bio-monitoring has been conducted in six locations (Refer Table 5.23)

Table 4.25 Surface Water Quality Monitoring Location Details

Location Code	Location	Geographical Coordinates	Selection Criteria
BM-1	Upstream of Meghna Minor Channel	23°36′52.2′′ N 90°35′35.4′′E	Understand the existing ecological health of the river.

[1] In practical hilsa breeding ground is far downwards (south) from the SMPCL by at least 100 Km. In this regard, the SMPCL has no direct influence on hilsa breeding. After late 80s Hilsa catch was declining in the nature drastically. For near about last 10 years government has taken massive program to protect juvenile and gravid hilsa, imposed seasonal ban on hilsa catch and is providing food aid to the fishermen during the ban period. Government has also declared 5 sanctuaries for hilsa. All these efforts together are helping to increase hilsa production. Every year itis observed that hilsa catch become prominent in August - October. This year, weather was most favourable for hilsa production, river was full to the brim, water current was high, all these factors helped to increase hilsa production dramatically. However, all these events happened after the study period. That is why, during the study time, it was observed that hilsa catch was low.

Location Code	Location	Geographical Coordinates	Selection Criteria
BM -2	Downstream of Summit Existing Discharge Point	23°36'43.44"N 90°35'23.19"E	Understand the existing ecological health of the rive and assess the impacts due to discharge from Summit M1 plant.
BM -3	Downstream of Orion Power Jetty	23°36'33.43"N 90°35'20.11"E	Understand the existing ecological health of the rive and assess the impacts due to operation of Orion Jetty and discharge from plant
BM -4	Downstream of Meghaghat Power Plant Discharge Point	23°36'19.19"N 90°35'25.90"E	Understand the existing ecological health of the rive and assess impacts due to discharge of Meghna Power Plant and assess the impact due to proposed Summit M2 plant.
BM -5	Near Meghanaghat Power Plant Intake Point	23°36'19.92"N 90°35'54.55"E	Understand the existing ecological health of the river and assess impacts due to upstream industries in Meghnaghat industrial area.
BM -6	Downstream of Meghna River, Char Balaki	23°36'2.10"N 90°35'16.69"E	Understand the existing ecological health of the river and assess impacts due to upstream industries in Meghnaghat industrial area and proposed Summit M2 project.

Note: laboratory analysis results were not available at the time of this report writing.

Secondary Data

Bio-monitoring conducted during CEIA Study

Plankton:

Winter season: Atotal of 14 species of phytoplankton and 8 species of zoo-planktons were recorded in the Meghna River.

Early summer season: 12 species of phyto-plankton and 8 species of zooplanktons were recorded. However at the minor channel of Meghna river, only three species of phyto-plankton and one species of zooplankton was recorded.

Benthos:

Winter season: Total 5 species of benthos were recorded in the Meghna River.

Early summer season: Total 5 species of benthos were recorded in the Meghna River.

Diversity Index: The diversity indices of Meghna river is presented ***Table 4.26.*** The diversity index indicates that ecological health of the Meghna River was moderate to good. The ecological health of Sitalakhya was poor and practically no lifeform was recorded in the major stretches of the river during the lean season.

Table 4.26 Species Diversity Indices of Meghna River

Winter	BM-1	BM-2	BM-3	BM-4	BM-5	BM-6	BM-7

Winter	BM-1	BM-2	BM-3	BM-4	BM-5	BM-6	BM-7
Phytoplankton	1.497	0.935	0.365	1.497	0.241	0.863	0.93
Zooplankton	1.386	1.082	0.283	0.207	0.363	0.265	0.334
Benthos	0.819	0.623	0.66	-	-	-	0.346
Early Summer							
Phytoplankton	1.273	1.526	1.157	1,336	1.010`	0.865	1.169
Zooplankton	1.502	0.831	0.864	1.103	0.641	0.000	0.802
Benthos	0.943	0.690	0.846	0.691	0.368	0.704	0.502

Source: Biomonitoring Survey, CEIA Study, 2016

Bio-monitoring conducted under Fishery Study

Phytoplankton

In this study, 14 species under 4 groups were encountered. Among which 5 species belongs to both in Bacillariophyceae and Chlorophyceae followed by 3 species to Cyanophyceaeand 1 species to Euglenophyceae. Chlorella, under Chlorophyceae group was found most governing genera 180 ind./L followed by Ulothrix 163 ind./ L, Melosira120ind./L under Bacillariophyceae.

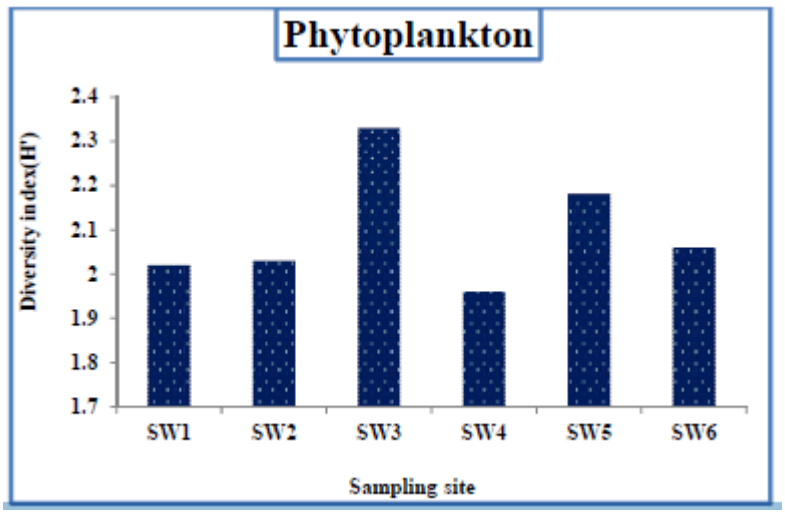
Zooplankton

In this study, 7 species under three zooplankton groups, of which 3 species belong to Cladocera followed by 2 species of Rotifera and 2 species of copepods were identified. Keratella under the group Rotifera 69 ind./L followed Moina under the Cladocera 51 ind./L.

Diversity index of Phytoplankton & zooplankton

The Shannon Weaver diversity index (H') of the survey area found to be oscillated from 1.96 (SW4) to 2.33(SW3) with mean value of 2.09±0.14.

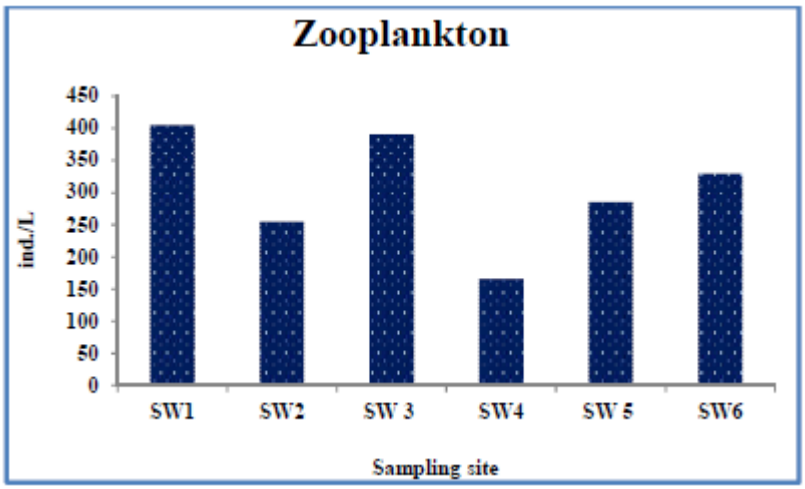
Figure 4.37 ***Diversity index (H') value of phytoplankton of different sampling sites of Meghna River***



Zooplankton

The Shannon Weaver diversity index (H') of zooplankton of the survey area found to be oscillated from 1.37 (SW4) to 1.88(SW6) with mean value of 1.67±0.18 (Fig. 6). The results suggesting that the overall condition of the sampling sites for zooplankton found to be pretty good.

Figure 4.38 ***Diversity index (H') value of zooplankton of different sampling sites of Meghna River***



Another fisheries study as part of this ESIA study has recently completed and the study report was awaited at the time of this report writing.[1].

4.5 SOCIAL ENVIRONMENT

The proposed Project site is located within Pirijpur Union Parishad in Sonargaon Upazilla, Narayanganj District. The socio-economic data of the Upazilla available from the secondary sources (published from reliable sources) were compiled and analysed. The socio-economic features emerging out of this broad analysis is discussed in sections below.

4.5.1 Study Area

This study area comprises of the area within the 5 km radius of the proposed project site boundary. It is expected that key environmental and social impacts will be manifested within this zone of influence. The preliminary assessment shows that the potential direct socio- economic impacts would be restricted within 2 km. The study area therefore is further divided into core zone and buffer zone. The core area (within 2 km) includes project footprint and direct social impacts caused due to the land procurement, impact on livelihoods or community health. The buffer area (between 2 -5 km) is considered as the area

[1] Scope of this study is include: (a) collection of secondary information on fisheries resources of the study area from published literature and other documents available in public domain (including interaction with relevant stakeholders such as government agencies); (b) inventory of types of fishes/shrimps of Meghna River within study area; (c) listing of fish catch season and commercial fish types in the Meghna river within study area; (d) adoption of major fishing method by fisher folks in this region or change to the existing "pulse" fishing methods; (e) limnology survey on benthos, phyto and zoo planktons through sample collection and laboratory analysis. .

beyond core zone which may experience indirect impacts such as influx, increase in traffic etc. The Union Parishads within study area is presented in ***Table 4.27*** and a map showing the same is presented in ***Figure 4.39*** and ***Figure 4.40***.

Table 4.27 Study Area Break-up

Sl. No.	Type of Area	Name of Administrative Unit		
		District	Upazilla	Union Parishad/ Paurosabha (Municipality)
1.	Core Area	Narayanganj	Sonargaon	Pirijpur
				Shambhupura
		Munshiganj	Gazaria	Hossaindi
2.	Buffer Area	Narayanganj	Sonargaon	Mugrapara
				Sonargaon PSA
				Shanmadi
			Bandar	Musapur
				Bandar
		Munshiganj	Gazaria	Tengerchar
				Baluakandi
				Gazaria
		Comilla	Meghna	Chalibhanga

The project footprint is mostly located in Pirijpur Union. As the project is located on the bank of a major river (Meghna) on which a significant number of fishermen depend for their livelihood, the neighbouring Union Parishads (both upstream and downstream) are considered for potential livelihood impacts. Preliminary consultations with communities revealed that though small number of fishermen families is found in Pirajpur Union, Char Balki which is under Hossaindi Union Parishad of Gazaria Upazila is a fishing hamlet. This hamlet is located on a riverine island across the project site, which is about 1.5 km from the project site and its habitants use adjacent areas for capture fishing as well as 'captive or cage fishing' locally referred to as 'kata fishing'. Therefore, it was decided to cover a wider area (2kms) as a core area for socio-economic impacts of the project.

4.5.2 Administrative Structure

The Summit M2 power plant is located within the Meghnaghat Power Hub in Sonargaon Upazila of Narayangunj District. The study area (5km radius) for the project is administratively divided into 3 districts covering 4 Upazilas – Sonargaon and Bandar under Narayangunj District, Gazaria under Munshigunj District, Meghna under Comilla District.

The core study area (2 km radius around the project footprint) covers 3 Union Parishads – Pirijpur, north-eastern part of Shambhupura in Sonargaon Upazila and Hossaindi in Gazaria District. The administrative units for the core area are given in the ***Table 4.27.***

4.5.3 *Demography of Project Area*

As per the Census of Bangladesh, 2011, the total population of Narayanganj District is 29,48,217, Munshigunj District is 14,45,660 and Comilla District is 53,87,288 comprising 6,75,652 , 3,13,258 and 10,53,572 households respectively. The average annual increase in population since 2001 has been estimated at 3.05 percent for Narayanganj District, 1.10 percent for Munshigunj District and 1.58 percent for Comilla District.

Table 4.28 provides an overview on the population trends of the two districts within the study area over a decade from 2001 to 2011.

Table 4.28 Population Trends of Narayanganj and Munshigunj Districts

Index	Population Details of Narayanganj District		Population Details of Munshigunj District		Population Details of Comilla District	
	2011	2001	2011	2001	2011	2001
Total Households	6,75,652	4,53,627	3,13,258	2,50,850	10,53,572	8,28,168
Total Population	29,48,217	21,73,948	14,45,660	12,93,972	53,87,288	45,95,557
Annual rate of Growth over period of 10 years (%)	3.05	2.16	1.10	0.85	1.58	1.32
Population Density per sq.km	4308	3161	1439	1355	1712	1490
Average Household (HH) size	4.34	4.76	4.55	5.13	5.07	5.54

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

Total population of Sonargaon and Bandar Upazila under Narayanganj District is 400,358 and 312,841 respectively and it comprises 89,565, 73,173 households respectively as per Census of Bangladesh, 2011. Gazaria Upazila under Munshiganj District and Meghna Upazila under Comilla District have a population of 157,988 and 1, 12, 453 as per Census 2011 reports and comprises of 34,994 and 21,617 households respectively. ***Table.4.29*** provides the population trends of the three Upazillas.

Table.4.29 Population trends of Sonargaon, Gazaria & Meghna Upazillas

Upazila	Index	2011	2001
Sonargaon	Total Households	89,565	60,805
	Total Population	4,00,358	3,05,562
	Annual rate of Growth over period of 10 years (%)	2.70	1.55
	Population Density per sq.km	2332	1780
	Average Household (HH) size	4.43	4.98
Gazaria	Total Households	34,994	26,651
	Total Population	1,57,988	1,38,108
	Annual rate of Growth over period of 10 years (%)	1.33	0.73
	Population Density per sq.km	1206	1055
	Average Household (HH) size	4.50	5.16
Meghna	Total Households	21,617	19,170
	Total Population	1,12,453	96,970
	Annual rate of Growth over period of 10 years (%)	1.47	0.97
	Population Density per sq.km	99.57	98.47

Upazila	Index	2011	2001
	Average Household (HH) size	5.20	5.05

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

Figure 4.39 Study Area Map showing Upazillas and Unions

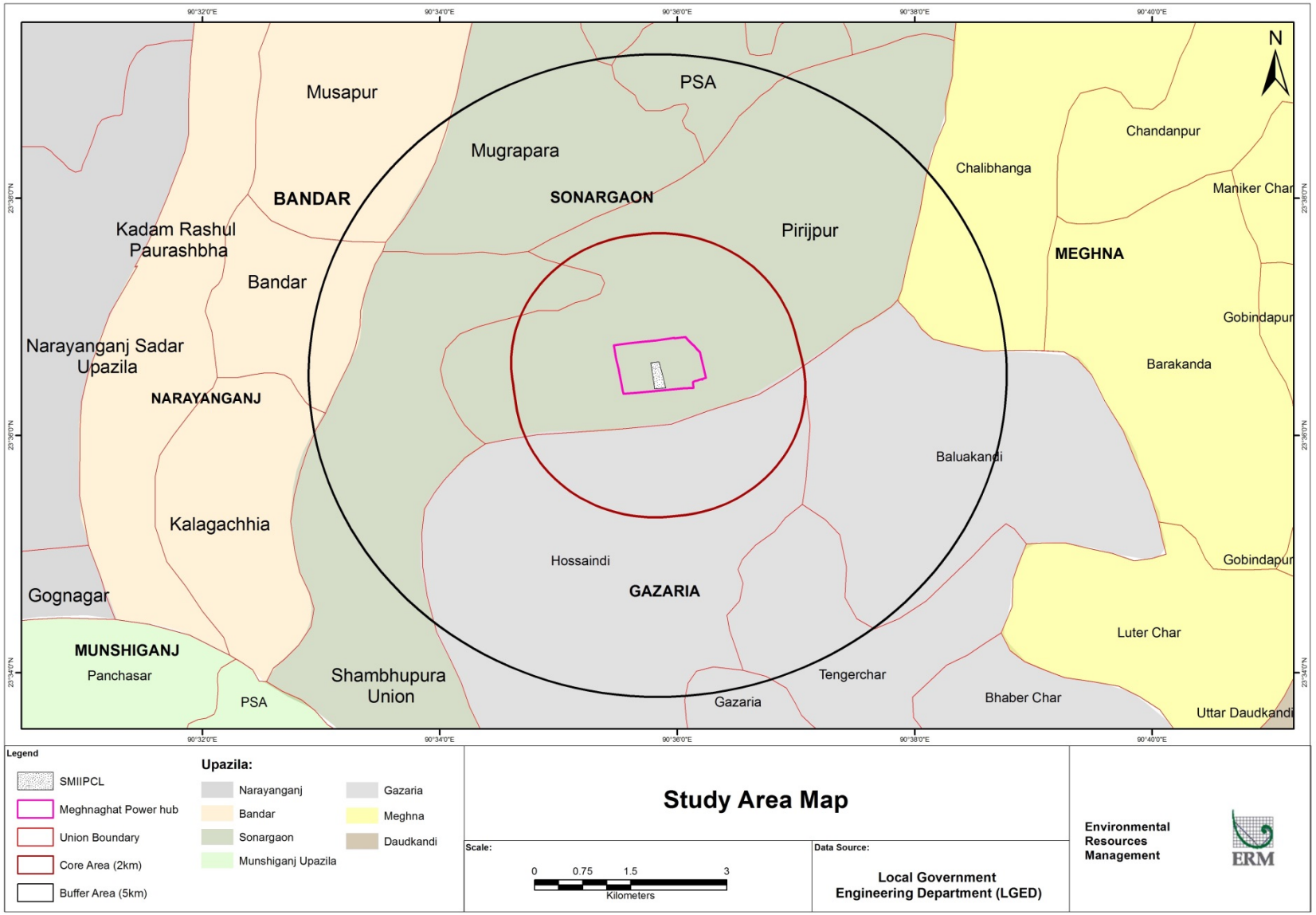
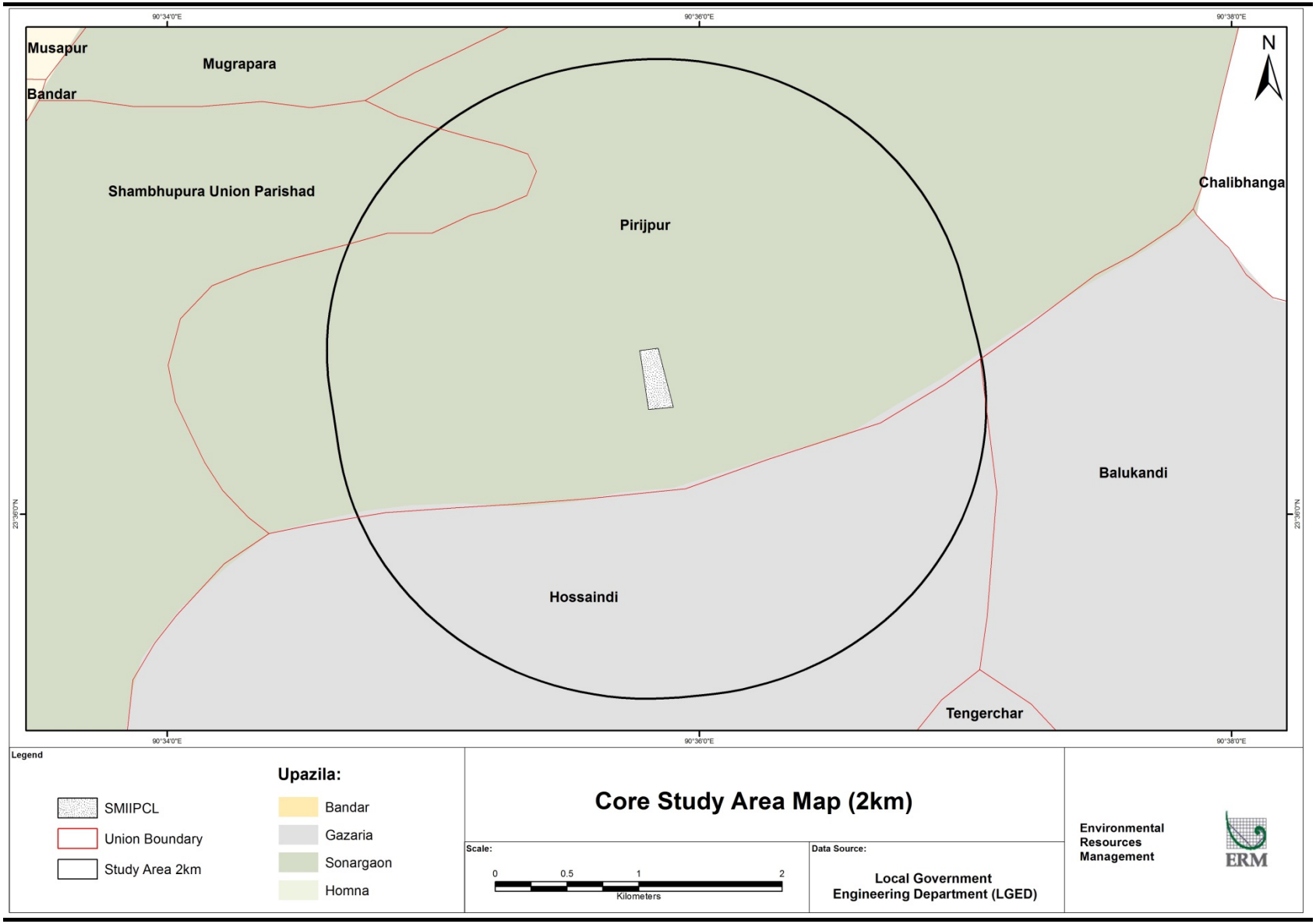


Figure 4.40 Core Study Area Map with Union Boundaries



Total population of the study area is 3,17,806 comprising of 71,264 household in 12 unions in three districts (As in 2011).

Core Area

The core study area covers Pirijpur and Shambhupura Union Parishads in Sonargaon Upazila covering a population of 45,440 and 26,646 respectively. It also covers Hossaindi Union Parishad in Gazaria Upazila comprising a population of 24,680.

Buffer Area

Total population in buffer area is 2,21,040 living in 50,134 households. Lowest and higest population is observed in Chalibhanga Union (13133) of Meghna Upazila and Sanmandi Union(38029) of Sonargaon Upazila comprising of 2420 and 8403 households respectively.

Demographic profile of the Union Parishads in core and buffer area is provided in ***Table 4.30.***

Table 4.30 Demography Profile of the Core Study Area

Union Parishad	Total HH	Total Population	Sex Ratio
Core Area			
Pirijpur Union	9917	45,440	119
Shambhupura Union	5,967	26,646	96
Hossaindi Union	5,246	24,680	113
Buffer Area			
Mugrapara	7,736	33,506	94
Sanmandi	8,403	38,029	101
Bandar	7,326	29,578	98
Musapur	5,918	25,933	97
Gazaria	3,573	15,570	108
Baluakandi	3,855	17,440	102
Tengerchar	3,614	15,055	96
Sonargaon Sadar Pourashabha	7,289	32,796	95
Chalibhanga	2,420	13,133	98

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

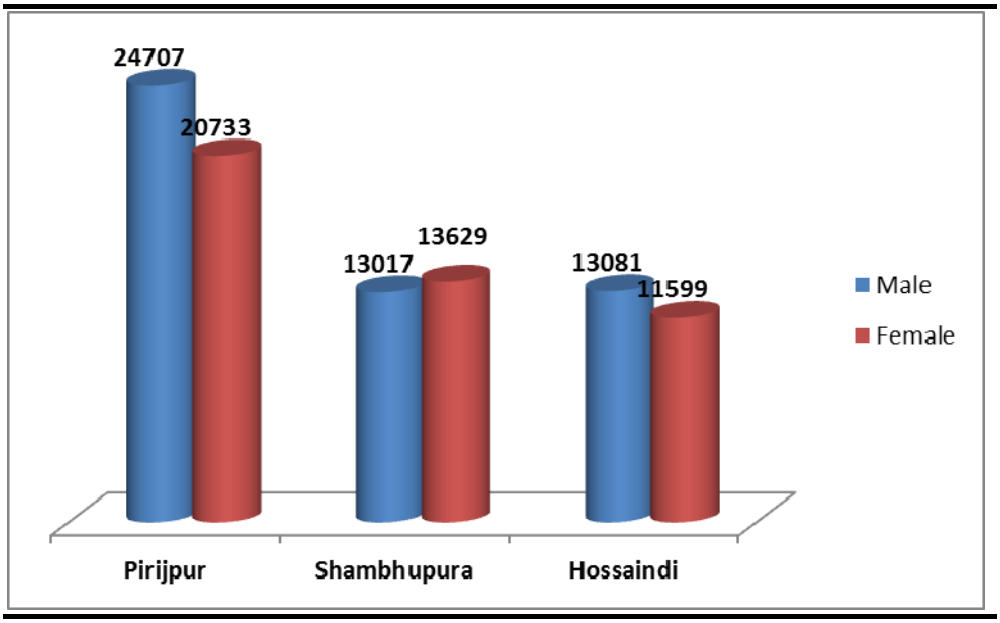
Decadal growth rate in Gazaria Upazila (1.49 percent) is higher than that of Munshiganj District. In Sonargaon Upazila the decadal growth rate is less than the Narayanganj District however the population in the upazila has increased by 31 percent. In Meghna Upazila the decadal growth rate is almost similar to Comilla District. The increase in population and decadal growth rate may be attributed to population influx due to rapid pace of industrialization in the region. However Meghna upazila witnessed very limited industrial growth.

Core Area

Comparison of the female and male population shows that in two of the unions (Pirijpu and Hossaindi) male population is higher than the female population. ***Figure 4.41*** provides the sex wise population distribution in the three union parishads within the core study area. Presence of higher number

of male population may be considered as an indication of presence of migrant workforce in the core area.

Figure 4.41 Sex wise Population Distribution within Core Study Area

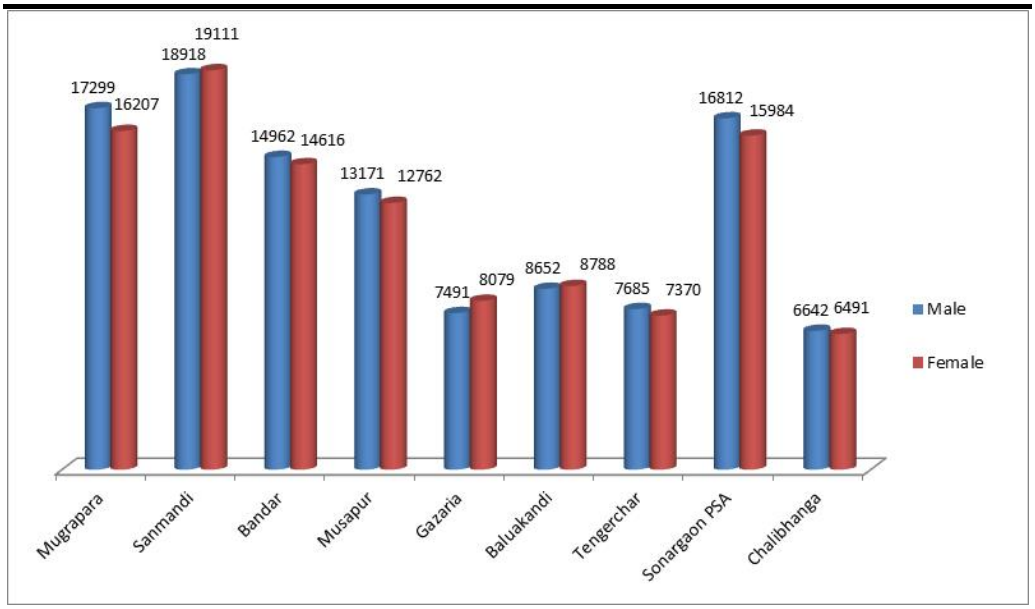


Source: Population and Housing Census 2011, Bangladesh Bureau of Statistics (BBS), 2011

Buffer Area

Comparison of the female and male population shows that in three of the unions (Sanmandi, Gazaria and Baluakandi) male population is higher than the female population. ***Figure 4.42*** provides the sex wise population distribution in the three union parishads within the core study area.

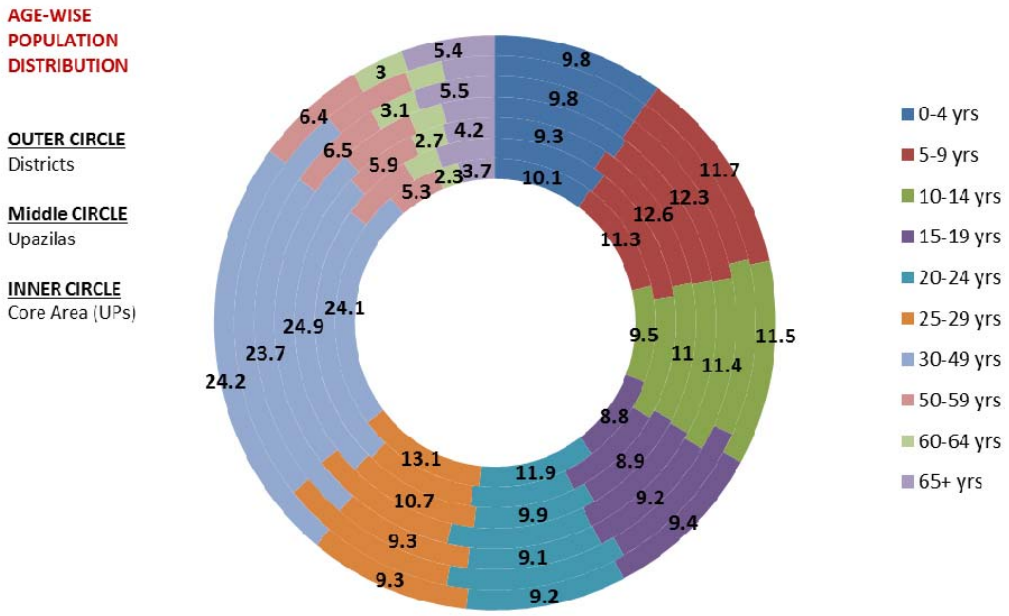
Figure 4.42 Sex wise Population Distribution within Buffer Study Area



The census of Bangladesh divides the population age groups into ten (10) categories. These being, those below the age of 4, between 5 and 9, 10 to 14, 15 to 19, 20 to 24, 25 to 29, 30 to 49, 50 to 59, 60 to 64 and those above the age of 64

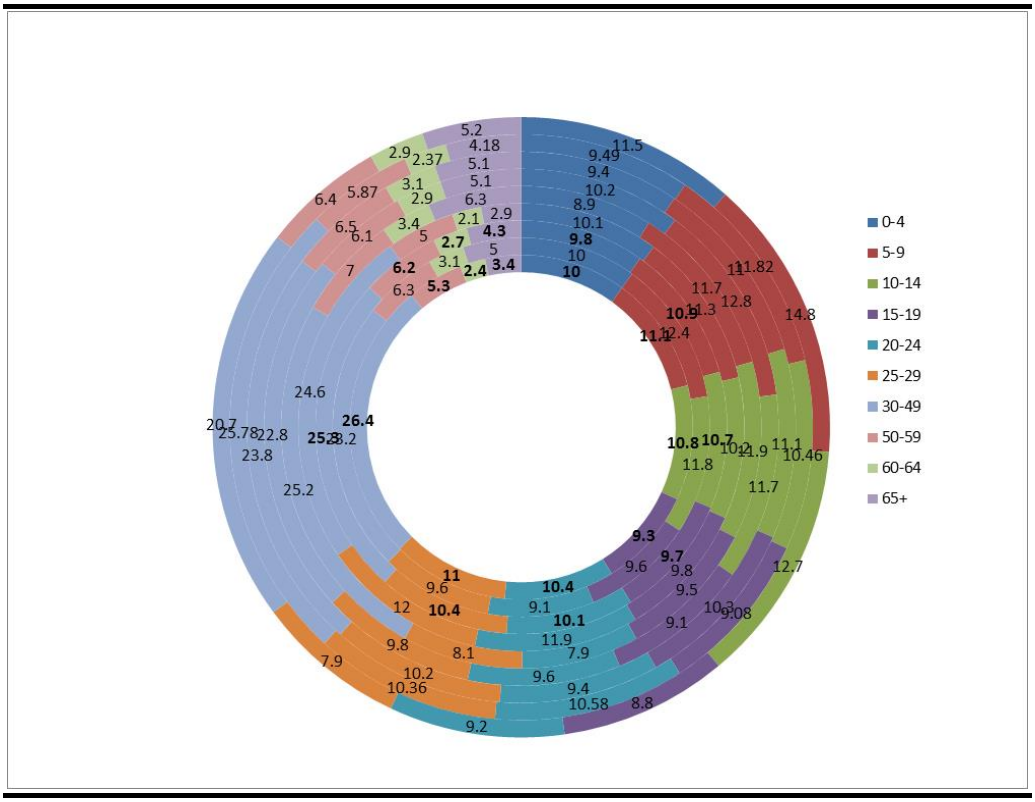
respectively. ***Figure 4.43*** and ***Figure 4.44***highlights the comparative trend in the age-wise population distribution in core study area and buffer area with that of the overall upazilla and district.

Figure 4.43 Comparison of Age-wise Population Distribution within Core Area, Upazila and District



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

Figure 4.44 Comparison of Age-wise Population Distribution within Buffer Area Unions



It can be observed from Figure 4.44 that the larger proportion of the population in both core and buffer area falls within the age group of 30 to 49

years followed by population within the age group of 05 to 09 years, though the age group are not in equal interval. The trend is similar at both Upazila and District level.

Thus, 50 percent of the population in the core and buffer area is in the economically active age group (15 -19 adolescent worker and 20-59 years as adult worker), while rest the remaining 50 percent of the population is understood to be dependent. There are about 25-30 percent of the population which falls within the age bracket of 15 to 30 years, which can be considered as the potential population which looks for livelihood diversification.

4.5.4 Vulnerability

In addition to the infant and elderly age group, widows/separated population and disabled/differently abled population are considered as vulnerable population. The disabled or differently abled population constitutes 1.2 percent of the total population with in the study area. The widowed population in the two districts is 0.65 percent and divorced/separated population is 0.1 percent. Widowed population in the core area is 2.3 percent and separated/divorced is 0.4 percent.

As per the international social safeguard requirements the ethnic minorities population is considered as the vulnerable population. The districts of Narayanganj and Munshiganj have ethnic minority population of 899 (0.03%) and 103 (0.007%) respectively as per Census, 2011 Bangladesh Bureau of Statistics. Also, as per Census 2011, only one ethnic minority household is present within the core study area.

4.5.5 Literacy Profile

Core Area

The literacy rate of Narayanganj District and Sonargaon Upazila is 57.1 and 54.6 percent respectively, which is lower than Pirijpur Union – those records for highest literacy rate within the core study area. The literacy rate of Munshiganj Within the core study area literacy rate in Pirijpur Union (59.8 percent) is higher than the national average literacy rate of 56.75 percent, while the overall literacy rate in other two unions – Shambhupura and Hossaindi is lower than the national rate. The higher literacy rate in Pirijpur and Shambhupura Unions, than the literacy rate of Sonargaon Upazila can be attributed to the presence of more educated industrial and factory workers in the area.

Buffer Area

Highest literacy rate (63.8 percent) was observed in Tengerchar union of Gazaria upazila and lowest literacy rate (36.4 percent) was observed in Chalibhanga union of Meghna Upazila.

Table 4.31 Literacy Profile in Study Area

	Male Literacy Rate	Female Literacy Rate	Overall Literacy Rate
Union Parishads (Core Study Area)			
Pirijpur	63.8	55	59.8
Shambhupura	57.3	53.5	55.3
Hossaindi	55.2	51.9	53.6
Union Parishads (Buffer Study Area)			
Mugrapara	64.7	60.5	62.7
Sanmandi	53.2	50.4	51.8
Bandar	55.9	54.9	55.4
Musapur	58.00	54.8	56.5
Gazaria	58.70	54.90	56.7
Baluakandi	61.8	53.6	57.7
Tengerchar	65.6	61.9	63.8
Sonargaon PSA	64.94	61.72	63.39
Chalibhanga	38.7	34	36.4
Upazilas			
Sonargaon	56.7	52.5	54.6
Gazaria	59.6	54.8	57.2
Meghna	44.6	48.2	41.0
Districts			
Narayanganj	59.5	54.6	57.1
Munshiganj	56.4	55.7	56.1
Comilla	54.9	56.7	53.3

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

With respect to literacy trends amongst males and females, it can be observed that literacy amongst male population is higher than female literacy rate in the core study area.

4.5.6 Public Infrastructure and Access to Amenities

Education Facility

As per district statistics, (2011) for Sonargaon Upazila there are 82 government primary school, 29 registered primary schools, there are no Government secondary school, however, there are 28 non- government secondary schools, no Government Colleges, 4 non-government college are present. Other than that 64 madrasah, 89 kawmi madrasah and 64 ebtedayee madrasah and 5 technical and vocational institutions are also present in this Upazila *(**Table 4.32**)*.

In Gazaria Upazila there are 63 government primary school, 16 registered primary schools, there are no Government secondary schools. However, there are 16 non- government secondary schools, one Government Colleges, one non-government college are present. Other than that 5 madrasah, no kawmi madrasah and 8 ebtedayee madrasah and one technical and vocational institution are also present in this Upazila.

In Meghna Upazila there are 42 government primary school, 14 registered primary schools, there are no Government secondary schools, however, there are 8 non- government secondary schools, no Government Colleges is present however one non-government college are present. Other than that 1

madrasah, 9 kawmi madrasah and 3 ebtedayee madrasah are also present in this Upazila.

Table 4.32 Education Infrastructure in Upazilas and Districts

Upazila / District	Govt. Primary School	Registered Primary School	Govt. Secondary School	Non-Govt. Secondary School	Govt. College	Non Govt. College	Madrasah	Kawmi Madrasha	Ebtedayee Madrasah	Technical & Vocational Institution
Upazilas										
Sonargaon	82	29	0	28	0	4	10	19	3	0
Gazaria	63	16	0	16	1	1	5	0	8	1
Meghna	42	14	0	8	0	1	1	9	3	0
Districts										
Narayanganj	425	79	2	163	4	21	64	89	64	5
Munshiganj	510	69	3	120	4	14	68	77	31	7
Comilla	1318	647	9	500	13	80	379	288	431	31

Source: District Statistics -2011 – Narayanganj and Munshiganj
Note: Union Parishad level data was not available in the District Statistics (2011).

Housing and Sanitation

Core Area - Housing

According population and housing census, there are 20,891 households with in the core study area (Pirijpur, Shambhupura and Hossaindi Unions). Distribution of households by structures shows that kutcha residential structures (65.4 percent) are highest within the core study area followed by semi-pucca structures (22 percent) and pucca structures (***Table 4.33***). Analysis of the census 2011 data shows that percentage of kutcha structures are highest in Hossaindi Union in Gazaria Upazila and pucca residential structure is highest in Pirijpur Union in Sonargaon Upazila.

Buffer Area - Housing

As per census data 2012, distribution of households by structures shows that average kutcha residential structures (70.07percent) are also highest within the buffer study area followed by semi-pucca structures (17.28 percent) and pucca structures (***Table 4.33***).

Table 4.33 Distribution of Type of Residential Structures in Core and Buffer Study Areas

Unions	No. of Households	Residential Structures			
		Pucca	Semi-pucca	Kutcha	Jhupri
Core Area					
Pirijpur	9757	21.5	31.5	46.8	0.2
Shambhupura	5961	9.4	21.9	67.8	0.9
Hossaindi	5173	5.5	12.6	81.6	0.3
Buffer Area					
Mugrapara	7736	28.2	22.7	48.8	0.2
Sanmandi	8403	5.20	9.40	85.20	0.20
Bandar	7326	12.8	22.7	64.2	0.2
Musapur	5918	8.9	16.3	73.7	1.1
Gazaria	3573	8.4	11.5	79.8	0.4
Baluakandi	3855	13.4	17.1	69.2	0.3
Tengerchar	3614	13.1	19.7	65.8	1.4
Sonargaon	7289	18.09	20.48	61.14	0.28
PSA					
Chalibhanga	2420	1.4	15.6	82.8	0.2

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

Core Area - Sanitation

The census 2011 information indicates that the sanitation facilities within the core study area comprises mostly of sanitary hardware with dry disposal mechanism (72.5 percent). A smaller percentage of the households (21.6 percent) were observed to be using sanitation facilities with water sealed sanitary latrines. Practice of open defecation or absence of any form of sanitation facilities was observed within the unions, although the percentage is low (***Table 4.34***).

Buffer Area - Sanitation

It is similar to the core area that the sanitation facilities within the buffer study area comprise mostly of sanitary hardware with dry disposal mechanism

(58.55 percent) and a smaller percentage of the households (23.50 percent) were reported to be using sanitation facilities with water sealed sanitary latrines. Practice of open defecation or absence of any form of sanitation facilities was observed within the unions, although the percentage is low (***Table 4.34***).

Table 4.34 Distribution of Sanitation Units in Core and Buffer Study area

Union	No. of Households	Sanitation Units			
		Water sealed	Non-water sealed	Non-sanitary	None
Core Area					
Pirijpur	9757	21.6	69	8.7	0.6
Shambhupura	5961	2.6	94	2.9	0.5
Hossaindi	5173	14.2	54.5	26.2	5.2
Buffer Area					
Mugrapara	7736	29.4	56.1	13.8	0.7
Sanmandi	8403	0.60	67.00	30.40	2.00
Bandar	7326	32.1	51.4	15.8	0.6
Musapur	5918	25	58.1	16.1	0.8
Gazaria	3573	13.70	73.20	12.6	0.50
Baluakandi	3855	40.1	48.1	9.8	2
Tengerchar	3614	44.3	44.5	10.5	0.6
Sonargaon PSA	7289	24.64	54.54	19.70	1.12
Chalibhanga	2420	1.7	74	20.4	3.9

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

Health Facility

The primary centres for immediate medical assistance at the Upazila are the private or government clinics and the health complexes located at in the upazilla and the union levels respectively. However, these clinics and health complexes are mostly for diagnosis of minor medical conditions and are not equipped to handle any serious medical conditions or surgical procedures. Assistance in those regards is provided at either district level hospital or private hospitals.

The ***Table 4.35*** provides an overview of the medical and healthcare infrastructure within the two Upazillas and Districts.

Table 4.35 Healthcare Infrastructure Statistics for Upazilas & Districts in Study Area

Upazila / District	Medical College Hospital	District Hospital	General Hospital	Upazila Health Complexes	Union Sub Centres	Private Clinics
Upazila						
Sonargaon	0	0	0	1	3	11
Gazaria	0	0	0	1	4	2
Meghna	0	0	0	1	5	0
District						
Narayanganj	0	1	1	4	12	65
Munshiganj	1	1	0	5	26	53
Comilla	6	0	0	6	140	113

Source: Health Bulletin 2016, for Sonargaon & Gazaria Upazilas, Narayanganj & Munshiganj & Comilla Districts

Financial Institutions

Details of the Financial Institutions in the three Upazilas – Sonargaon, Gazaria and Meghna and three Districts – Narayanganj, Munshiganj and Comilla are provided in ***Table 4.36***.

Table 4.36 Financial Institutions in Upazilas & Districts in Study Area

Upazila/ District	Nationalized Commercial Bank	Private Commercial Bank	Krishi Cooperative Bank	Grameen Bank
Upazila				
Sonargaon	7	7	2	3
Gazaria	7	6	2	3
Meghna	2	2	1	2
District				
Narayanganj	83	50	14	15
Munshiganj	52	33	17	24
Comilla	123	85	45	84

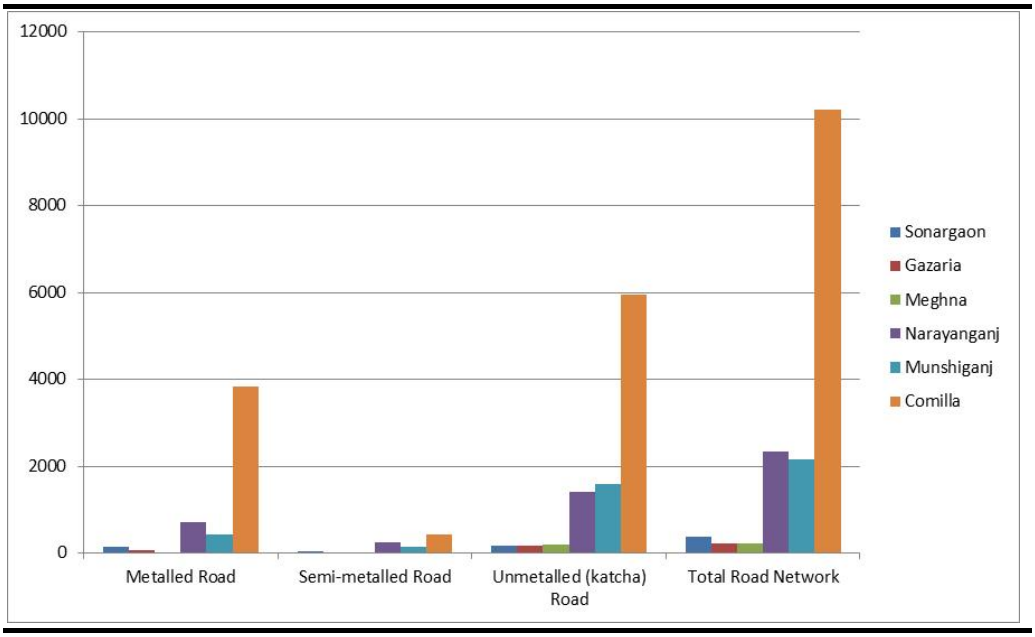
Source: District Statistics -2011 – Narayanganj, Munshiganj and Comilla

Road and Transportation

The districts of Narayanganj , Munshiganj, Comilla have a total road network of 2348.12 km, 2160.83 km, 10217 respectively. In Sonargaon , Gazaria and Meghna Upazila total road network is 364.25 km, 232 km and 219 km respectively.

Figure 4.45 provides the percentage of different type of road with in the study area. Percentage of un-metalled road in both the Upazilas is higher than the metalled roads. However, within the Meghnaghat Power Hub the blacktop motorable roads are available. There is existing road connection upto the Project site. This infrastructure may be required to be improved to make it capable of handling the transport load due to industrialisation.

Figure 4.45 Percentage of different type of road network with the study area



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

Waterway

Sonargaon and Meghna Upazila is not connected by waterways, however Gazaria Upazila is connected by 18 km waterways (river and canals) in monsoon and 28 km of waterways round the year as per information available from District Statistics, 2011.

Railway

Both Sonargaon, Gazaria and Meghna Upazilas are not connected by railways.

Power Supply

In Sonargaon Upazila 96.9 percent of the households and in Gazaria Upazila 77.6 percent households have electricity connection. Percentage of household electricity connection is higher in Pirijpur Union (98 percent) and Shambhupura Union (97.4 percent) than the average electrification at Upazila level. Average 86.84 percent household has electricity connection.

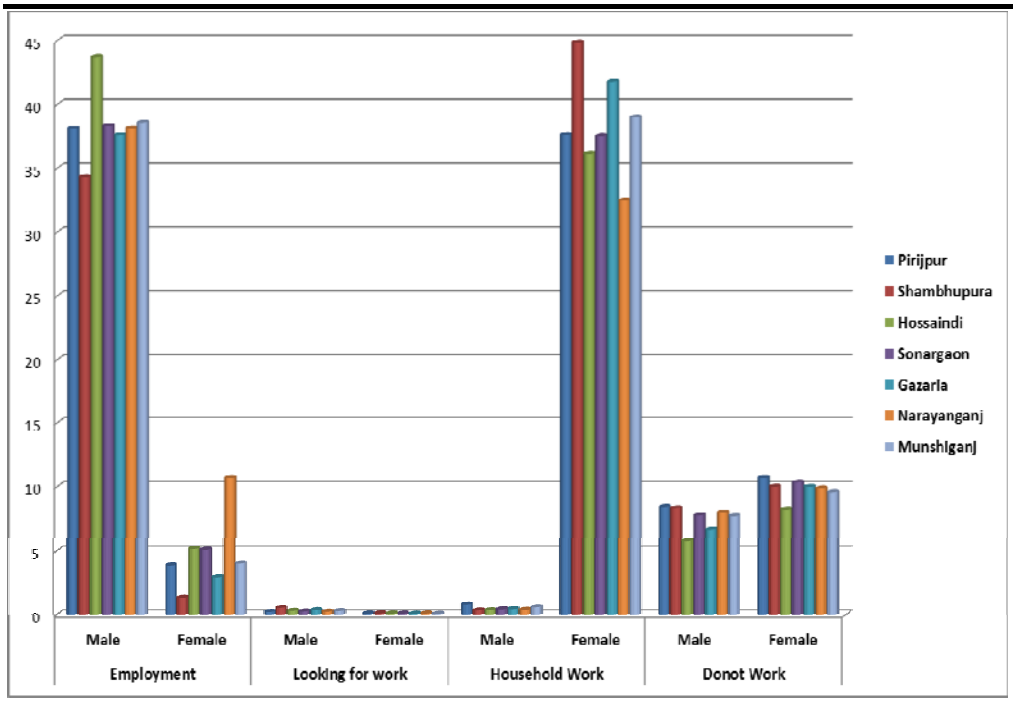
4.5.7 Occupational Pattern

Core Area

The employed population in the districts of Narayanganj and Munshigunj are 3,25,273 and 1,47,819, which is 48.82 percent and 42.64 percent respectively of the total population. Within the core area the employed population is higher in Hossaindi Union which is south –west of Pirijpur Union, indicating that a large population of workers working in the Meghnaghat industrial hub potentially resides in this union. In core study area Pirijpur, Shambhupura and Hossaindi, the rate of employment is 42.02, 35.68 and 48.94 percent respectively.

Employment status of women shows that 32.48 percent in Narayanganj and 39 percent in Munshigunj are involved in household work. In core study area 39.55 percent women are involved in household activities and about 10 percent of the female population do not work at all.

Figure 4.46 Employment Pattern of Core Area

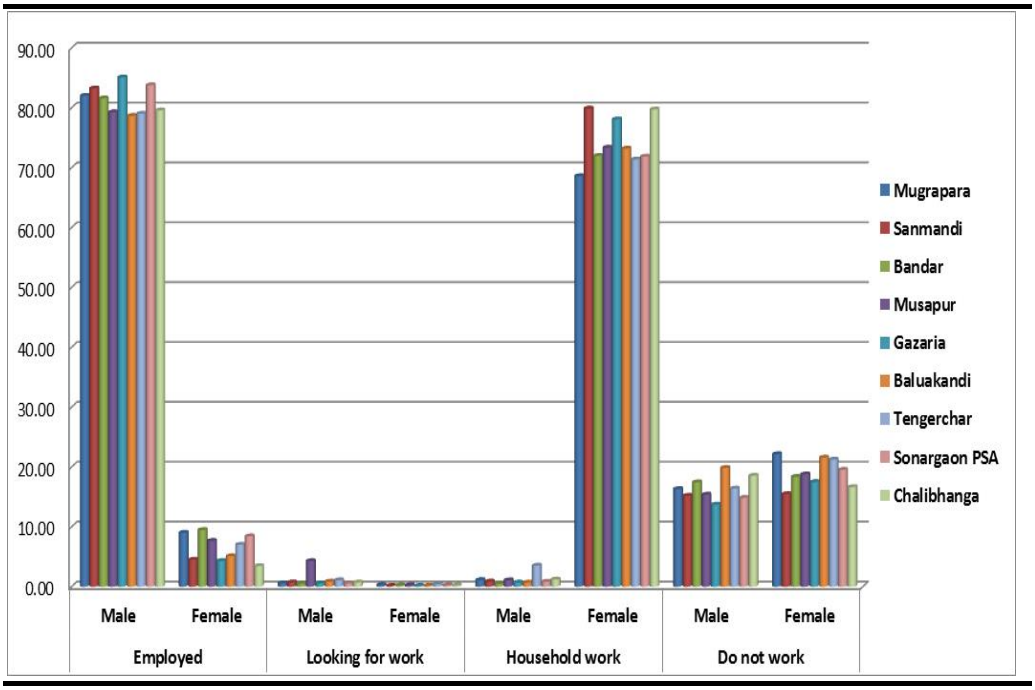


Source: Population and Housing Census 2011, Bangladesh Bureau of Statistics (BBS), 2011

Buffer Area

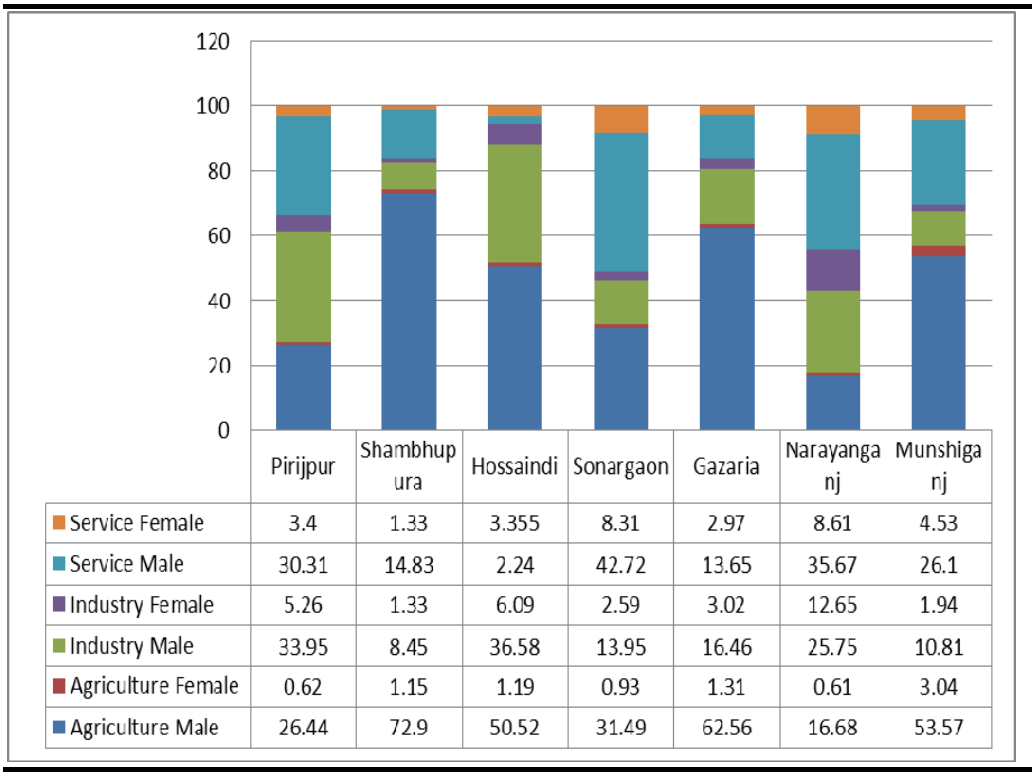
Within Buffer area male population are more employed than the female population; and female population are mainly involved in household work. Highest and lowest employed male population was found in Gazaria Upazila and Baluakandi Union respectively.

Figure 4.47 Employment Pattern of Buffer Area



It can be observed from population census data that the main source of livelihood for a majority of the population is agriculture and allied activities. Being an industrial zone, industry and service sector provides a considerable opportunity of employment. Percentage of industrial workers is highest in Hossaindi Union (36.58 percentage) within the core study area, followed by Pirijpur Union (33.95 percentage). Service sector employment is higher in Narayanganj District than in Munshiganj.*(Figure 4.48)*

Figure 4.48 Sector Wise Employment in Core Area

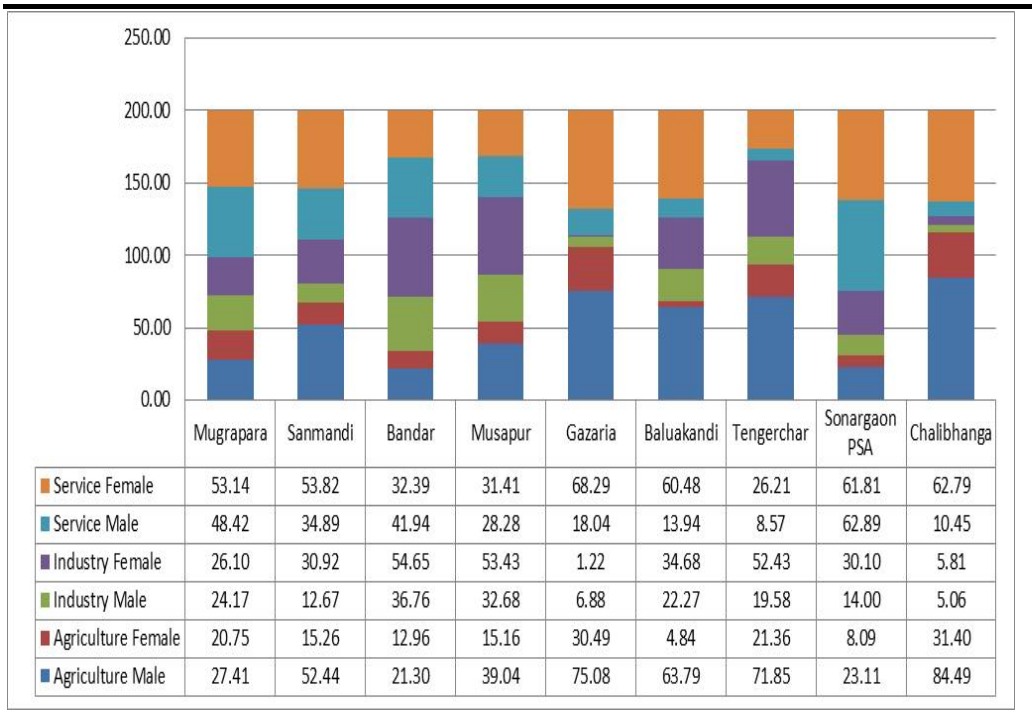


	Pirijpur	Shambhupura	Hossaindi	Sonargaon	Gazaria	Narayanganj	Munshiganj
Service Female	3.4	1.33	3.355	8.31	2.97	8.61	4.53
Service Male	30.31	14.83	2.24	42.72	13.65	35.67	26.1
Industry Female	5.26	1.33	6.09	2.59	3.02	12.65	1.94
Industry Male	33.95	8.45	36.58	13.95	16.46	25.75	10.81
Agriculture Female	0.62	1.15	1.19	0.93	1.31	0.61	3.04
Agriculture Male	26.44	72.9	50.52	31.49	62.56	16.68	53.57

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

It can be observed from population census data that the main source of livelihood for a majority of the population is service and industry. Being an industrial zone number of industrial workers and service sector work provides a considerable amount of employment. *(Figure 4.49)*

Figure 4.49 Sector Wise Employment in Core Area



	Mugrapara	Sanmandi	Bandar	Musapur	Gazaria	Baluakandi	Tengerchar	Sonargaon PSA	Chalibhanga
Service Female	53.14	53.82	32.39	31.41	68.29	60.48	26.21	61.81	62.79
Service Male	48.42	34.89	41.94	28.28	18.04	13.94	8.57	62.89	10.45
Industry Female	26.10	30.92	54.65	53.43	1.22	34.68	52.43	30.10	5.81
Industry Male	24.17	12.67	36.76	32.68	6.88	22.27	19.58	14.00	5.06
Agriculture Female	20.75	15.26	12.96	15.16	30.49	4.84	21.36	8.09	31.40
Agriculture Male	27.41	52.44	21.30	39.04	75.08	63.79	71.85	23.11	84.49

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

Industrialisation and the Local Economy

The local economy is driven by the presence of a large number of industries and their ancillary/associated activities. Now Narayanganj and especially Sonargaon is an industrial zone. There are already three power plants adjacent to the project. Within three kilometre radius of this project, there are shipyards, cement plants, a print and packaging industry to name a few.

Manychatal (rice husking mills) are found on this bank of the Meghna River. So, many local people are getting employment in the chatal for husking rice, and most of them are female workers. On the opposite bank of the river from the project site, there are many more industries, e.g. shipbuilding industry, chemical factory, refinery etc. making the area around the project industrially significant at a highest level.

Agriculture

The study area is low- lying especially Sonargaon portion. Main crops grown are Aus, Aman and Boro. The paddy is grown in the main three seasons of the year. Besides these, potatoes, sweet potatoes, oil seeds, vegetables, arum, til

(sesame), wheat, sugarcane, mustard, bottle gourd etc. are cultivated in the study area. Fruits like, jackfruit, lemon, watermelon are also produced.

Fishing

Meghna River is enriched with different kinds of fishes and many people around the area depend on fishing across Meghna River for their living. Production of cultured fish is 250kg/Acre (0.25 metric ton) and open water fish production is 500 kg/Acre (0.5 ton.). Major fish varieties are Ruhi, Katla, Taki, Kai, Magur, Singhi and Boal etc. Kai and Singhi are nearly extinct varieties. And rare fishes like River Pangas, Rani, Raia, Mahashail and Lacho fish are totally extinct varieties.

Three kinds of fishermen can be found in the study area.

- Subsistence: These fishermen catch fish for just to have one or two meal. They don't depend on fishing for their living.
- Intermittent: These fishermen catch fish as a part time profession to add a little in their overall income.
- Professional: These fishermen catch fish almost every day and their livelihood depends on it. Fishing is considered to be their main source of income

It is reported that there are fishing community or fishing households who reside along the banks of the Meghna River. Preliminary consultations reveal that around 40-50 fishermen families live in Char Balaki, Pachani and Dudghata and nearly 150 fishermen fish in the core area. Most of these fishermen come from neighbouring areas i.e. Char Balaki, Pachani and Dudghata, which are also fall within the core area. Their fishing practices and locations change according to the seasonal conditions. Further details are currently being studied to understand their dependence on Meghna River and its aquatic life as part of the fisheries study.

Cattle Rearing

There are no cattle farms /animal husbandry farms in the area but people have been observed to keep a few cows in their home as means of supplementing their income sources. Most of the cattle owners work in various industries near the project site and keep cows as a source of additional income. These cows graze near the project site – approximately around 25-30 Nos. The owners can be expected to find other grazing grounds after the completion of the project considering that the number of cows is few and there are empty lands that are available within the industrial area adjacent to the project site.

4.5.8 Cultural Resources

No significant archaeological or historically important structure or sites are reported from the study area. But at about six to seven kilometre distance

from the project site, the historical Panam City is situated. However, there will not be any impact on this historic site due to the project.

There are few other historically significant places situated in the Sonargaon Upazila namely Single domed mosque built by Jalaluddin Fatheh Shah, Tomb of Sultan GhiyasuddinAzam Shah, single domed mosque built by AlauddinHussain Shah, Tomb of Shah Langar, PanchPirDargah, grand trunk road, Khasnagardighi, Company Kuthi, Yusufganj mosque, Goaldi mosque and Langalband (holy bathing spot). None of these places are close enough to be adversely affected by the project.

5.1 SCREENING

5.1.1 Project Categorisation as per DOE, Ministry of Environment and Forest, Bangladesh

Depending upon location, size and severity of pollution loads, projects/ activities have been classified in the ECR, 1997 into four categories: *Green*, *Orange A*, *Orange B* and *Red*, respectively, to nil, minor, medium and severe impacts on important environmental components (IECs).

As per the *Schedule-1* of the ECR 1997, corresponding category related to power plants and associated facilities (e.g. laying of natural gas pipeline from nearest distribution point up to the power plant; water pipelines for intake and outfall; and fuel oil supply pipeline), fall under ***Red Category*** for the following components:

- Item 6 : power plants
- Item 64: water, power and gas distribution line laying/ relaying/ extension.

5.1.2 Project Categorisation as per ADB Safeguard Policy Statement

Categorization for the proposed Project was undertaken by using ADB's Rapid Environmental Assessment (REA), Involuntary Resettlement (IR) and Indigenous People (IP) Assessment checklists during the screening and scoping exercise. The REA checklist of the Project for the Thermal Power Plant Sector has been presented in *Annex B*. The IR Assessment checklist and Indigenous People (IP) Assessment checklist have been presented in *Annex C* and *Annex D*, respectively. The findings of the assessment are presented in ***Table 5.1***.

Table 5.1 Project Categorisation as per ADB Safeguards

S. No.	Criteria	Relevance	Remarks	Category
1	**Environmental Categorization**			
(a)	Irreversible	Environmental issues and impacts of the Project are anticipated during the construction and operation of the power plant and development of associated infrastructure (such as gas pipeline from valve station to the plant, construction and operation of jetty at Meghna	Irreversible impacts due to the Project include: • Increase noise and vibration during the plant construction and operation • Change in air quality due to existing and proposed projects • Occupational health and safety; • Community health and safety; • Risks due to transport, storage and	***Based on, irreversible, diverse and cumulative impacts, it should be categorized as 'A'.***

S. No.	Criteria	Relevance	Remarks	Category
		River, etc.).	handling of highly flammable chemicals; • Associated development in the area.	
(b)	Cumulative	Three operational power plants in the neighbourhood. Planned developments within the power hub. No. of other industrial operations within Meghnaghat north and south industrial areas	Cumulative impacts on physical, biological and socio economic environmental conditions	
(c)	Diverse	Nature of activities	The nature of activities is not diverse for the area, as there are already three operational power plants, however pollution load will increase.	
(d)	Unprecedented	Change in landuse	The Project is a green-field project being proposed on developed land within a Power Hub. Summit Group is already having an operational power plant next to it. The Project and its impacts are therefore having precedence; however, this development is going to attract more industrial and infrastructure development in the study area. There will however be no change of land use due to the Plant	
2	**Involuntary Resettlement Categorization**			
(a)	Mode of Acquisition	By Land Lease Agreement	14.28 acres of land for the Project will be obtained through process of land lease agreement from BPDB. In addition to that about 9.4 acres of land will be required for Gas Supply Line, Laydown Area and Worker's Accommodation during construction period. This will be obtained through land lease agreement from BPDB and	***The land will be obtained by the Project Proponent through land lease agreement from BPDB. No land acquisition will take place for the proposed project.*** ***No evidence of any form of land related***

S. No.	Criteria	Relevance	Remarks	Category
			Government.	***dependence (homestead area or livelihood) was observed at the site location.*** ***Hence on Involuntary Resettlement, the Project shall be categorised as 'C'.***
(b)	Precedence	BPDB currently owns the land (14.28 acres) and intends to lease to the Project Proponent for a period of 22 years. In addition, land is intended to be taken from BPDB and Government through land lease agreement for Gas Supply Line, Laydown Area and Worker's Accommodation during construction period.	The proposed project area was acquired by BPDB in 1997-98. Prior to acquisition this char area was only used for cultivation in dry season. Presently there is no cultivation done. The project area is fenced and grazing is not observed. There is no settlement, trees or and crop cultivation in the project area. Therefore, R&R issue is not applicable for this project.	
(c)	Irreversible	Project affected households	Land acquisition was undertaken by BPDB in 1997-98; the affected persons have already been compensated.	
3	**Indigenous People Categorization**			
(a)	Presence	Existence of indigenous people	The census data (2011) of Bangladesh shows that the total population of ethnic minority in Sonargaon Upazila is 162 and in Pirijpur Union Parishad is 6. There are 42 ethnic households in Sonargaon Upazilla and 1 household in Pirijpur Union. There will be no impact on the ethnic minority household.	***In case of no foreseen adverse impact, project shall be categorized as 'C'.***
(b)	Impact	Impact on indigenous/ ethnic/ scheduled tribes	No adverse impact on the Ethnic Minority is foreseen	

5.1.3 Project Categorisation as per IFC Performance Standards

With reference to the IFC's environmental and social screening criteria, it is anticipated that the proposed Project will fall under *Category A* for the following reasons:

- **Irreversible:** Environmental and social impacts of the project are anticipated during the construction and operation of the power plant. The irreversible impacts will encompass increase noise and vibration during the plant construction and operation, change in air quality due to existing and proposed projects, affected aquatic ecology and surface water quality due to hot water discharge from the power plant in case of accidental discharge without cooling, occupational health and safety issues, community health and safety issues, risks

due to transport, storage and handling of highly flammable chemicals as well as toxic chemicals and associated development in the area. These impacts will irreversible in nature without any mitigation measures and hence require proper attention to mitigate and minimise the overall impact in the project influence area.

- **Cumulative:** Cumulative impacts on physical, biological and socio-economic environmental conditions are anticipated due to proposed power projects within the same airshed as well as other developmental activities including upgradation of Dhaka – Chittagong Highway and new bridge construction on the River Meghna.
- **Unprecedented:** The Project is a green-field project. The Project site is a developed land, already earmarked for the power plant. Summit Group is already having an operational power plant next to it. The Project and its impacts are therefore having precedence. It is to be noted that this development will attract more industrial and infrastructure development in the study area. There will however be no change of land use due to the Plant.

5.1.4 Project Screening using Summit Corporation Limited ESMS Checklist

Summit Corporation Limited, the parent company of SMIIPCL has developed and adopted an Environmental and Social Management System (ESMS) from Year 2017. For all the new projects (greenfield/ brownfield), it requires a project screening for decision making (go/ no-go) as well as identification of further actions such as due diligence and/or environmental and social impact assessment studies or other specific studies in order to identify, assess and mitigate environmental and social impacts that could arise due to project development.

Since the Summit M2 project is a greenfield development and hence checklist for greenfield development has been prepared based on available information about the site and surroundings as well as available project information. Same is presented in ***Annex E***.

The project is categorised as **Category A** as per "Rational of Categorisation" provided in Corporate ESMS of SCL, particularly due to irreversible and diverse impacts of air emissions and greenhouse gases emissions and existing air quality in the study area, which is having high particulate matter concentrations.

5.2 SCOPING

5.2.1 Identification of Potential Environmental and Social Impacts

Potential environmental and social impacts have been identified through a systematic process whereby the activities (both planned and unplanned) associated with the construction and operation of the Project have been considered with respect to their potential to interaction with sensitive environmental and social resources or receptors. Scoping of potential impacts has been undertaken in two stages:

- Stage 1: Identification of potential interactions between project activities and environmental receptors; and
- Stage 2: Prioritization of these interactions in terms of their potential to cause significant impacts taking into consideration the current knowledge of project activities, and the existing condition/ sensitivities of environmental and social baseline.

The approach taken and outcomes for each stage are discussed in the subsequent section.

5.2.2 Scoping Matrix

The Scoping Matrix enables a methodical identification of the potential interactions each Project activity may have on the range of resources/receptors within the Area of Influence for the Project.

The matrix consists of a list of resources/receptors that could be affected by the Project activities, set against a list of Project activities. Entries in the matrix cells are coloured to indicate whether:

- An interaction is not reasonably expected (white);
- An interaction is reasonably possible but none of the resulting impacts are likely to lead to significant effects (grey); or
- The interaction is reasonably possible and at least one of the resulting impacts is likely to lead to an effect that is significant (black).

All potential interactions, regardless of probability of occurrence, are considered at this stage.

Table 5.2 Scoping Matrix of Potential Interactions

Project Activity/ Hazards	Environmental Resources													Social Resources								
	Land Forms/ Profile	*Soil/ Sediment Quality*	*Land Use*	*Air Quality*	*Climate Change*	*Drainage Pattern*	*Surface Water Quantity/Quality*	*Ground Water Quality*	*Ambient Noise Levels*	*Vibration*	*Occupational Health & Safety*	*Terrestrial Ecology*	*Aquatic Flora / Fauna (Biodiversity)*	*Demographics (i.e. Displacement)*	*Economy & Livelihoods*	*Social & Cultural Structures*	*Land Use (including Economic Displacement)*	*Infrastructure & Services*	*Cultural Resources*	*Community Health & Safety*	*Vulnerable Groups*	*Social/ Community Cohesion*
Construction Phase – Summit M2 Project																						
Land acquisition/ purchase / lease	■																					
Site clearing and levelling		■		■					■													
Site preparation		■		■		■																
Earth moving		■		■					■													
Building of structures including temporary structures		■																■		■		
Heavy equipment operations and piling				■					■	■										■		
Storage, handling and disposal of waste		■					■													■	■	
Generation of sewage							■															
Influx of construction workers															■	■		■				
Transportation of equipment and materials over water							■								■							
Transportation of personnel and material by road				■						■								■		■	■	
Storage and handling of chemicals (unplanned release)													■							■		
Washing of vehicles and equipment							■															
Concreting works		■				■																
Operation Phase – Summit M2 Project																						

Project Activity/ Hazards	Environmental Resources													Social Resources								
	Land Forms/ Profile	*Soil/ Sediment Quality*	*Land Use*	*Air Quality*	*Climate Change*	*Drainage Pattern*	*Surface Water Quantity/Quality*	*Ground Water Quality*	*Ambient Noise Levels*	*Vibration*	*Occupational Health & Safety*	*Terrestrial Ecology*	*Aquatic Flora / Fauna (Biodiversity)*	*Demographics (i.e. Displacement)*	*Economy & Livelihoods*	*Social & Cultural Structures*	*Land Use (including Economic Displacement)*	*Infrastructure & Services*	*Cultural Resources*	*Community Health & Safety*	*Vulnerable Groups*	*Social/Community Cohesion*
Air emissions from stacks of the plant				■							▒									▒		
GHG emissions					■										▒					▒		
Noise generation due to operation of plant and auxiliaries									■	▒	■									▒		
Water demand for plant operations							▒								▒					▒		
Wastewater discharge/ disposal		▒					■	▒					▒							▒	▒	
Wastes – domestic waste and other non-hazardous wastes handling, storage															▒					▒		
Hazardous material and waste storages		■					▒	■			▒											
Natural gas transportation by pipeline																				▒		
HSD transportation by barges				▒			■		▒				▒							▒		
HSD transportation by pipeline											▒									▒		
Transportation of personnel, raw material/s and disposal of wastes																				▒		
Employment															▒							
Cumulative Impacts – Proposed Power Plants in Meghnaghat Power Hub and Char Balaki																						
Air emissions from stacks				■							▒									▒		
Noise generation due to operation of plant and auxiliaries									■	▒	■									▒		

□ = Represents "no" interactions is reasonably expected

▒ = Represents interactions reasonably possible but none of the outcome will lead to significant impact impacts

■ = Represents interactions reasonably possible with one of the outcomes may lead to potential significant impact

5.2.3 Environmental and social impacts

Key environmental impacts

Cumulative Impacts

There are three operating power plants in Meghnaghat Power hub; these are 337 MW Duel Fuel Summit M1 CCPP (natural gas and HSD), 450 MW Meghna CCPP (natural gas) and 100 MW Engine based Power Plant (HFO). A 750 MW CCPP power plant (RLNG) within Meghnaghat Power Hub and a 650 MW coal based power project at Char Balaki are also proposed within or near to the Meghnaghat Power hub. Thus the project impacts cannot be assessed in isolation and the cumulative impacts are anticipated and also need to be assessed. The information about the existing power plants will be taken into consideration from the primary and secondary baseline data, whereas impact due to proposed power plants will be assessed using mathematical model, wherever practical to assess the cumulative impact on the receptors within the study area.

Land Contamination

The entire project site is developed land, which has been filled with the sand to raise the site level above the highest flood level. Source of the filling material is not known and hence the quality of the filled material needs to be ascertained during the soil sampling at site. Also, construction solid wastes will adversely impact upon soil quality and land aesthetics.

Construction Period

As Bangladesh has a long monsoon period from mid-May to early-October months, the scheduling of the construction period will be an important issue in terms of construction management and safety of the workers from construction schedule as well as safety and health related concerns.

Population Influx

The proposed project will result in influx of workers to the area because of construction activities, and hence potential employment and contract opportunities. This may result in stress on the local resources in absence of proper planning for the drinking water and sanitation facilities of the workers.

Impact on Meghna River

Treated effluent including cooling water blow down[1] from the Plant will be discharged into River Meghna by a buried pipeline of about 0.5 km. The project will be providing induced draft cooling towers to reduce the water requirement for the Plant and the discharge capacity will be of the order of 300

[1] Cooling tower bleed-off/blowdown is the flushing of a portion of high mineral concentration cooling tower system water down the drain, while simultaneously replacing it with fresh water. This process dilutes the system water mineral concentrations that steadily increase due to water evaporation. Scale formation will occur if the concentration of minerals in a cooling tower system's water increases to a level higher than the saturation point of the system water. The mineral content above the saturation point will fall out of the solution of the water and form hard mineral scale throughout the system.

m^3/hr. It is to be noted that the discharge will not be continuous. It is reported that the blow down will be retained at central monitoring basin along with other treated effluent from the plant and will be tested for water quality including temperature before discharge into the Meghna River. Any likelihood of impact due to hot water discharge and/or treated effluent discharge on aquatic fauna and downstream users' is studied in this study.

There is no specific standard with respect to hot water discharge from thermal power plants in Bangladesh; however, as per Schedule 10 (Standards for Waste from Industrial Units or Projects Waste) of the ECR 1997, discharge water temperature shall not exceed 40°C during summer season and 45°C during winter season. Therefore, there is a need to design the cooling water system for the Project, based on the River water temperature during summer and winter seasons. However, during the consultation with the Fisheries Department (done earlier for similar type of Project), the department has suggested that the temperature rise be maintained within 3°C from ambient river water temperature.

Also, as per the IFC EHS Guidelines for Thermal Power Plants, thermal discharge should be designed to ensure that discharge water temperature does not result in exceeding relevant ambient water quality temperature standards outside a scientifically established mixing zone. The mixing zone is typically defined as the zone where initial dilution of a discharge takes place within which relevant water quality temperature standards are allowed to exceed and takes into account cumulative impact of seasonal variations, ambient water quality, receiving water use, potential receptors and assimilative capacity among other considerations. It also states that establishment of such a mixing zone is project specific and may be established by local regulatory agencies and confirmed or updated through the project's environmental assessment process.

There is no specific limit for temperature increase by thermal discharge from cooling system has been given in Performance Indicators presented in Table 5 of EHS Guidelines. It only states that Elevated temperature areas due to discharge of once-through cooling water (e.g., 1 °Celsius above, 2 °Celsius above, 3 °Celsius above ambient water temperature) should be minimized by adjusting intake and outfall design through the project specific EA depending on the sensitive aquatic ecosystems around the discharge point. However, as per the IFC General EHS guidelines use of heat recovery methods or other cooling methods to reduce the temperature of heated water prior to discharge should ensure that the discharge water temperature does not result in an increase greater than 3^oC of ambient temperature at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity among other considerations.

Noise and Vibrations

There will be impact of noise and vibration from the plant (during construction as well as operation) on the settlements in the close vicinity. These impacts will be from proposed power plant as well as from other power plants (existing and proposed) in the form of cumulative impacts. Though the nearest settlement (Islampur) is about 650 m away from the project boundary and site is already fenced, the noise and vibration impacts are required to be studied by baseline ambient noise monitoring and prediction of impacts due to proposed power plants.

Air Emissions

The existing power plants and the proposed Project are based on dual fuel (natural gas and HSD). Primary fuel for both the plants is natural gas, which is considered as a cleaner fuel, however these plants also pollute the area with NOx and CO emissions and can impact air quality of the area in absence of proper pollution control measures. In addition, use of HSD as an alternate fuel will increase the SO_2, NOx and PM concentrations in the ambient air. Further to this, conceptualised future power hub developments will also have cumulative impact on the ambient air quality of the area.

Health and Safety issues

Probability of occurrence of worker accidents is anticipated to be high in all construction works. Concentration of labour force in the work area is anticipated to create unhygienic conditions. Safety can be a major concern related to HSD supply pipeline and huge quantity of tank storage at site. Also there are risks related to the operation of the thermal power plant.

Social Impacts

Land Acquisition

As discussed earlier, the project does not involve acquisition of private land, though historically (1997-98) land acquisition had been undertaken and after which the land was handed over to BPDB. The land acquisition was done for establishing the power-hub. A part of land area, particularly char land (land on the banks of river which is prone to river erosion) was reportedly used for agriculture during the dry season. Most of them did not have a legal title to cultivate land. The details of the extent of the private land acquired for the power hub by BPDB is not available, though it was learnt some private land belonging to the Union Parishad Pirijpur was involved. As the project does not propose to acquire any private land, there will be no physical or economic displacement.

Impact on Livelihood

The project is expected to provide opportunity to unskilled wage labours in the locality. The wage earning will supplement their earnings from agriculture, fishing and household industries. Cooling tower blowdown and

other treated effluent from the Plant will be discharged into River Meghna by a pipeline of about 0.5 km. The project will be providing cooling towers to reduce the water requirement for the Plant and the discharge capacity will be about 300 m^3/hr and same will not be continuous.

However, it needs mentioning that a section of local population is engaged in fishing activity in the Meghna River. In the post monsoon season the fishermen practise kata fishing [1]in that area. Movement of the barges during the construction phase may put the kata fishing activities of the local fishermen at risk. To assess the impact on fishermen, The ESIA study will map the fishing villages, fishing locations and fish landing centres for nearby fishermen with respect to the project related impacts.

Population Influx

The proposed project will result in influx of workers to the area because of construction activities, and hence potential employment and contract opportunities will be created. The project will also facilitate in-migration of labour, skilled workers and staffs (national and expatriates) who would live or stay in the locality for varied length of time. This may result in stress on the local resources in absence of proper planning for the drinking water and sanitation facilities of the workers.

Labour Issues

The project in construction and operation phase will employ labour that would give rise to a range of labour issues including protecting their rights, providing them requisite facilities, protecting their health, and providing a safe working condition to them. Hence, a detailed examination is required to assess the risks to the labours engaged during the project work.

Community health and safety

The population influx is expected to expose the local population to an increased risk of communicable and vector borne diseases in the locality. Hence, a close assessment of the health care facilities available in the project area and community health and safety is necessary.

Occupational Health and Safety

In addition to the labour employed for the construction, there will be a sizable number of skilled and supervisory staff engaged during the project construction and operation. The assessment of risk to their health and safety of their workplace will also be undertaken during impact assessment.

Impact on indigenous or ethnic communities/groups, if any

[1] Kata fishing is done by piling of tree branches, bushes or water hyacinth set on the river or *beel* (big pond) bottom. Fish are usually attracted into the kata by the shelter provided and by the increased food supply. During the dry season, fish can become densely amassed in a kata and thus becomes easier to catch once they have taken refuge there. To harvest a kata zone, blocking nets is set around the kata, the branches are removed and blocking net is closed up. Final harvest may be with a beach seine or castnet inside the blocking net.

The preliminary social screening of the area based on Census 2011 data of Bangladesh within the core study area shows that there is only one household of ethnic community[1] with a total population of 6 in Pirijpur Union. There are no major residential settlements adjacent to the project site. Hence, impacts on indigenous communities are not significant.

Impact on Cultural Resources

The project site does not have any structure with cultural and heritage significance. There are no mosques and other religious places around the project site. Hence, impacts on cultural resources are not anticipated.

[1]Ethnic groups in the project context as defined by the Census 2011 of Bangladesh, includes communities like Orao . Coach, Sawntal and others.

6 IMPACT ASSESSMENT & MITIGATION/ ENHANCEMENT MEASURES

6.1 INTRODUCTION

This section assesses the manner in which the Project will interact with elements of the physical, ecological, social, cultural or human environment to produce impacts to resources/receptors. This has been organized as per the various stages of the project lifecycle to understand the risks and impacts associated with each of these individual stages.

The Project does not envisage any significant environmental/ social impact in the pre-construction phase, which primarily involves feasibility study and possession of land for development of the power plant, as the land required for the project is already under possession of BPDB. Hence, the environmental and social impacts due to the Project activities are considered in the two distinct stages of the Project life cycle: (a) construction of the Plant (Construction Phase); and (b) operation and maintenance of the Plant (Operation Phase).

Environmental and social impacts during decommissioning of the Plant have not been considered in the impact assessment, as these will depend on the options available at the time of expiry of the power purchase agreement between SMIIPCL and BPDB. The design life of the power plant is estimated to be 30 years, which is almost 8 years longer than the project life as depicted in the LOI term. If the Power Purchase Agreement, Land Lease Agreement, Gas Supply Agreement and the other relevant agreements are not extended or renewed and an alternative economical fuel is available, the power plant may be retrofitted to support alternative power generation. This option would be possible, provided that the required retrofits and new emission rates meet the applicable standards and guidelines. If retrofitting is not a feasible option, and the operational life of the Power Plant expires, the power plant will be decommissioned according to the requirements of the authorities at that time. SMIIPCL will require undertaking an appropriate assessment of environmental and social risks and impacts with respect to the most feasible option.

Impacts are identified and predicted based on the analysis of the information collected from the following:

- Project information (as outlined in ***Section 2***);
- Baseline information (as outlined in ***Section 4***).

The identification of likely impacts during construction and operation phases has been carried out based on likely activities having their impact on environmental and socio-economic parameters, which are presented in ***Section 5.2***. The details of the activities and their impacts have been worked out in the following sections.

6.2 IMPACT ASSESSMENT METHODOLOGY AND APPROACH

Impact identification and assessment starts with scoping and continues through the remainder of the impact assessment process (IAP). The principal impact assessment (IA) steps are summarized in ***Section 1.5.4***.

6.2.1 *Prediction of Impacts*

Prediction of impacts is essentially an objective exercise to determine what could potentially happen to the environment as a consequence of the project and its associated activities. This is essentially a repeat of the process undertaken in scoping, whereby the potential interactions between the project and the baseline environment are identified. From these potential interactions, the potential impacts to the various resources/receptors are identified, and are elaborated to the extent possible. The diverse range of potential impacts considered in the IA process typically results in a wide range of prediction methods being used including quantitative, semi-quantitative and qualitative techniques. The nature and types of impacts that has been addressed in this EIA is defined in the ***Box 6.1*** below.

Box 6.1 Nature and types impacts considered for impact assessment

- **Negative**, when impact is considered to represent adverse change from the baseline or to have introduced a new undesirable factor; and
- **Positive or beneficial**, when impact is considered to represent improvement to baseline or to have introduced a new desirable factor.
- **Direct,** impacts that result from a direct interaction between the project and a resource/ receptor
- **Indirect**, impacts that follow on from the direct interactions between the project and its environment as a result of subsequent interactions within the environment; and
- **Induced**, impacts that result from other activities (which are not part of the project) that happen as a consequence of the project

6.2.2 *Evaluation of Impacts*

In assessing the significance of impact, the following impact characteristics are taken into consideration:

Determining Magnitude of an impact

Magnitude, i.e. severity of an impact or degree of change caused by a project activity is a function of one or more of the following characteristics:

- *Scale*: Degree of damage that may be caused to the environmental components concerned.
- *Extent*: The extent refers to spatial or geographical extent of impact due to proposed project and related activities.
- *Duration*: The temporal scale of the impact in terms of how long it is expected to last.

Criteria have been defined for each of these key elements and classified based on the level of impacts (low, medium and high) on the environmental component, presented in ***Table 6.1*** below:

Table 6.1 Magnitude Prediction Criteria

Impact Elements	Criteria	Ranking
Scale	• Irreversible damage to natural environment and/or difficult or may not to revert back to earlier stage with mitigation; • Major changes in comparison to baseline conditions and / or likely to regularly or continually exceed the standard; • Reversible damage to natural environment but likely to easily revert back to earlier stage with mitigation; • Perceptible change from baseline conditions but well within acceptable norms. • Effect is within the normal range of natural variation; • No perceptible or readily measurable change from baseline conditions;	High Medium Low
Extent	• Project site and the entire study area (10 km from Summit M2 site) • Project site & its immediate vicinity (2.0 km from Summit M2 site) • Project site & its immediate vicinity (0.5 km from Summit M2 site)	National Regional Local
Duration	• Spread beyond the lifecycle of the project • Spread across several phases of the project lifecycle • Only during particular activities or phase of the project lifecycle	Long term Medium term Short term

Definitions of magnitude for physical, biological and human environmental resources or receptors are defined subsequently:

Table 6.2 Magnitude Definitions for Physical, Biological & Human Resources/Receptors

Magnitude Definitions	Biophysical and Environmental Receptors	Socio-economic, Cultural and Community Health Receptors
Negligible	Immeasurable, undetectable or within the range of normal natural variation	Change remains within the range commonly experienced within the household or community.
Small	Slight changes in background levels well within accepted norms. Emissions/ Discharges are well within benchmark discharge limits. The effected environmental conditions are expected to be recovered within a few months	Perceptible difference from baseline conditions. Tendency is that impact is local, rare and affects a small proportion of households and is of a short duration.
Medium	Temporary or localised change in physical or biological environment. The recovery of such changes returning to background levels thereafter and / or Occasional exceedance of benchmark emission/ discharge limits	Clearly evident difference from baseline conditions. Tendency is that impact affects a substantial area or number of people and/or is of medium duration. Frequency may be occasional and impact may be

Magnitude Definitions	Biophysical and Environmental Receptors	Socio-economic, Cultural and Community Health Receptors
		regional in scale.
Large	Change over a large area or ecological conditions that lasts over the course of several months with quality likely to cause secondary impacts; and / or routine exceedance of benchmark emission/ effluent discharge limits	Change dominates over baseline conditions. Affects the majority of the area or population in the Area of Influence and/or persists over many years. The impact may be experienced over a regional or national area.
Positive	In the case of positive impacts, no magnitude is assigned, unless there is ample data to support a more robust characterization. It is usually sufficient to indicate that the Project will result in a positive impact, without characterizing the exact degree of positive change likely to occur.	

Note: In the case of impacts resulting from unplanned events, the same resource/ receptor-specific approach to concluding a magnitude designation was followed, but the 'likelihood' factor was considered, together with the other impact characteristics, when assigning a magnitude designation.

Magnitude essentially describes the intensity of the change that is predicted to occur in the resource/receptor as a result of the impact. The magnitude combines the impact characteristics of Extent, Duration and Scale and is a multiplicative factor of these three criteria set. Based on the above understanding magnitude of impact is assessed as per the ***Table 6.3***.

Table 6.3 Assessing Magnitude of Impact

Extent	Duration	Scale	Magnitude
Local	Short Term	Low	Negligible
Regional	Short Term	Low	Small
Local	Medium term	Low	Small
Local	Short Term	Medium	Small
National	Short Term	Low	Small
Local	Long term	Low	Small
Local	Short Term	High	Small
Regional	Medium term	Low	Small
Regional	Short Term	Medium	Small
Local	Medium term	Medium	Small
National	Medium term	Low	Medium
National	Short Term	Medium	Medium
Regional	Long term	Low	Medium
Regional	Short Term	High	Medium
Local	Long term	Medium	Medium
Local	Medium term	High	Medium
Regional	Medium term	Medium	Medium
National	Long term	Low	Medium
National	Short Term	High	Medium
Local	Long term	High	Medium
National	Medium term	Medium	Large
Regional	Long term	Medium	Large
Regional	Medium term	High	Large
National	Long term	Medium	Large
National	Medium term	High	Large
Regional	Long term	High	Large
National	Long term	High	Large

Determining Sensitivity/ Importance/ Vulnerability of Receptor

In addition to characterising the magnitude of impact, the other principal step necessary to assign significance for an impact is to define the sensitivity/ vulnerability/ importance of the impacted resources/ receptor. There are a range of factors to be taken into account when defining the sensitivity/ vulnerability/ importance of the resource/ receptor, which may be phisical, biological, cultural or human as per the following understanding:

- Where the resource is physical (for example, fresh water body) its quality, sensitivity to change and importance (on a local, regional, national importance) are considered.
- Where the resources/ receptor is biological or cultural (for example, wildlife habitat), its importance (for example local, regional or national importance) and its sensitivity to the specific type of impact are considered.
- Where the receptor is human, the vulnerability of the individual, community or wider societal group is considered.

Definition as defined in ***Table 6.4*** has been adopted to determine sensitivity/ importance/ vulnerability of environmental resources or receptor.

Table 6.4 Sensitivity/Importance/ Vulnerability Criteria

Sensitivity Criteria	Contributing Criteria
High	• Existing physical environment quality is already under stress; • Ecologically sensitive/ protected area, provides habitat for globally protected species; • Profound or multiple levels of vulnerability that undermine the ability to adapt to changes brought by the project. • Human receptors/ vulnerable community are located within the project footprint and directly affected by the project
Medium	• Existing physical environment quality shows some sign of stress; which is sensitive to change in quality or physical disturbance; • Natural habitat provides habitat for wildlife, which are protected under National regulations; • Some, but few areas of vulnerability; still retaining an ability to at least in part adapt to change brought by the project. • Human receptors/ vulnerable community are located adjacent the project site and likely to be affected by the project
Low	• Existing physical environment quality is good; • Modified habitat provides habitat for common species; • Human receptors are located away and are not likely to be affected due to the project related activities

Definitions as to determine sensitivity/importance/ vulnerability of environmental resource or receptor are defined as follows:

Table 6.5 Definitions of Sensitivity/Importance /Vulnerability Biophysical and Human

Sensitivity	Biophysical and Environmental Receptors	Socio-economic, Cultural and Community Health Receptors

Sensitivity	Biophysical and Environmental Receptors	Socio-economic, Cultural and Community Health Receptors
Low	Existing physical environment quality is good and the ecological resources that it supports are not sensitive to disturbance	Minimal vulnerability; consequently with a high ability to adapt to changes brought by the Project and opportunities associated with it.
Medium	Existing physical environment quality shows some signs of stress and/ or supports ecological resources that could be sensitive to change in quality or physical disturbance.	Some, but few areas of vulnerability; still retaining an ability to at least in part adapt to change brought by the Project and opportunities associated with it.
High	Physical environment quality is already under stress and/ or the ecological resources it supports are very sensitive to change	Profound or multiple levels of vulnerability that undermine the ability to adapt to changes brought by the Project and opportunities associated with it.

Evaluating Significance of Impacts

Once magnitude of impact and sensitivity/ vulnerability/ importance of resource/ receptor have been characterised, the significance was assigned for each impact. Impact significance is designated using the matrix shown in ***Figure 6.1.***

Figure 6.1 Assessing Significance of Impact due to Proposed Project

		Sensitivity/Vulnerability/ Important Resource/Receptor		
		Low	**Medium**	**High**
Magnitude of Impact	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

The matrix applies universally to all resources/receptors, and all impacts to these resources/receptors, as the resource/receptor-specific considerations are factored into the assignment of magnitude and sensitivity/vulnerability/ importance designations that enter into the matrix. Table 6.6 provides a context for what the various impact significance ratings signify.

Table 6.6 Categorise of Impact Significance

Impact Category	Description of Impact Significance		
	Biophysical and Environmental Receptors	**Social and Cultural Receptors**	**Community Health**
Positive	Positive impacts provide resources or receptors, most often people, with positive benefits. The concepts of equity have been considered in assessing the overall positive nature of some impacts such as economic benefits, or opportunities for employment, improvement in infrastructure and overall development of region		
Negligible	An impact of negligible significance is one where a resource/ receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations	Inconvenience caused, but with no consequences to livelihoods, culture or quality of life.	Receptors may experience annoyance, minor irritation, or stress associated with change; minimal impact to perceived quality of life. Does not require treatment. No long-term consequences for the health of individuals and the community.
Minor	An impact of minor significance is one where a resource/ receptor will experience a noticeable effect, but the impact magnitude is sufficiently small and/or the resource/receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude should be well within applicable standards/ guidelines	Impacts are short term and temporary and do not result in long term reductions in livelihood or quality of life.	Temporary reduction to health status of certain individuals that can be easily treated and does not result in long term consequences for community health. Impacts may lead to greater health inequalities in Project area.
Moderate	An impact of **moderate** significance has an impact magnitude that is within applicable standards/guidelines, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. The emphasis for moderate impacts is on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP).	Adverse impacts that notably affect livelihood or quality of life at household and community level. Impacts can mainly be reversed but some households may suffer long-term effects.	High risk of diseases or injuries as well as exposure to Project operational risks to the local community. May result in long term but reversible community health impacts.
Major	An impact of **major** significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of Impact assessment is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long-term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied).	Diverse primary and secondary impacts that will be impossible to reverse or compensate for, possibly leading to long-term impoverishment, or societal breakdown.	Loss of life, severe injuries or chronic illness requiring hospitalization. Exposure to and incidence of diseases not commonly seen previously in the area. Likely to have long-term consequences for community health.

Residual Impact Evaluation

Once mitigation and enhancement measures are declared, the next step in the IA Process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation and enhancement measures.

6.2.3 Identification of Mitigation and Enhancement Measures

Once the significance of an impact has been characterised, the next step is to evaluate what mitigation and enhancement measures are warranted. For the purposes of this IA, ERM has adopted the following Mitigation Hierarchy:

- **Avoid at Source;** Reduce at Source: avoiding or reducing at source through the design of the project.
- **Abate on Site**: add something to the design to abate the impact.
- **Abate at Receptor:** if an impact cannot be abated on-site then control measures can be implemented off-site.
- **Repair or Remedy:** some impacts involve unavoidable damage to a resource and these impacts can be addressed through repair, restoration or reinstatement measures.
- **Compensate in Kind, compensate through other means**: where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate.

The priority in mitigation is to first apply mitigation measures to the source of the impact (i.e., to avoid or reduce the magnitude of the impact from the associated Project activity), and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets (i.e., to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude).

6.2.4 Management and Monitoring

The final stage in the IA Process is definition of the management and monitoring measures that are needed to identify whether: a) impacts or their associated Project components remain in conformance with applicable standards; and b) mitigation measures are effectively addressing impacts and compensatory measures and offsets are reducing effects to the extent predicted.

A Environmental Management Plan, which is a summary of all actions which the Project Proponent has committed to executing with respect to environmental/social/health performance for the Project, is also included as part of the ESIA report. The Environmental and Social Management Plan includes mitigation measures, compensatory measures and offsets and management and monitoring activities.

6.3 ASSESSMENT OF ENVIRONMENTAL IMPACTS - CONSTRUCTION PHASE

Construction of the power plant will be carried out by the EPC Contractor (to be appointed by SMIIPCL). The construction phase for the Project will comprise of primarily two distinct phases: (a) civil construction work that would require a minimum of one year for completion; and (b) mechanical and electrical work for Plant commissioning during simple cycle and combined cycle. The entire construction phase is expected to continue for 30 months. The approximate number of workers for both civil and mechanical works is expected to be around 800 (during peak construction), whereas average workforce will be around 500. The workers will be sourced both locally as well as from outside. A summary of the activities with the potential to cause impacts to the surrounding environment and human receptors is presented below.

- **Site preparation**: include site clearance from existing debris/ construction material of Summit M-1, site levelling and compaction.
- **Civil work for power plant:** Construction of lay down areas and construction workers camp (within Project area), internal roads, site drainage, piling and excavation for foundations work, buildings, etc.;
- **Construction of a temporary jetty:** to receive construction material, machinery and heavy power plant equipment;
- **Procurement and transportation of power plant equipment:** will include Transportation of construction materials, construction machinery and equipment for the power plant through the existing access road and the temporary jetty via Meghna River;
- **Installation of power plant equipment:** will include installation of GTG, HRSG, STG, cooling tower, transformer, switch yard, etc.
- **Installation of gas pipeline:** About 0.5 km long gas pipeline will be constructed from the proposed GTCL Valve Station within Meghnaghat Power Hub.
- **Installation of water intake structure and pipeline:** water intake pontoon at Meghna River and raw water pipeline of about 100 m (above or underground) from Meghna River to the project site.
- **Construction of on-site and off-site work facilities:** including site office, sanitation and labour accommodation
- **Construction of pipeline for HSD transfer:** to receive fuel oil from existing tank farm of Summit M1 project.
- **Commissioning of Simple Cycle and Combined Cycle Plant.**

6.3.1 *Soil and Sediment Quality*

Criteria

For the assessment of soil and sediment quality, the sensitivity and magnitude criteria outlined in ***Table 6.7*** and ***Table 6.8***, respectively have been used.

Table 6.7 Sensitivity Assessment Criteria for Soil and Sediment quality (compaction, erosion and contamination) and Landuse

Sensitivity Criteria	Contributing Criteria	
	Environment	*Social*
Soil and sediment Quality related criteria as compaction, erosion and contamination and Landuse change	The extent to which the soil and sediment quality plays an ecosystem role in terms of supporting biodiversity. This includes its role as in supporting a lifecycle stage	The extent to which the soil and sediment quality provides a use (agricultural use, fishing) to the local communities and businesses, or is important in terms of national resource protection objectives, targets and legislation
Low	• The soil quality does not support diverse habitat or populations and/or supports habitat or population of low quality. • The sediment quality does not support diverse aquatic habitat or populations and and/or supports aquatic habitat or population of low quality.	• The soil and sediment quality has little or no role in provisioning of services as agricultural uses for the local community.
	• Designated area, No change or negligible Change from designated Landuse. • Minor Visual Change.	• Landuse not of relevant use by Community.
Medium	• The soil quality supports diverse habitat or population of flora and fauna and supports habitats commonly available in the Project AoI. • The sediment quality does not support diverse aquatic habitat and supports habitats commonly available in the waterbody across the Project AoI.	• The soil and sediment has local importance in terms of provisioning services as agricultural services but there is ample capacity and / or adequate opportunity for alternative sources of comparable quality i.e. ready availability across the AoI.
	• Perceived change from designated landuse. • Visual Change but common feature in Project AoI.	• Landuse of important local use by communities.
High	• The soil quality supports economically important or biologically unique species or provides essential habitat for such species. • The sediment quality supports economically important or biologically unique aquatic species or provides essential habitat for such species.	• The soil and sediment is wholly relied upon locally, with no suitable technically or economically feasible alternatives, or is important at a regional level for provisioning services.
	• Major change in Landuse. • Visual Change aesthetically affecting locals.	• Landuse of regional importance. Change would impact Landuse classification of the area.

Table 6.8 Criteria for Impact Magnitude for Assessment of Impact to Soil and Sediment Quality and Landuse

Magnitude Criteria	Negligible	Small	medium	Large
Soil compaction and erosion	• Qualitative-No perceptible or readily measurable change from baseline conditions • Scale-Localized area as Particular activity areas • Time-Short duration (few days) or one time as temporary	• Perceptible change from baseline conditions but likely to easily revert back to earlier stage with mitigation • Scale- -Project site, activity areas and immediate vicinity not impacting any sensitive receptor • Sort term-Only during particular activities or phase of the project lifecycle as civil works or construction phase (few months)	• Clearly evident (e.g. perceptible and readily measurable) change from baseline conditions and/or likely take time to revert back to earlier stage with mitigation • Scale- Project site, activity areas and immediate vicinity impacting sensitive receptor/s • Long term-Spread across several phases of the project lifecycle (few years)	• Major (e.g. order of magnitude) change in comparison to baseline conditions and/or likely difficult or may not to revert back to earlier stage with mitigation • Scale-Regional or international; • Permanent change
Soil and sediment contamination	Well within Dutch standard[1]	Well within Dutch standard[2]	Exceeds Target Value but well within Interventional Value of Dutch Standard	Exceeds Interventional Value of Dutch Standard and needs intervention.

Sources of Impact

Potential sources of impacts to soil and sediment quality due to the construction phase activities include:

- Transportation of construction material, equipment and personnel;
- Storage of construction materials including hazardous material;
- Civil work activities;

[1] Dutch Target and Intervention Values (Soil remediation Circular 2013), *https://rwsenvironment.eu/subjects/soil/legislation-and/soil-remediation/*
The assessment of potential impacts to soil and sediment has been considered as per the Dutch Standard as Bangladesh does not have any local standards for soil or sediment quality.

[2] Dutch Target and Intervention Values (Soil remediation Circular 2013), *https://rwsenvironment.eu/subjects/soil/legislation-and/soil-remediation/*

- Storage, handling and disposal of wastes generated from site clearance, site excavation and formation, civil works and activities of construction workers (general waste and sewage).
- Erection of Power Plant Building.

The proposed project will be constructed within the land allotted to SMIIPCL, which is already developed. The proposed site including entire Power Hub area was filled up river sand to raise the site above flood level. There is hardly any top soil in the proposed site. Therefore, no adverse impact on top soil is envisaged due to construction of plant and associated facilities.

The potential source of impact on soil and sediment quality could arise due to
- Spillage of fuel, lubricant and paints from storage site;
- Spillage of fuel, lubricant during handling and transport from jetties to site; and,
- Disposal of construction materials and MSW in non-designated areas.

Embedded Control Measures

The embedded control measures are as follows:
- Construction waste will be utilised for filling of site within the plant;
- Municipal solid waste generated from the construction site will be disposed in the nearby MSW waste dumping site.
- Any bitumen waste will be stored separately in lined areas to be disposed-off to licensed contractors.

Receptors/ Resource

Project site was also used as laydown area during the construction of Summit M1 project and due to that soil was found compacted. After the completion of commissioning of Summit M1 project, the site was handed over to BPDB. Due to no activities on site since last 2-3 years, long grasses and shrubs were grown at site.





The analysis of soil sampling in the Project area indicates that the soils are mainly sandy loam to silty clay. Both soil and sediment samples were found to be slightly acidic in nature (i.e. pH between 5.10 and 6.34). The soil at the project site contains sand depositions from the river used for filling. It does not support any diverse habitat or species and agricultural activities. Heavy metal concentrations were also found well below the intervention values.

Therefore, the sensitivity of soil and sediment resources was considered to be low.

Impact Significance

Soil Compaction

The Project site contains sand depositions from the river used for filling to raise the height of the entire site above the highest flood level recorded. Laydown area, fabrication yard and construction camp are also planned within the Project area and hence, soil compaction will be limited to these areas within the Meghnaghat Power Hub. It is also to be noted that due to previous use of project site as laydown area, major portion of the site is already compacted.



Project Site



Area near Temporary Jetty Location

Movement of heavy vehicles and heavy construction machinery will also cause soil compaction however a permanent access road to the Project site is already in place and being used by the existing power plants. Soil compaction and possible damage to the soil structure due to heavy vehicular movement will only be limited to the laydown areas and Project site. The area identified for temporary jetty was already used in the past during construction of Summit M-1 project for unloading and transportation of heavy lifts during the commissioning of plant. Based on the impact magnitude assessment criteria as given in ***Table 6.8*** the impact was assessed as **negligible.**

Impact	*Soil Compaction*				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to Project Site, gas pipeline RoW and temporary jetty site vicinity as well as areas identified for laydown and construction workers camp (within project site). Main access road and access to temporary jetty location, valve station and water intake location already exist.				
Frequency	Primarily during Civil work				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		

Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is considered **negligible.**			

Soil erosion

The project AOI is prone to soil erosion due to nature of soil (silty) enhanced by heavy rains in the area. Average annual rainfall based on rainfall data recorded in Narayanganj for last 45 years is about 2,000 mm. Of the annual rainfall, about 80% fall during five monsoon months (May to September) with June and July getting the maximum rains. As mentioned earlier, the project site within the complex is already raised and is having retaining wall to control any surface runoff (refer to picture below). Soil erosion will typically be worse during the monsoon months during the initial site preparation and compaction works.



Based on the impact magnitude assessment criteria as given in ***Table 6.8*** the impact was assessed as **negligible.**

Impact	*Soil Erosion*				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Project site and access road				
Frequency	Primarily during Civil work				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		

Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is considered **negligible.**			

Soil and Sediment Contamination (Spills and Leaks)

Soil contamination during the construction phase may result from leaks and spills of oil, lubricants, fuel from heavy equipment or leakage from chemical/fuel storage. Sediment contamination may take place during the construction of the temporary jetty and unloading of heavy equipment. Such spills can have long-term impact on soil and sediment quality, but are expected to be localised in nature. While the risk of accidental spillage of potentially hazardous substances is low, proper handling and disposal of contaminated materials will further reduce the risk if such event does take place. The following prevention and mitigation measures will be proposed in the Specification Manual for EPC Contractors:

- The Contractor will prepare unloading and loading protocols for the temporary jetty and train staff to prevent spills and leaks
- The Contractor will prepare guidelines and procedures for immediate clean-up actions following any spillages of oils, fuels or chemicals;
- A site specific Emergency Response Plan will be prepared by the Contractor for soil clean-up and decontamination

Soil samples analysis indicates that the soil/fill material at the Project site is not contaminated. Spill control measures such as storage and handling of chemicals and fuels on impervious areas (such as concrete surfaces) will be implemented to minimize impacts in case of spills. Loaders to be used near the temporary jetty will be checked for lubricant leaks and workers trained not to dispose of waste in the area. Liquid effluents arising from construction activities will be treated to the standards specified in *Schedule 9 and 10 of ECR, 1997 of the GOB (**Table 3.8*** and ***Table 3.9**);* and the applicable World Bank/IFC guidelines (***Table 3.9***) prior to discharge. Therefore, the likelihood of unplanned events (i.e. spills and leaks) leading to soil and sediment contamination is considered likely. Based on the impact magnitude assessment criteria as given in ***Table 6.8*** and impact has been considered as **minor.**

Impact	*Soil and Sediment contamination from spills and leaks*				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to Project Site and temporary jetty				
Frequency	Limited to construction Phase primarily during transportation, handling and storage of materials, waste and equipment installation				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large

Resource/ Receptor Sensitivity	Low	Medium	High	
Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is considered **minor.**			

Soil Contamination from Waste Handling

Soil may become contaminated due to improper handling and storage of waste. The majority of the generated wastes will be non-hazardous. General construction waste will comprise of surplus or off-specification materials such as concrete, steel cuttings/filings, wooden planks, packaging paper or plastic, wood, plastic pipes, metals, etc. During the construction phase of the Project, solid waste generation will mainly be concrete waste and bitumen. It is estimated that approximately 100 – 150 m^3 of such waste will be produced. The inert wastes will be stored near the proposed project site and will be reused under floors or under road to increase the California Bearing Ratio (CBR)[1] value. Bitumen or any hazardous wastes will be disposed off to licensed contractors. Domestic wastes consisting of food waste, plastic, glass, aluminium cans and waste packages will also be generated by the construction workforce.

A small proportion of the waste generated during construction will be hazardous and may include:

- Used paint, engine oils, hydraulic fluids and waste fuel;
- Spent solvents from equipment cleaning activities; and
- Spent batteries or spent acid/alkali from the maintenance of machinery on site.

If improperly managed, hazardous waste may create impacts on land. With reference to similar projects, it is anticipated that the quantity of hazardous waste (mainly waste lubricant oil and waste paints/solvents) will be less than 100 litres per month. The construction contractor will handle, store and dispose of all waste in accordance with applicable GOB guidelines. Concrete waste of inert nature will be stored near the concrete batching plant and will be reused under floors or internal roads. Any bitumen waste will be stored separately in lined areas to be disposed-off to licensed contractors. There is a potential for direct, long-term negative impacts to soil quality from improper waste handling; however, with the implementation of the mitigation measures discussed above the impacts to soil quality as discussed in ***Table 6.8*** is assessed to be **negligible.**

Impact	*Soil Contamination from Waste Handling*			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent

[1] The **California Bearing Ratio** (**CBR**) is a penetration test for evaluation of the mechanical strength of road subgrades and base courses.

Impact Extent	Local		Regional		International
Impact Scale	Limited to Project Site				
Frequency	Limited to construction Phase primarily during transportation, handling and storage of waste				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low		Medium		High
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible.**				

Mitigation Measures

Potential impacts to soil and sediment during the construction phase are attributed to soil compaction, erosion and soil /sediment contamination from spills and leaks and wastes.

The following measures will be implemented to mitigate potential soil compaction and erosion:

- All areas of excavation shall be closed and compacted before the monsoon season to prevent soil erosion.
- Storm water shall be properly channelized to settling tanks for controlling soil erosion.
- Demarcating routes for movement of heavy vehicles;
- Stripping and placing soils when dry, and not when wet;
- Building small bunds in areas with slope to prevent soil erosion.

The following measures will be implemented for the storage and handling of chemicals and to minimise impacts to soil/sediment:

- Fuel tanks and chemical storage areas will be sited on sealed areas and provided with locks to prevent unauthorized entry;
- Use of spill or drip trays to contain spills and leaks;
- Use of spill control kits to contain and clean small spills and leaks.
- The storage areas of oil, fuel and chemicals will be surrounded by bunds or other containment device to prevent spilled oil, fuel and chemicals from percolating into the ground or reaching the receiving waters;
- The Contractor will prepare unloading and loading protocols for the temporary jetty and train staff to prevent spills and leaks
- The Contractor will prepare guidelines and procedures for immediate clean-up actions following any spillages of oils, fuels or chemicals;
- A site specific Emergency Response Plan will be prepared by the Contractor for soil clean-up and decontamination; and
- The construction contractor will implement a training program to familiarise staff with emergency procedures and practices related to contamination events.

The measures in place to properly manage waste and thereby minimize any impacts to soil and sediment quality are:

- Design processes to prevent/minimise quantities of wastes generated and hazards associated with the waste generated;
- Training labourers for waste disposal in designated areas and use of sanitation facilities;
- Proper storage of the construction materials and wastes to minimise the potential damage or contamination of the materials; and
- Implementation of construction materials inventory management system to minimise over-supply of the construction materials, which may lead to disposal of the surplus materials at the end of the construction period.
- Segregation of hazardous and non-hazardous waste and provision of appropriate containers for the type of waste type (e.g. enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimise odour nuisance);
- Storage of wastes in closed containers away from direct sunlight, wind and rain;
- Storage of waste systematically to allow inspection between containers to monitor leaks or spills;
- Ensuring that storage areas have impermeable floors and containment, of capacity to accommodate 110% of the volume of the largest waste container; and
- Disposal of waste by licensed contractors.

Residual Impacts

Criterion	Rating pre mitigation	Rating post mitigation	Remark
Soil and Sediment contamination from spills and leaks			
Residual Impact	Minor	Negligible	With implementation of the precautionary and the mitigation measures mentioned for the storage and handling of chemicals and to avoid /minimise impacts to soil/sediment the residual impact would be negligible.

6.3.2 *Water Resources*

Criteria

For the assessment of water resources, the sensitivity and magnitude criteria outlined in ***Table 6.9*** and ***Table 6.10*** have been used respectively.

Table 6.9: Sensitivity Assessment Criteria for Water Resources (Surface water and Ground water)

Sensitivity Criteria	Contributing Criteria	
	Environment	*Social*

Sensitivity Criteria	Contributing Criteria	
Water Resources -Surface water and ground water (quality/quantity related criteria)	The extent to which the water resource plays an ecosystem or amenity role in terms of supporting biodiversity either directly or indirectly, particularly with respect to dependent ecosystems.	The extent to which the water resource provides or could provide a use (drinking water, agricultural uses, washing and other domestic or industrial, use as waterways) to the local communities and businesses, or is important in terms of national resource protection objectives, targets and legislation.
Low	The water resource does not support diverse aquatic habitat or populations, or supports aquatic habitat or population that is of low quality.	The water resource has little or no role in terms of provisioning services as agricultural water source, other domestic uses as washing, bathing, industrial use and waterways for the local community. The groundwater resource is not currently abstracted and used in the vicinity of the Project, but is of sufficient quality and yield to be used for that purpose in the future (and there is a reasonable potential for future use).
Medium	The water resource supports diverse populations of flora and / or fauna but available in the surface water bodies in the region.	The surface water resources have local importance in terms of provisioning services but there is ample capacity and / or adequate opportunity for alternative sources of comparable quality. The groundwater resource is an important water supply, and is currently used, but there is capacity and / or adequate opportunity for alternative sources of comparable quality.
High	The water resource supports economically important or biologically unique aquatic species or provides essential habitat for such species	The surface water resources are wholly relied upon locally, with no suitable technically or economically feasible alternatives, or is important at a regional or transboundary watershed level for provisioning services The groundwater resource is wholly relied upon locally, with no suitable technically or economically feasible alternatives, or is important at a regional or national level for water supply or contribution to groundwater dependent ecosystems (e.g. transboundary rivers).

Table 6.10 Criteria for Impact Magnitude for Assessment of Impact to Surface and Ground water Resources

Magnitude Criteria	Negligible	Small	Medium	Large
General Criteria	No perceptible or readily measurable change from baseline conditions.	Perceptible change from baseline conditions but likely to be within applicable norms and standards for mode of use.	Clearly evident (e.g. perceptible and readily measurable) change from baseline conditions and / or likely to approach and even occasionally exceed applicable norms and standards for mode of use.	Major changes in comparison to baseline conditions and / or likely to regularly or continually exceed applicable norms and standards for mode of use.
Water Quality	Discharges are expected to be well within statutory limits*	Discharges are expected to be within statutory limits*	Occasional breach(es) of statutory discharge limits (limited periods) expected*	Repeated breaches of statutory discharge limits (over extended periods) expected*
	Groundwater quality be well within ambient levels or allowable criteria** Abstractions from or discharge to aquifer(s) are unlikely to cause water quality issues.	Groundwater quality be within ambient levels or allowable criteria** or may exceed for 1-2 parameters which is common occurrence due to geological regime of the area. Abstraction or discharge to aquifer(s) may cause small but local changes in water quality in the aquifer system. These can be considered potential short-term localized effects on groundwater quality which is likely to return to equilibrium conditions within	Groundwater quality exceeds ambient levels or allowable criteria** for key parameters. Abstraction or discharge to aquifer(s) are expected to cause potential localized effects on groundwater quality which are likely to be fairly long lasting and / or give rise to indirect ecological and / or socio-economic impacts.	Groundwater quality exceeds ambient levels or allowable criteria**. Abstractions or discharge to aquifer(s) are expected to cause potentially severe effects on groundwater quality which are likely to be long-lasting (e.g. years or permanent) and / or give rise to indirect ecological and / or socio-economic impacts.

Magnitude Criteria	Negligible	Small	Medium	Large
		a short (months) timeframe.		
Water Quantity	There is likely to be negligible (less than 1% of lean season flow) or no consumption of surface water by the Project at any time	The Project will consume surface water, but the amounts abstracted are likely to be relatively small in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation)	The Project will consume surface water, and the amounts abstracted are likely to be significant in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation)	The Project will consume surface water, and the amounts abstracted are likely to be very significant in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation)
	There is likely to be negligible or no abstraction, use of or discharge to the groundwater by the Project at any time.	The Project will consume groundwater or deliver discharge to groundwater, but the amounts abstracted / discharged are likely to be relatively small in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation).	The Project will consume groundwater or discharge to groundwater, and the amounts abstracted / discharged are likely to be significant in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation).	The Project will consume groundwater or discharge to groundwater, and the amounts abstracted / discharged are likely to be very significant in comparison to the resource available at the time of use (i.e. taking into account seasonal fluctuation).

*The quality assessment of potential impacts to surface water has considered according to Schedule 9 of ECR, 1997 of the GOB and the World Bank/IFC General EHS Guidelines (refer to ***Table 2.9***).

**The quality of groundwater was compared with Schedule 3 (B) (Standards for drinking water) of ECR 1997 of the GOB.

Sources of Impact

The potential sources of impact to surface and ground water resources are:

- Excavation activities at the Project site and for gas pipeline RoW may increase the erosion, especially during rainfall, which may increase the suspended sediment concentrations and pollute water sources. Similar impacts are possible from construction of the temporary jetty for receiving heavy equipment, construction material etc.;
- Sewage generated from the construction workforce (toilets). Liquid effluents will be generated from washing of construction equipment and vehicles;
- Commissioning phase testing of pipelines and wastewater generation; and
- Inappropriate storage of waste leading to water quality impacts from runoff entering the adjoining channel to the Project site or seepage to ground water.

Embedded Control Measures:

The project embedded control measures are as follows:

- Storm water drainage with sedimentation tank.
- Storage of chemical, fuel in paved storage area.
- Septic tank and soak pit will be provided in construction site for treatment of domestic waste water.

Receptors

The major surface water body adjacent to the Project site is Meghna River, which forms boundary of Meghnaghat Power Hub from three sides. This will be used as means of transport for heavy equipment and temporary jetty constructed on it. Details of the hydrology and drainage pattern in the AOI are discussed in ***Section 4.3.7.*** Based on the sensitivity assessment criteria described in ***Table 6.9,*** both surface and ground water resource was found to be medium.

Impact Significance

Wastewater Discharge

Wastewater will be generated from washing of equipment and machinery on site. This wastewater may contain suspended solids and traces of hydrocarbon. The contractor will be responsible for ensuring that any wastewater discharged meets the standards stipulated in *Schedule 10 of ECR, 1997* and the applicable *World Bank/ IFC General EHS Guidelines* prior to discharge of such wastewater. Sanitary facilities including toilets will be provided for the use of the construction workforce both on-site and at the workers' accommodation. Such sewage streams are likely to be high in organic matter, suspended solids, coliform and other pollutants. Septic tanks will be provided to treat sanitary wastewater. Potential impacts are expected to be short-term and localised in nature. Based on the above discussion and referring to the magnitude criteria in ***Table 6.10***, the impact to surface water from wastewater discharges during construction is assessed to be **minor.**

Impact	*Wastewater discharge*				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to discharge outside the project boundary on Meghna River				
Frequency	Limited to construction Phase –washing of machinery, equipment, use of sanitation facilities, cleaning of pipelines				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	

	Significance of impact is considered **minor.**

Groundwater Contamination

Groundwater contamination during the construction phase may occur from unplanned events such as leaks and spills of oil, lubricants, fuel from heavy equipment, improper handling of sewage or chemical/fuel storage. As per the geotechnical investigation of the site, the groundwater of the site is primarily distributed in the silty fine Sand (Layer 1) with semi permeability water bearing aquifer. According to the investigation work the depth of groundwater during pre-monsoon varies from 4.50m −4.60 m. The soil type of the area is sandy soil. This type of soil does allow easy percolation into the subsoil and subsequently the ground water. The spillage of chemical and fuel may easily contaminate the ground water. Considering the shallow ground water table and nature of soil, water tight septic tank floor will be constructed. The contractor will be responsible for ensuring periodic desludging[1] of the septic tank and that any wastewater discharges meet the standards stipulated in *Schedule 9 of ECR, 1997* and the *applicable World Bank/ IFC General EHS Guidelines* prior to discharge of such wastewater, if required. While there is a potential for long-term direct impacts to groundwater quality from construction, with the implementation of mitigation measures for proper handling of chemicals, waste and liquid effluents, impact to ground water would be limited. Based on the above discussion and referring to the magnitude criteria in ***Table 6.10***, the impact to groundwater from spills and leaks is assessed to be **minor**.

Impact	*Ground water contamination*				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to Project site, ancillary areas and jetty site				
Frequency	Limited to construction Phase and unplanned events as leaks, spills, sewage discharge				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **minor.**				

[1] Frequent desludging inhibits the anaerobic action in the septic tank. Therefore, the tank shall be cleaned when the tank is filled more than 60% of the depth of the tank.

Mitigation Measures

The following measures will be implemented to reduce impacts to surface water and groundwater:

- Vehicle servicing areas and wash bays will, as far as practical, be located within roofed and cemented areas. The drainage in these covered areas will be connected to oil/water separator and channelized properly to the land/inland waters ;
- Oil leakage or spillage will be contained and cleaned up immediately. Waste oil will be collected and stored for recycling or disposal;
- Oil and grease separator shall be used for wastewater generated from cleaning activities;
- Any surplus wastewater from the concrete batching will be treated to comply with discharge standards before it is discharged to the Meghna River;
- Adequate sanitary facilities, i.e. toilets and showers, will be provided for the construction workforce;
- Workers will be trained in the use of designated areas/bins for waste disposal and encouraged to use toilets.
- Septic tanks will be provided to treat sanitary wastewater with arrangement of periodic desludging; and
- All sewage and liquid effluent will be treated to meet the standards specified in *Schedules 9* and *10 of the ECR, 1997* respectively and *IFC EHS Guidelines* prior to discharge to land/inland waters.

Residual Impacts

Criterion	Rating pre mitigation	Rating post mitigation	Comment
Wastewater discharge			
Residual Impact	Minor	Negligible	With implementation of the precautionary and the mitigation measures mentioned for prevention of surface water contamination the residual impacts would be negligible.
Groundwater contamination			
Residual Impact	Minor	Negligible	With implementation of the precautionary and the mitigation measures mentioned for prevention of groundwater contamination the residual impacts would be negligible.

6.3.3 Air Quality

Criteria

For the assessment of air quality, the sensitivity and magnitude criteria outlined in Table 6.11 and Table 6.12 respectively have been used. The standards considered for assessment of potential impacts to air quality, are *Schedule 11 ECR, 1997 of the GOB*. The air quality impacts associated with the

construction activities have been assessed qualitatively, using professional judgement and based on past experience from similar projects.

Table 6.11 Sensitivity Criteria for Air quality

Sensitivity Criteria	Contributing Criteria	
	Human Receptors	*Ecological Receptors*
Low	Locations where human exposure is transient.[1]	Locally designated sites; and/or areas of specific ecological interest, not subject to statutory protection (for example, as defined by the project ecology team).
Medium	Locations where the people exposed are workers [2], and exposure is over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day[3].	Nationally designated sites.
High	Locations where members of the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day).	Internationally designated sites.

Table 6.12 Criteria for Impact Magnitude for Assessment of Impact to Air Quality (Construction Phase)

Magnitude Criteria	Negligible	Small	medium	Large
Air Quality	• Total site area < 500 m²; • Soil type with large grain size (e.g. sand); and/or • Total material moved < 5,000 tonnes.	• Total site area 500 m2 to 2,500 m2; • Soil type with large grain size (e.g. sand); and/or • Total material moved 5,000 to 20,000 tonnes.	• Total site area 2,500 m² to 10,000 m²; • Moderately dusty soil type (e.g. silt); and/or • Total material moved 20,000 tonnes to 100,000 tonnes.	• Total site area > 10,000 m²; • potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size); and • Total material moved 100,000 tonnes.

[1] As per the GOB and World Bank/IFC guidelines, there are no standards that apply to short –term exposure, eg one or two hours, but there is still a risk of health impacts, albeit less certain.

[2] Notwithstanding the fact that the air quality objectives and limit values do not apply to people in the workplace, such people can be affected to exposure of PM10. However, they are considered to be less sensitive than the general public as a whole because those most sensitive to the effects of air pollution, such as young children are not normally workers. For this reason workers are included in the medium sensitivity category.

[3] *Schedule 11 ECR, 1997 of the GOB* and *the World Bank/IFC General EHS Guidelines.*

Sources of Impact

The potential sources of impacts to air quality are as follows:

- Site preparation and levelling;
- Excavation of soil to create building and equipment foundations;
- Pile driving for the equipment foundation;
- Exhaust emission from movement of heavy equipment by barge, heavy loaders, trucks;
- Loading and unloading of materials,
- Wind-blown dust while handling of construction materials like cement, sands, etc.
- Fugitive dust emission due to construction activities such as earth moving, building foundations for plant, transportation of construction materials, etc.
- Operation of diesel generators and other diesel based construction machineries;
- Dust generated from stockpiles of materials, waste, loose earth, handling and moving excavated material and transporting wastes on vehicles; and
- Installation of gas pipeline.

Dust generated from many of these activities will increase the particulate matter levels in ambient air. Vehicles and equipment exhaust emissions can lead to increases in levels of nitrogen oxides (NO_x), sulphur dioxide (SO_2), particulate matter (PM_{10} and $PM_{2.5}$), volatile petroleum hydrocarbon constituents and carbon monoxide (CO), which are key pollutants of concern with respect to human health.

Embedded Control Measures:

The project embedded control measures are as follows:

- Vehicle, equipment and machinery used for construction would conform to applicable emission norms.
- Concreting works, including operation of concrete batching plant, which will be located away from sensitive receptors and additional net fencing on section of boundary wall facing the residential receptors to reduce dust transport.

Receptors

From the landuse analysis and field study, it is clear that most of the land surrounding the Project site is industrial land followed by waterbody (Meghna River). Settlements are located beyond 600 m with homestead plantation. On the immediate east, there is existing power plant (Summit M-1) followed by another power plant (Meghnaghat Power) followed by settlement of Islampur, which is approximately 600 m from the proposed project site. The immediate south of the Project site has Meghna River with a width of more than 1.5 km, whereas on the west there are two vacant plots of Meghnaghat Power Hub followed by Meghna River. On the north to the site, there are

vacant areas of Meghnaghat Power Hub to be used for power infrastructure (i.e. sub-station and gas receiving station) followed by Meghna River. As can be referred from Table 6.11 and above discussion, the human receptors were assessed to be of Medium sensitivity, whereas ecological receptors were considered as of Low sensitivity.

Impact Significance

Dust Generation

Most of the construction activities mentioned above have the potential to generate dust. The extent of impacts from dust will depend on the exact location of these activities and on the weather conditions; stronger winds and dry conditions will enhance the transfer of dust, while damp or wet conditions will reduce this impact. Construction dust dispersion is expected to be localised due to the relatively high mass of the dust particles which will tend to confine the most significant dust impacts to the area within 100 m of the source. The potential for dust emissions during the wet season will be small, due to the moistening of any dust by rainfall. During the dry season, dust suppression techniques will be used and stockpiles will be covered to minimise fugitive dust emissions from spoil storage.

As the dust is expected to settle within 200 m and dust suppression techniques will be practiced, the main receptors would be workers on site and neighbouring plant and people living near the access road.

The fugitive dust related impacts will be minimal as the proposed plant will be constructed within the Meghnaghat Power Hub. The site is already developed; therefore, extensive earth work like filling levelling, top soil removal, etc., will not be required. The construction material will be stored in the covered storage area; generation of windblown dust is expected to be minimum.

On the basis of the above factors and the magnitude criteria described in Table 6.12, and considering the high levels of SPM and PM_{10} recorded during the baseline monitoring in the surrounding areas, the magnitude of the impact associated with the emission of dust during construction activities is predicted to be medium and the significance of the impacts is assessed to be **moderate**.

Impact	*Air quality degradation due to dust generation*				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Within 100 m from project boundary and within 100 m from access road				
Frequency	Limited to civil works in Construction Phase and storage and handling of construction material (sand, cement etc.)				
Impact Magnitude	Positive	Negligible	Small	Medium	Large

Resource/ Receptor Sensitivity	Low	Medium	High	
Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is considered **moderate.**			

Exhaust Emissions

Heavy equipment such as excavators, cranes, and compactors will be used onsite. Emissions from these equipment and diesel generator sets used to generate power will cause impacts to ambient air quality. Transportation of construction material by barges and other transport vehicles per hour during daytime will also contribute to exhaust emissions.

Impacts from vehicle emissions decrease rapidly with increasing distance from the source and are not likely to be significant at distances of more than 200 m from the source; they are usually minor at a distance of more than 50 m with limited no. of vehicles plying the access road. The distance between the Project site boundary and the closest residential dwelling is more than 600 m (Islampur), however, there are a few settlements located along the access road. It is also to be noted that most of the construction material will be transported by waterway and hence, access road will be used mainly for site access and transportation of personnel.

The implementation of the good site practices, such as the regular maintenance of vehicles and equipment, using cleaner fuels and switching off vehicles when not in use will reduce exhaust emissions from the operation of the diesel-powered construction equipment and therefore minimise adverse air quality impacts. Based on the above discussion and Table 6.12, the air quality impacts associated with the vehicular and equipment emissions during construction activities are assessed to be of **minor** potential significance, as few dwellings are located within 100 m from access road.

Impact	*Air quality degradation due to exhaust emissions*				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Within 100 m from project boundary and within 100 m from access road				
Frequency	Limited to Construction Phase primarily due to transportation of material and use of heavy machinery and DG sets				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **minor.**				

Mitigation Measures

The mitigation measures listed below will be implemented to ensure that air quality impacts during the construction phase are as low as reasonably practicable.

To reduce dust impacts, the following measures will be put in place:

- Implementation of a regular watering and sprinkling dust suppression regime, during the dry season;
- Concrete batching plant will be located within the project site and to keep it away from sensitive receptor/s;
- No stockpiles shall be maintained outside project site, and maximum possible distance between the stockpiles and receptors will be maintained;
- Covering and/or watering of all stockpiles of dusty materials such as excavated spoils to avoid fugitive dust emissions;
- During construction, the approach road will be kept clean, free from mud and slurry.
- Black topping of the access road during the construction phase itself to reduce dust generation; and
- Waste from construction will not be burned.

Exhaust emissions will be minimized as follows:

- The movement of construction vehicles will be minimised and a 20 km/hr speed limit will be enforced around the construction site;
- All diesel-powered equipment will be regularly maintained and idling time reduced to minimise emissions;
- Low sulphur diesel (S<0.5%) will be used in diesel powered equipment in collaboration with best management practices;
- Vehicle / equipment air emissions will be controlled by good practice procedures (such as turning off equipment when not in use); and
- Vehicle / equipment exhausts observed emitting significant black smoke in their exhausts will be serviced/ replaced.

Residual Impacts

Criterion	Rating pre mitigation	Rating post mitigation	Comment
Air Quality Degradation due to dust generation			
Residual Impact	Moderate	Minor	With implementation of the precautionary and the mitigation measures mentioned for prevention/reduction of dust generation the residual impacts would be minor.
Exhaust Emissions			
Residual Impact	Moderate	Minor	With implementation of the precautionary and the mitigation measures mentioned for minimizing exhaust emissions the residual impacts would be minor.

6.3.4 *Noise*

Criteria

The noise impact assessment was conducted with reference to Bangladesh *Environmental Conservation Rules, 1997* and the *IFC EHS Guidelines*. Details of the standards are presented in Table 3.10. Furthermore, for the assessment of ambient noise, the sensitivity and magnitude criteria outlined in Table 6.13 and Table 6.14, respectively have been used:

Table 6.13 Sensitivity Assessment Criteria for Ambient Noise Impacts

Sensitivity Criteria	Contributing Criteria	
Ambient Noise	Human receptor	Ecological Receptor
Low	Industrial Use	Locally designated sites; and/or areas of specific ecological interest, not subject to statutory protection (for example, as defined by the project ecology team).
Medium	Residential and Recreational Space	Nationally designated sites.
High	Educational/ Religious/ Medical Facilities	Internationally designated sites.

Table 6.14 Magnitude Assessment Criteria for Ambient Noise Impacts

Magnitude Criteria	Negligible	Small	medium	Large
Noise	• Predicted noise levels are at or less than 3 dB (A) above the relevant limits / thresholds*. • Short term exposure (Few hours in a day and not continuous)	• Predicted noise levels are 3 to less than 5 dB (A) above the relevant limits / thresholds*. • Short term exposure (< 1 month)	• Predicted noise levels are between 5 and 10 dB (A) above the relevant limits / thresholds*. • Medium Term Exposure (1 to 6 months)	• Predicted noise levels are more than 10 dB (A) above the relevant limits / thresholds*. • Long term exposure (> 6 months)

*Note: reference to Bangladesh Environmental Conservation Rules, 1997 and the IFC EHS Guidelines presented in Table 3.10.

Sources of Impact

The potential sources of noise during the construction phase of the Project include equipment, machinery and transportation used for the construction activities. The heavy equipment used for the construction activities will be the major sources of noise. This will include piling and preparing concrete foundations for major plant and buildings. There is expected to be an increase in traffic and thereby in traffic noise impacts to receptors near the existing access road from the transportation of equipment, construction materials and workers. To minimise these impacts, only those vehicles meeting the

standards stipulated in *Schedule 5* of the *Environmental Conservation Rules, 1997* will be used.

Construction works are expected to last for 30 months. As per the *Master Specifications*, the Contractor is required to seek permission from the authorities to carry out construction works at night (2100 to 0600) on weekdays.

The detailed breakdown of activities is not available at this stage, and as the Contractor has not yet been appointed, no construction plant inventory is available at the time of assessment. Therefore, an assumed plant inventory is provided in ***Table 6.15***. Assumptions have made regarding the type, number and Sound Power Levels (SPLs) of construction plant, based on similar projects and publicly available data. It has been assumed that only one of each type of plant will be on-site during any day or night period. Re-assessment of noise levels may be required if the actual plant inventory and SPL vary from the assumed list.

Table 6.15 Assumed Construction Equipment Sound Pressure Level Inventory

Construction Equipment	SPL, dB(A)
Bulldozer	114
Backhoe	93
Impact pile driver	90
Loaders	113
Vibratory roller	91
Fuel truck	76
Cranes	105
Truck	76
Grader	93
Fork lifts	75
Compressors	104
Generators	106

Source: SoundPlan 7.2 database for construction equipment

Although construction equipment and materials will be delivered by road / temporary jetty, this will result in slight increase in heavy traffic movement and thereby in traffic noise impacts to receptors near the access road. To minimise these impacts, only those vehicles meeting the standards stipulated in *Schedule 5* of the *Environmental Conservation Rules, 1997* will be used.

Embedded Control Measures:

The project embedded control measures are as follows:

- Vehicle, equipment and machinery used for construction activities would conform to applicable noise norms.
- Piling and major noise generating activities will be limited during daytime only.

- PPE will be provided to the construction workers.

Receptors

Baseline noise monitoring was carried out at 10 locations. The results of baseline monitoring indicated that ambient noise levels at residential areas were high compared to the applicable standards. The nearest residential receptor (Islampur) is located at about 650 m from the Summit M2 project boundary and about 50 m from the Meghnaghat Power Hub boundary, which will be exposed to noise from construction activities. As per Census 2011, this area is having 217 households with a population of 1,144.

As can be referred from Table 6.13 and above discussion, the receptors as well as the ecological receptors were assessed to be of Low sensitivity, whereas the human settlements in the surrounding areas (residential areas) were assessed to be of Medium sensitivity.

Impact Significance

Methodology: The environmental noise prediction model SoundPLAN 7.2 was used for modelling noise emissions from the construction equipment. The operation of construction equipment with 80% usage scenario was modelled to cover the construction phase. As a conservative approach to the assessment, atmospheric absorption during sound transmission was not included in the assessment. In addition, to represent a worst-case scenario for the assessment, all construction equipment was assumed to be operating simultaneously. Attenuation due to the boundary wall of the power generation complex that has already been constructed has been considered in the modelling.

Predicted Noise Levels at Receptors: The predicted noise levels within the Project AOI during day and night time are presented in Figure 6.2 and Figure 6.3, respectively. Predicted noise levels at 10 receptors (where baseline noise levels were also monitored) have been presented in Table 6.16.

Figure 6.2 Predicted Construction Noise Levels during Daytime (Leq $_{day}$)

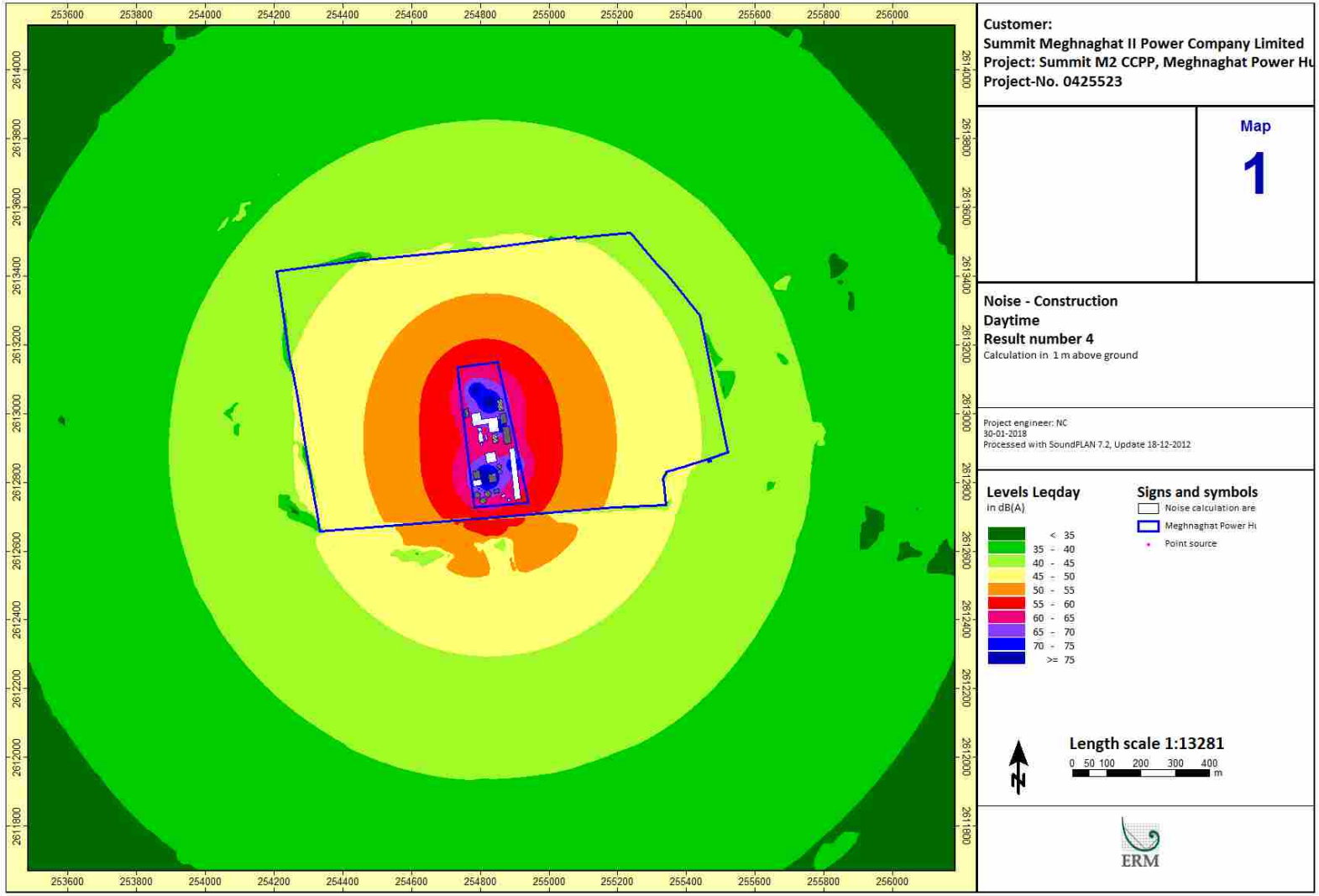


Figure 6.3 Predicted Construction Noise Levels during Night time (Leq $_{night}$)

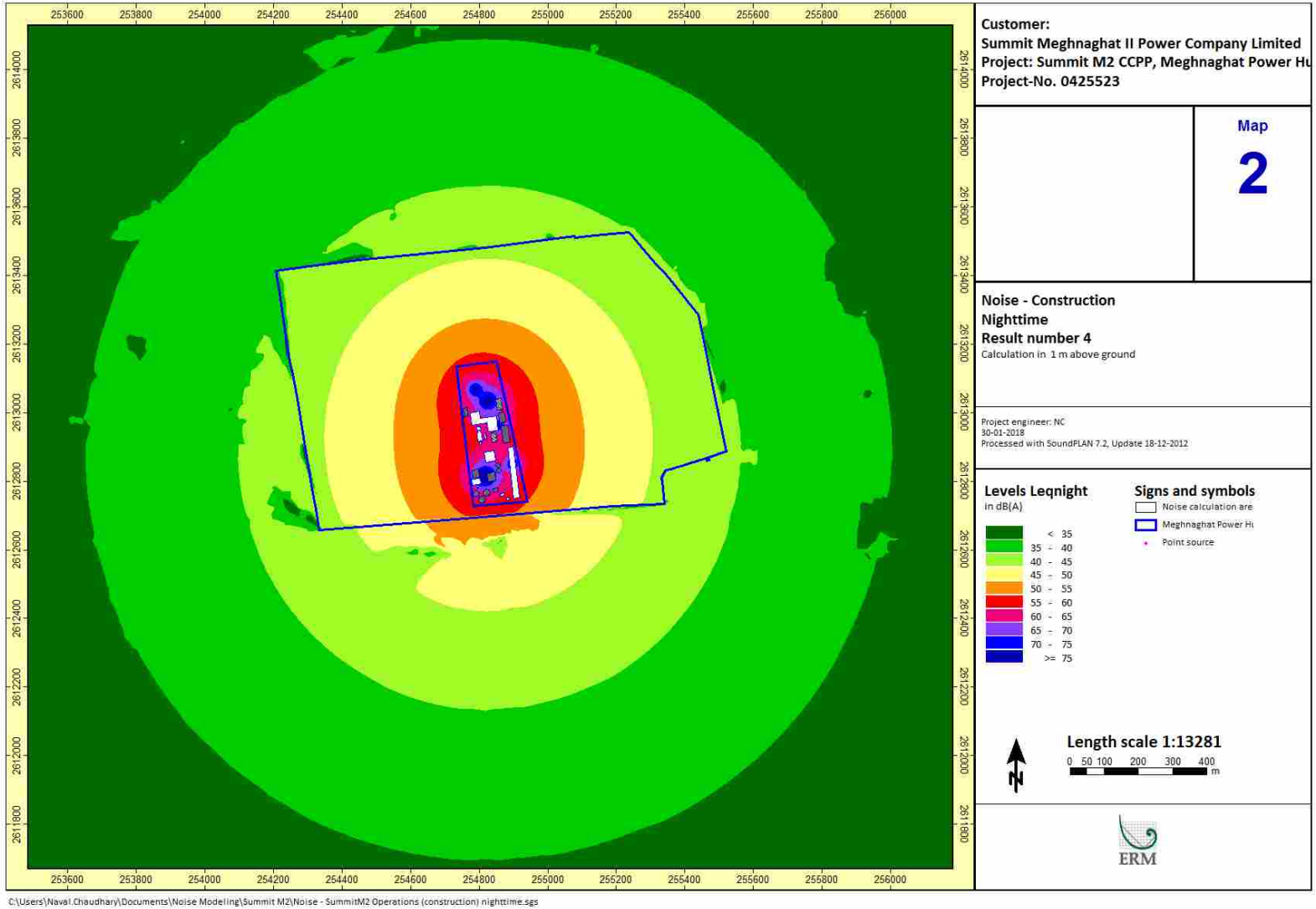


Table 6.16 Predicted Noise Levels at Noise Receptors during Construction Phase

Receptor Code	Sampling Location	Approximate Distance to Power complex Boundary (m) and Direction from Project Site	Baseline Sound Pressure Levels at Receptors, Leq (dBA)[1]		Predicted Sound Pressure Levels at Receptors, Leq (dBA)		Total Sound Pressure Level (Baseline + Predicted), Leq (dBA)		Applicable Standard (dB(A))[2] [3] as per Landuse	
			Leq $_d$*	Leq $_n$*	Leq $_d$	Leq $_n$	Leq $_d$	Leq $_n$	Leq $_d$	Leq $_n$
NQ1	Northern side of Project Area; near GTCL	Within	66.1	58.0	57.4	53.4	**66.6**	**59.3**	***75***	***70***
NQ2	Northern side of Project Area; Near Summit Watch Tower	Within	71.2	64.6	46.7	47.0	**71.2**	**64.7**	***75***	***70***
NQ3	Mugrapara	3 km (NW)	57.5	48.3	26.5	21.6	**57.5**	**48.3**	***55***	***45***
NQ4	Ganganagar	At boundary (E)	58.2	48.7	32.4	30.0	**58.2**	**48.8**	***75***	***70***
NQ5	Eastern side of Power Hub	300 m (E)	59.4	53.4	39.6	36.8	**59.4**	**53.5**	***75***	***70***
NQ6	Southern Side of the Power Hub	At boundary (S)	65.5	59.8	57.1	50.4	**66.1**	**60.3**	***75***	***70***
NQ7	Islampur Village	50 m (SE)	61.3	49.7	44.1	40.8	**61.4**	**50.2**	***60***	***50***
NQ8	New Town	900 m (ENE)	69.8	60.9	34.8	32.1	**69.8**	**60.9**	***60***	***50***
NQ9	Mongoler Gaon/ Dudhghata	1000 m (NW)	59.5	46.9	33.6	31.2	**59.5**	**47.0**	***55***	***45***
NQ10	Charbalaki village	1000 m (WSW)	57.8	48.3	34.0	29.6	**57.8**	**48.4**	***55***	***45***

[1] Ambient noise levels as monitored during the baseline survey

[2] Environmental Conservation Rules, 1997 (Schedule 4) amended September 7, 2006

[3] IFC/WB EHS Guidelines: Noise Management dated April 30, 2007 gives, Noise level guidelines for Residential; institutional and educational receptors in daytime (07:22:00) and night time (22:00-7:00) as 55 and 45 one hour Leq dBA respectively. For industrial and commercial receptors it is 70 one hour Leq dBA for both night and day time.

It is evident from Table 6.16 that ambient noise levels due to construction phase of Summit M2 project will be well within the applicable standard during day and night time at 5 receptors, out of total 10 receptors considered in the study. All the exceedances are due to already higher baseline noise levels during day and night time, whereas predicted noise levels were found to be meeting applicable standards with respect to land use criteria. Higher noise levels at NQ8 are due to its proximity to Dhaka – Chittagong Highway and not directly linked with Meghnaghat Power Hub. Furthermore, noise levels at day and night time will be slightly higher than the applicable standard (with < 5 dBA increase from the applicable standard) at 5 locations. The results also clearly indicate that the project construction activities will not increase the existing noise levels by more than 3 dB(A) outside the Meghnaghat Power Hub. Due to this the noise impact from Summit M2 construction during day and night time is expected to be **negligible** to **minor.**

Impact	*Noise from Construction Activities and transportation of man/ material (Daytime and Night time)*			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent
Impact Extent	Local	Regional	International	
Impact Scale	Within 500 m of Project site and 100 m along the access road			
Frequency	Limited to construction Phase and noise generating construction activities			
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Receptor Sensitivity	Low	Medium	High	
Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is considered **negligible** to **minor.**			

Mitigation Measures

The following mitigation measures will be implemented to minimise potential noise impacts during the construction phase in all periods:

- Normal working hours of the contractor will be between 06:00 and 21:00 hours from Monday to Sunday. If work needs to be undertaken outside these hours, it should be limited to activities that do not exceed the noise criteria at nearby noise sensitive receptors;
- Only well-maintained equipment will be operated on-site;
- Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components should be conducted;
- Machinery and construction plant that may be in intermittent use (e.g. trucks) shall be shut down or throttled down during non-work periods;
- Low noise equipment shall be used as far as practicable;
- The number of equipment operating simultaneously shall be reduced as far as practicable;

- Equipment known to emit noise strongly in one direction should be orientated so that the noise is directed away from nearby NSRs as far as practicable;
- Noisy plant (such as breakers and rollers) shall be located as far away from receptors as practicable.

Residual Impacts

Criterion	Rating pre mitigation	Rating post mitigation	Comment
Change in Ambient Noise Levels during daytime			
Residual Impact	Negligible to Minor	Negligible to Minor	With implementation of the precautionary and the mitigation measures mentioned for prevention/reduction in noise generation at source impacts would be negligible.

6.4 ASSESSMENT OF ECOLOGICAL IMPACTS – CONSTRUCTION PHASE

ERM Impact Assessment Standards defines sensitivity of ecological receptors by determining the significance of effects on species and habitats separately. The impact assessments were undertaken based on following impact assessment matrix as presented in ***Table 6.17*** and ***Table 6.18*** respectively.

Table 6.17 Habitat-Impact Assessment Criteria

Habitat Sensitivity/ Value		Magnitude of Effect on Baseline Habitats			
		Negligible	Small	Medium	Large
Negligible	Habitats with negligible interest for biodiversity.	Not significant	Not significant	Not significant	Not significant
Low	Habitats with no, or only a local designation / recognition, habitats of significance for species listed as of Least Concern (LC) on IUCN Red List of Threatened Species, habitats which are common and widespread within the region, or with low conservation interest based on expert opinion.	Not significant	Not significant	Minor	Moderate
Medium	Habitats within nationally designated or recognised areas, habitats of significant importance to globally Vulnerable (VU) Near Threatened (NT), or Data Deficient (DD) species, habitats of significant importance for nationally restricted range species, habitats supporting nationally significant concentrations of migratory species and / or congregatory species, and low value habitats used by species of medium value.	Not significant	Minor	Moderate	Major
High	Habitats within internationally designated or recognised areas; habitats of significant importance to globally Critically Endangered (CR) or Endangered (EN) species, habitats of significant importance to endemic and/or globally restricted-range species, habitats supporting globally significant concentrations of migratory species and / or congregatory species, highly threatened and/or unique ecosystems, areas associated with key evolutionary species, and low or medium value habitats used by high value species.	Not significant	Moderate	Major	Critical
Negligible	Effect is within the normal range of natural variation				
Small	Affects only a small area of habitat, such that there is no loss of viability / function of the habitat				
Medium	Affects part of the habitat, but does not threaten the long-term viability / function of the habitat.				
Large	Affects the entire habitat, or a significant proportion of it, and the long-term viability / function of the habitat is threatened.				

Table 6.18 Species-Impact Assessment Criteria

Baseline Species Sensitivity/ Value		Magnitude of Effect on Baseline Habitats			
		Negligible	Small	Medium	Large
Negligible	Species with no specific value or importance attached to them.	Not significant	Not significant	Not significant	Not significant
Low	Species and sub-species of LC on the IUCN Red List, or not meeting criteria for medium or high value.	Not significant	Not significant	Minor	Moderate
Medium	Species on IUCN Red List as VU, NT, or DD, species protected under national legislation, nationally restricted range species, nationally important numbers of migratory, or congregatory species, species not meeting criteria for high value, and species vital to the survival of a medium value species.	Not significant	Minor	Moderate	Major
High	Species on IUCN Red List as CR, or EN. Species having a globally restricted range (ie plants endemic to a site, or found globally at fewer than 10 sites, fauna having a distribution range (or globally breeding range for bird species) less than 50,000 km2), internationally important numbers of migratory, or congregatory species, key evolutionary species, and species vital to the survival of a high value species.	Not significant	Moderate	Major	Critical
Negligible	Effect is within the normal range of variation for the population of the species.				
Small	Effect does not cause a substantial change in the population of the species, or other species dependent on it.				
Medium	Effect causes a substantial change in abundance and / or reduction in distribution of a population over one, or more generations, but does not threaten the long term viability / function of that population, or any population dependent on it.				
Large	Affects entire population, or a significant part of it causing a substantial decline in abundance and / or change in and recovery of the population (or another dependent on it) is not possible either at all, or within several generations due to natural recruitment (reproduction, immigration from unaffected areas).				

6.4.1 Terrestrial Habitat

Source of Impact

The potential impact on terrestrial ecology may arise due to:

- Vegetation clearance;
- Fugitive dust emission and deposition of plant;
- Noise & vibration.

Embedded Control Measures:

The control measures are as follows:

- Water sprinkling for dust suppression;
- Engineering control measures to minimise the noise level from construction machineries and equipment.

Impact Assessment:

The potential impact on terrestrial ecology is discussed as follows:

Vegetation Clearance:

The proposed Summit M2 project will be constructed within the Meghnaghat Power Hub. The site is already developed- the low-lying riverine Island was filled up with white sand. The major vegetation was observed in the proposed site including Power hub were shrubs (*Calotropis procera* and *Lantana camara*) and seasonal herbs. The species composition in the Power Hub is not unique to site; these are common the study area. Clearance of shrubs would not disturb the species composition or lead to threat of these plant species. The scale of impact can be considered as low. Extent of impact will be within the project site and proposed laydown area (proposed within the Power Hub). Extent of impact will be local. The clearance of vegetation and change of land use – duration of impact is long term. The proposed project site and study area (10 km around the project site) has mostly modified habitat like homestead vegetation, agricultural land, etc. with few Near Threatened faunal species can be categorised as medium sensitivity. The potential impact on terrestrial habitat including protected species due to vegetation clearance is assessed to be **minor**.





Fugitive Emission:

The fugitive emissions are likely to be generated during construction phases. Due to relatively large particulate matter sizes associated with the fugitive emission from construction site and the relatively short release height of the pollutants, such negative impacts are usually confined in relatively small areas; estimated to be 100 to 200 m from construction activity site/s. The deposited particulate matter may block the plant leaf stomata hence inhibit gas exchange, or smother the plant leaf surfaces reducing photosynthesis levels. Within the 200 m from the proposed project site, there is no natural vegetation; the major vegetated area is the greenbelt plantation of Meghnaghat Power Plant or any agricultural land. The scale of impact can be considered as low. Duration of impact will be short term. The impact on the terrestrial flora is assessed to be **minor**.

Noise & Vibration:

The operation of construction machineries and vehicles will generate noise and vibration. The increased level of noise and vibration in and around proposed project site may cause disturbance to local faunal species. However, it is expected that the noise will be attenuated within the 500 m from the construction site. There is no significant faunal habitat within the 500 m from the proposed site. The potential impact on fauna including protected bird species is assessed to be **minor**.

Impact	Impact on Terrestrial Habitat due to construction activities			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Short Term	Medium Term	Long Term	
Impact Extent	Local	Regional	National	
Impact Scale	Low	Medium	High	
Impact Magnitude	Positive	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High	
Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Minor**			

Mitigation Measures

- Land clearing will be kept minimum to the extent practicable for the approach road and gas pipeline;
- Wherever feasible, depending upon availability of space within plant and/or along the access road, plantation activities shall be performed.
- Engage with local forest department and Upazilla administration for plantation activities outside the project area.
- Strict instruction should be given to the construction workers not to cut trees from the nearby areas for their fuel and timber use;

- Use of LPG/ Kerosene for cooking need to be provided/ encouraged in order to reduce the impacts on vegetation from the vicinity of the Project site;
- Construction workers will be given conservation and awareness training to promote sustainable resource use.

6.4.2 Aquatic Habitat

Source of Impact:

Impacts to the aquatic habitat during construction phase may happen due to:
- Construction of jetty
- Discharge of untreated surface runoff;
- Discharge of waste water from (wash water from machineries & equipment);
- Discharge of domestic waste water.

Embedded Control Measures:

The control measures are as follows:
- Treatment of domestic waste water through septic tank and soak pit;
- Storage of diesel, lubricant and waste oil in paved surface with secondary containment.

Impact Assessment:

Construction of Jetty:

Construction of jetty will generate suspended solids and turbidity. The higher value of suspended solid and organic rich sediment load during dredging and surface runoff cause low DO. Lowering of DO will ultimately affect the aquatic ecology.



Surface Runoff:

The project will be constructed on the available land in the Power Hub area. As the site is already developed, major soil work will not be required. However, earth work for foundation during monsoon season will generate sediment. Direct discharge of surface runoff into river will increase the suspended solids. Increase of suspended solid will affect the DO level in the surface water body. The turbid water and lower DO will affect the primary productivity of the impacted area.

During construction activities, construction machineries and vehicle will be utilised. For the operation of construction machineries and vehicle, oil (diesel) and lubricant will be utilised; accidental spillage and leakage of oil and lubricant is likely to get mixed up with runoff water. The discharge of oil and grease contaminated runoff water without treatment has likely impact on water quality of the receiving water body. The degradation of water quality will affect the primary productivity of the river.

Generation and Discharge of Domestic Waste Water:

During construction activity, approximately 800 workforce (peak construction period) will be engaged. It is estimated that, 30-35 KLD wastewater will be generated from the construction site and construction camp. It is proposed to treat the waste water through septic tank and soak pit. Degradation of water quality due to above mentioned activity will affect the primary productivity of the river; which ultimately affect the fish population, if not properly managed.

As the major earth work (raising of site level) is not expected in the construction site; generation of suspended solid may not be significant. Proper storage of oil and used oil may not cause generate significant increment in pollution load to the receiving water body and subsequently may not cause significant impact the local aquatic ecology. The extent of impact will be regional. The duration of impact will be short term; i.e. only during monsoon season. The potential impact on aquatic habitat including fishes due to above mentioned activity is assessed to be **minor**.

Impact	Impact on Aquatic Habitat due to construction activities			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Short Term	Medium Term	Long Term	
Impact Extent	Local	Regional	National	
Impact Scale	Low	Medium	High	
Impact Magnitude	Positive	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High	
Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Minor**			

Mitigation Measures

- The ideal time to enter the Channel by vessels from main River should be preferably mid-afternoon as during this time the faunal activity reduces;
- Adequate precaution should be taken during vessel navigation towards the temporary jetty to avoid any damage to "Katta" fishing.
- Avoid any discharges on the river near temporary jetty area from the vessels/ barges.

6.5 ASSESSMENT OF ENVIRONMENTAL IMPACTS - OPERATION AND MAINTENANCE PHASE

The assessment of operational phase impacts includes those arising both from routine operations and maintenance of the power plant, including the gas and HSD supply systems. An activity-impact interaction matrix for the operation phase of the Project is presented in Table 5.2**.**

6.5.1 *Soil and Sediment Quality*

Contamination of soil and sediment from wastes

The potential sources of waste generation during operation of the Power plant are from the following:

- Office and Canteens;
- WTP, ETP and STP;
- Gas Turbines;
- Laboratories;
- GT Compressors;
- Lube oil systems;
- DG sets; and
- Power house and workshop area.

Criteria

Bangladesh is having rules and regulations for waste management, which are covered under Hazardous Wastes and Ship Breaking Waste Management Rules, 2011. This will also apply to the Project.

Receptors

Land around the Project site is developed land from filling of river sand and the filling was done about 18 to 20 years ago. Meghna river forms boundary of the Meghnaghat Power Hub from three sides. Improper storage, handling and disposal of solid and hazardous waste may lead to contamination of the land and water bodies nearby. In addition, waste can generate odour and cause health hazards to employees and communities nearby. Referring to sensitivity criteria described in ***Table 6.7*** and details provided in ***Section 6.3.1***, the receptor soil and sediment has been assessed low.

Embedded Control Measures

- segregation measures,
- collection and disposal by licensed waste collectors,
- dedicated storage areas with secondary containment

Impact Significance

The impact assessment of the wastes generated from the sources identified above is summarized below:

Generation of Non-Hazardous Solid Waste

The type and approximate volume of non-hazardous solid waste anticipated from operational activities will be as follows:

- Office and kitchen - 8 to 10 T/year;
- Dewatered sludge from the STP sludge – 50 - 60 kg/year; and
- Air filters from the gas turbines, 300 kg/year.

The unplanned storage and disposal of these wastes may have a direct impact on land and water resources. The solid and non-hazardous wastes generated from the various areas during operations will be collected and segregated at the point of generation and stored in proper designated areas and disposed of through waste disposal contractors or authorized recyclers.

Generation of Hazardous Waste

The type and approximate volume of hazardous waste anticipated from operational activities will be as follows:

- Chemical waste generated, 500-600 m^3/year;
- Chemical Cleaning waste from the CT compressor, 500-600 l/year;
- Waste/used oil from the power house and workshop, 3.0 to 4.0 m^3/year;
- Dewatered sludge from the WTP and ETP[1], 350 - 400 kg/year;
- Oil/dust contaminated cloths and rags from the lube oil system and spill kit waste, 500 - 600 kg/year; and,
- Bio-medical waste from infirmary at site[2].

These hazardous wastes, if haphazardly stored, may be incompatible in nature and can result in ignition, generation of toxic fumes etc. In addition, improper handling, storage and disposal can cause spillage or leachate generation, which in turn can contaminate the land and ground water.

It is planned that hazardous wastes generated from the proposed Project will be collected and stored in designated roofed-areas and/or barrels with

[1] As per local regulations (Guidelines for Sludge Management (February 2015)), sludge characteristics need to checked prior to classification of waste as hazardous or non-hazardous waste and accordingly to select disposal option.

[2] Segregation, storage, disposal as per the Medical Waste Management & Processing Rules, 2008

concrete flooring and secondary containment and disposed of/ sold through contractors or treated prior to discharge.

Given the planned embedded controls, the impacts magnitude during operation as a result of solid and hazardous waste generation is assessed as ***small***.

Impact	*Contamination of Soil and Sediment from Wastes*				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to Project Site Surroundings and nearby communities				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible.**				

Mitigation Measures

In addition to the proper collection, storage and disposal options the following steps will be taken further to manage hazardous wastes:

- Wastes will be stored in a manner that will prevent contact between incompatible wastes i.e. post compatibility checks,
- Proper labelling of hazardous wastes;
- Special care will be taken in the storage areas to prevent any spillage of hazardous wastes and restrict access (except for trained staff) to such areas;
- Periodic audits will be carried out for such areas and containers; also on the segregation and collection systems and the findings will be documented and appropriate action taken against irregularities;
- A spill response plan and emergency plan will be prepared to address accidental spillages or release of hazardous wastes; and
- A proper manifest record will be maintained of waste travelling/ removed from the site; and
- Disposal of hazardous waste by engaging DOE approved waste management agencies.

6.5.2 *Water Resources*

Sources of Impact

The potential sources of impact to surface and ground water resources during the operational phase include:

- The discharge of effluent and sewage from the operational plant that may have an impact on land or the quality of surface water; and
- The abstraction of ground water for drinking purposes for the employees of the power plant.

Criteria

For the assessment of water resources, the sensitivity and magnitude criteria outlined in Table 6.9 and Table 6.10 have been used respectively. The assessment of potential impacts to surface water has considered *Schedule 3 (a), 9 and Schedule 10 of ECR, 1997 and IFC EHS guidelines for thermal power plants* and general guidelines (refer to Table 3.8 and Table 3.9)**.** For groundwater, *Schedule 3 (b) of ECR, 1997,* standards for drinking water has been considered.

Receptors

Surface water: The source of water would be the Meghna River. Based on the sensitivity criteria Table 6.9**,** surface water resource is assessed as Medium.

Groundwater: Ground water samples analysis indicate high levels of iron with other parameters being within standard permissible limits for drinking water specified by Bangladesh ECR, 1997 Schedule 3 (B). Groundwater is used by local residents in the area for drinking. Based on the sensitivity criteria Table 6.9**,** ground water resource is assessed as Medium.

Impact Significance

Surface water abstraction

About 1,000 m^3/hr (0.27 m^3/s) of water will be abstracted for the Meghna River for the proposed plant, which is about 0.0045% of the lean season flow (6,000 m^3/s). Therefore based on the impact magnitude criteria described in Table 6.10 and referring to above discussion, the impact of water abstraction on Meghna River for the proposed plant would be **negligible.**

Impact	*Impact from Surface Water Abstraction*				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Downstream of Meghna River				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible.**				

Water Pollution from Wastewater Discharge

Approximately 20 m^3/hr of treated effluent and about 280 m3/hr (blowdown) will be discharged from the plant to the Meghna River and duration of discharge will be 3 to 4 hrs per day. The sources of liquid effluent generation in the Plant include:

- Oily effluents from Steam turbine building, Combustion turbine building, Transformer yard of CTG and STG, Compressor and CCW pump house, Emergency DG set area;
- HRSG blow down;
- Sampling rack waste;
- CTG auxiliary CT blow down;
- CTG washing;
- HRSG washing;
- Filters (service water filtration plant) back wash; and
- CW side stream filter backwash.

Theses discharges may have a direct impact on the water quality which in turn would have ecological implications, if the treatment is not appropriate and meet the applicable discharge standards.

As discussed in ***Section 2.3.3*** and in the water balance **(**Figure 2.8**)** all the wastewater generated at various areas of the Project will be segregated at the source of generation according to their type. Effluents will be collected at CMB, which will acts as an equalization basin having at least four (4) hours detention period. Acid and alkali dosing facility is provided at CMB to maintain the pH, BOD and COD. Treated effluent [as per the GOB Environment Conservation Rule (1997) Schedule 10 (Standards for Waste from Industrial Units or Project Waste) and the applicable World Bank Group environmental requirements (which ever more stringent)] from CMB will be discharged to the Meghna River through channel buried pipeline of about 500 m and the blowdown temperature differential will always maintained below 3^oC. Use of treated water for plantation/ green areas will also be explored.

In addition, instrumentation will be used to monitor the Plant's compliance with discharge limits. In the event that effluent discharge is detected above the effluent discharge limit criteria, isolation valves will automatically close and stop the discharge. The overall impact to the surface water quality with the treatment prior to disposal on natural drainage channel and magnitude criteria described in Table 6.10 is assessed as **negligible**.

Impact	*Wastewater Discharge*			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent
Impact Extent	Local	Regional	International	
Impact Scale	Discharge into natural drainage			
Frequency	Not Applicable			

Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible.**				

Mitigation Measures

The following mitigation measures are suggested to minimize the impact on river water quality;

- Daily monitoring of temperature at the intake and discharge point;
- Discharge system shutdown in event that discharge temperature of effluent exceeds standard;
- Efforts to be made to increase the cycle of concentration to reduce the volume of blow down and consequently the volume of make-up water required by the cooling tower.
- Waste water of similar nature from different units will be treated in accordance to *GOB Environment Conservation Rule (1997) Schedule 10 (Standards for Waste from Industrial Units or Project Waste)* and the applicable World Bank Group environmental requirements and World Bank/IFC guidelines.

Groundwater contamination

There is a risk of impacts to groundwater quality from the storage and handling of hazardous materials in the Project AOI. The hazardous materials to be stored at the site will include acids, alkalis, diesel fuel, maintenance oils and lubricants, etc. for the water treatment plant, process plant operation, and the laboratory. Maximum storage capacity of different chemical is provided in ***Table 2.9***. The hazardous materials will be stored in a dedicated room at the water treatment plant area. HSD to be used as secondary fuel for power generation is not planned to be stored within site and hence, management of same will be under the purview of Summit M1 project. Diesel for emergency DG sets will be stored in above ground oil tanks located in the vicinity of the Emergency DG set. The storage arrangements will include secondary containment measures and spill kits for spillage control. Given the control measures which will be implemented during operations, and adequate training of operational staff in spill response measures, the impact to groundwater from the plant operations is assessed as ***minor.***

Impact	*Groundwater contamination*			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent
Impact Extent	Local	Regional	International	
Impact Scale	Project Footprint Area			

Likelihood	Unlikely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low		Medium	High	
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **minor.**				

Mitigation Measures

Other mitigation measures which will be adopted to reduce impacts on water quality to As Low as Reasonably Practicable are as follows:

- For minimising use of antifouling and corrosion inhibiting chemicals appropriate depth of water intake will be maintained and use of screens will be ensured;
- Minimum required quantities of chlorinated biocides or alternatively intermittent shot dosing of chlorine will be practised rather than continuous low level feed;
- Waste storage areas will be equipped with secondary containment and spill control measures (similar to the hazardous material storage areas) to limit impact to ground;
- Liquid wastes such as waste oil, etc. will be collected and stored for recycling in cemented areas; and
- All drainage/tanks, etc. will be positioned on concrete hard standing to prevent any seepage into ground.

6.5.3 Air Quality

Sources of Impact

The Project includes dual fuel fired combined cycle power plant (CCPP), consisting of 1 GT, 1 HRSG and 1 ST. The hot flue gas will heat boiler feed water to produce steam, which will be used to drive a steam turbine to produce more electricity in combined cycle operation. In the combined cycle operations, the flue gas will be allowed to exit through the main stack.

Two scenarios are considered for each fuel type (i.e. primary fuel – Natural Gas and secondary fuel – HSD). The scenarios considered are presented in Table 6.19.

Table 6.19 Modelling Scenarios for Air Quality Impact Assessment

Fuel	Scenario	Description
Natural Gas (Primary Fuel)	1	Plant running in combined cycle (During normal operations after commission of combined cycle system)
HSD (Secondary Fuel)*	2	Plant running in combined cycle (During normal operations after commission of combined cycle system)

* *In order to consider worst case scenario, the plant availability has been considered as 90% time of the year.*

The operation of the plant with natural gas as fuel in combined cycle will generate flue gas emissions containing NOx. Emissions of SO_2 are likely to be negligible, as natural gas typically has a no sulphur level (as per the natural gas specifications for the Project). Particulate emissions are likely to be negligible (< 10 mg/Nm^3); as natural gas is a gaseous fuel (there is no supplementary fuel to be used in the GT). It is noted however that particulate emissions (<1 µm diameter) in the form of un-burnt hydrocarbons and Volatile Organic Chemicals (VOCs) such as benzene and formaldehyde, may be released if poor air/fuel mixing and the incomplete combustion of the fuel source occurs. However, operation of the plant with HSD as fuel in combined cycle will generate flue gas emissions containing NOx, SO_2, and PM.

Summary of Emission Sources and Emission Rates

The emission source during the operation of the Plant in combined cycle operation will be main stack (attached to HRSG). Emissions from stack based on the combined cycle operation along with stack parameters depending upon the fuel are presented in Table 6.20 and Table 6.21, respectively.

Table 6.20 Emission Parameters for the Power Plant with Natural Gas as Fuel

Stack	Stack Height (m)	Stack Internal Diameter (m)	Flue Gas Exit Velocity (m/s)	Flue Gas Temperature (°K)	Volumetric Flow Rate (Nm^3/s)	Emission Concentration**		Emission Rate	
						NOx	PM_{10}	NOx	PM_{10}
						mg/Nm^3	mg/Nm^3	(g/s)	(g/s)
Main Stack	75	4.85	20	373	287	51	10	14.7	2.87

** Guaranteed emissions provided by the OEM for natural gas as fuel

Note: Stack parameters are as provided by the client.

Table 6.21 Emission Parameters for the Power Plant with HSD as Fuel

Stack	Stack Height (m)[1]	Stack Internal Diameter (m)	Flue Gas Exit Velocity (m/s)	Flue Gas Temperature (°K)	Volumetric Flow Rate (Nm^3/s)	Emission Concentration*			Emission Rate		
						NOx	SO_2	PM_{10}	NOx	SO_2	PM_{10}
						mg/Nm^3	kg/hr	mg/Nm^3	(g/s)	(g/s)	(g/s)
Main Stack (with 100% load)	75	4.85	20	373	287	152	370	50	44.8	102.8	14.75
Main Stack (with 80% load)	75	4.85	20	373	287	152	303	50	44.8	84.3	14.75
Main Stack (with 60% load)	75	4.85	20	373	287	152	241	50	44.8	66.8	14.75
Main Stack (with 40% load)	75	4.85	20	373	287	513	176	50	151.4	48.8	14.75

Note: Stack parameters are as provided by Client. Stack height is calculated based on SO_2 emission load, which will be generated during plant operation with HSD.

* Guaranteed emissions of NOx and Particulate Matter provided by the OEM for liquid fuel.

[1]Calculated stack height based on SO_2 emission at 100% load was estimated as 82.5m with hourly emission rate of 370 kg/hr. However, the project will be primarily based on RLNG and with HSD the plant will not run with 100% load throughout the year. It is also to be noted that as per Power Sector Master Plan in Bangladesh, Coal and RLNG have been considered to be two main primary fuels for power generation after depletion of indigenous natural gas reserves. Therefore, HSD will always be used for peak generation. Based on available information, following will be the running hours with different loads:

					KJ/Kwh, net, LHV		
Load	100%		20.00%	Time	6,881.00		
Load	80%		10.00%	Time	6,469.00		
Load	60%		10.00%	Time	6,800.00		
Load	40%		15.00%	Time	7,469.00		
Load	0%		15.00%	Time			
	40.00%		70.00%				
Capacity=	541.00	MW					

Considering above loads and running time, average SO_2 emission rate will be of the order of 260 kg/hr. Based on this emission rate, the calculated stack height is 74.24 m. Hence, stack height of 75 m has been considered for the project.

Criteria

For the assessment of air quality, the sensitivity and magnitude criteria outlined in Table 6.11 and Table 6.23, respectively have been used. The standards considered for assessment of potential impacts to air quality, are *Schedule 11 ECR, 1997 of the GOB*.

Table 6.22 Sensitivity Criteria for Air quality

Sensitivity Criteria	Contributing Criteria	
	Human Receptors	*Ecological Receptors*
Low	Locations where human exposure is transient.[1]	Locally designated sites; and/or areas of specific ecological interest, not subject to statutory protection (for example, as defined by the project ecology team).
Medium	Locations where the people exposed are workers [2], and exposure is over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day[3].	Nationally designated sites.
High	Locations where members of the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day).	Internationally designated sites.

Table 6.23 Criteria for Impact Magnitude for Assessment of Impact to Air Quality (Operation Phase)

Magnitude Criteria	Negligible	Small	Medium	Large
Air Quality change in undegraded airshed (Baseline < applicable air quality standard (AQS))	• Project contribution < 25% of AQS	• Project contribution > 25% of AQS but < 50% of AQS; and Predicted environmental concentration < 100% of	• Project contribution > 25% of AQS but < 50% of AQS; and Predicted environmental concentration >100% of	• Project contribution > 50% of AQS but < 100% of AQS; and Predicted environmental concentration >100% of

[1] As per the GOB and World Bank/IFC guidelines, there are no standards that apply to short –term exposure, eg one or two hours, but there is still a risk of health impacts, albeit less certain.

[2] Notwithstanding the fact that the air quality objectives and limit values do not apply to people in the workplace, such people can be affected to exposure of PM10. However, they are considered to be less sensitive than the general public as a whole because those most sensitive to the effects of air pollution, such as young children are not normally workers. For this reason workers are included in the medium sensitivity category.

[3] *Schedule 11 ECR, 1997 of the GOB.*

Magnitude Criteria	Negligible	Small	Medium	Large
		AQS	AQS; or • Project contribution > 50% of AQS but < 100% of AQS; and Predicted environmental concentration <100% of AQS;	AQS; or • Project contribution > 100% of AQS
Air Quality change in degraded airshed (Baseline > AQS)	• Project contribution < 10% of AQS	• Project contribution > 10% of AQS and < 15% of AQS	• Project contribution > 15% of AQS and < 25% of AQS	• Project contribution > 25% of AQS

Receptors

From the landuse analysis and field study, it is clear that most of the land surrounding the Project site, as well as eastern and southern side is industrial land. Nearest settlement from the site is Islampur, which is at a distance of about 650 m from the site. Other settlements in the northern and western side of the project are located at about 1 km distance. Meghna River on the southern side is having more than 1.5 km width and after that there is industrial area on the bank of the Meghna River. As can be referred from Table 6.11 and above discussion, the human receptors were assessed to be of Medium sensitivity, whereas ecological receptors were considered as of Low sensitivity.

Prediction of Impacts

Impacts due to the operation of the plant were assessed by modelling projected emission rates (Table 6.20 and Table 6.21) using the AMS/EPA Regulatory Model (AERMOD). AERMOD is a modelling system consisting of three separate modules: AERMET, AERMAP and AERMOD. AERMET is a meteorological pre-processor and uses hourly surface observations, cloud cover, and upper air parameters from twice-daily vertical sampling of the atmosphere to create two output files consisting of surface and vertical profile data, respectively. The terrain pre-processor AERMAP uses DEM maps as well as user generated receptor grids. AERMAP's output file consists of the x, y locations of each receptor, mean sea level (MSL) elevation and hill profile parameters. The hill profile parameter is used in determining plume flow around elevated terrain.

Model Options: The AERMOD model was run with the following regulatory default options in this assessment:

- Stack-tip downwash;
- Elevated terrain effects;

- Use of calms processing routine;
- Use of missing data processing routine; and
- No exponential decay

Meteorological Data: The input meteorological data for the AERMOD was generated using the MM5 model, which was downscaled to fine grid data suitable for modelling. The data used in the study was site specific and was collected over one year period (2016). In all there were 8760 hours of meteorological data used in the model. This quantity of data allows an adequate assessment of hourly, 8-hourly, daily and annual average pollutant concentrations around the Project site. The annual wind rose diagram and wind class frequency distribution are presented in ***Figure 6.4*** and ***Figure 6.5***, respectively.

Terrain Data: Terrain data for the AERMAP model were taken from the 30 m SRTM database, while land cover data was sourced from satellite imagery of the Project site and its surroundings.

Receptors: The receptor grid or network, defined the locations of predicted ground level concentrations (GLCs) used to assess compliance with the relevant standards or guidelines. The following comprehensive fine and coarse receptor network was used for this analysis:

- Upto 1 km from Project site a grid of 100 m x 100 m was created;
- Between 1 km to 3 km from project site grid spacing was 150 m x 150 m;
- Between 3 km to 5 km from project site grid spacing was 200 m x 200 m; and,
- Between 5 km to 10 km from project site grid spacing was 500 m x 500 m.

This network used Cartesian (X, Y) receptors with UTM coordinates. Base elevation of all the receptors were found using terrain elevations interpolated from SRTM (~30 m) Digital Elevation Model (DEM) data. In addition to that 8 discrete Cartesian receptors were also taken into consideration, where the ambient air quality monitoring is currently being done as part of establishing the baseline conditions.

The discrete Cartesian receptor locations are shown in Figure 6.6 and details have been presented in Table 6.24**.**

Table 6.24 Monitoring Locations with respect to the Project

S. No.	Location Code	Location Name	UTM Co-ordinates* (m)			Distance and Direction from Plant boundary
			Easting	Northing	Elevation	
1	AQ1	Islampur	255424	2612838	10	0.65km; SE
2	AQ2	Nayagoan	254228	2614000	6	1.1 km; N
3	AQ3	Pratapnagar	257128	2613834	7	2.5 km; E
4	AQ4	Dudhghat	253048	2613455	9	1.8 km, NW
5	AQ5	Loshkordi-Husendi	255745	2611267	16	2.0 km, South
6	AQ6	Char Balaki	253044	2612255	9	1.8 km; W
7	AQ7	Mograpara	255012	2615347	11	2.4 km; N

S. No.	Location Code	Location Name	UTM Co-ordinates* (m)			Distance and Direction from Plant boundary
			Easting	Northing	Elevation	
8	AQ8	Pirizpur	256452	2615052	10	2.7 km, NE

* UTM Zone - 46

Figure 6.4 Annual Windrose of the Project Site

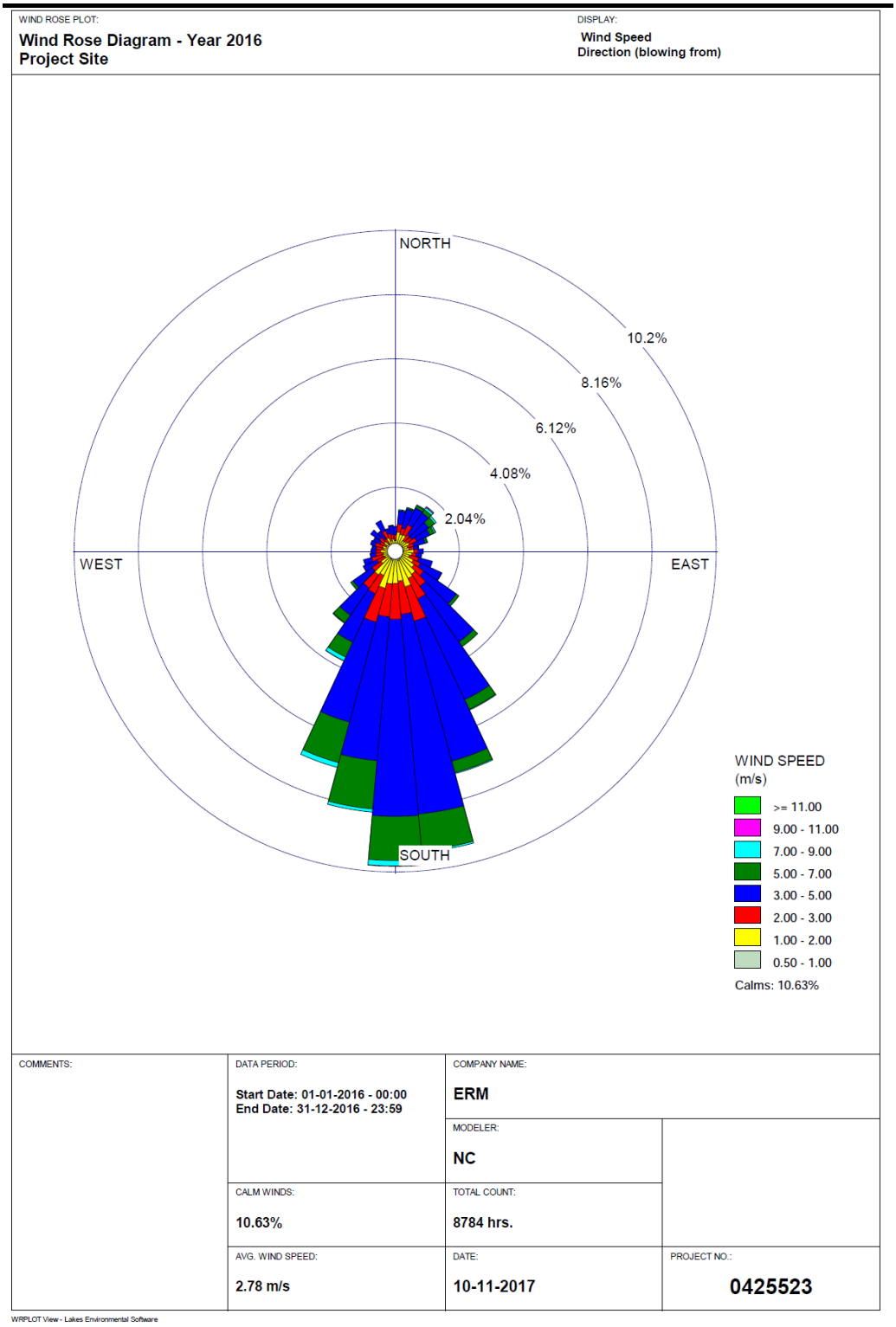


Figure 6.5 Wind Class Frequency Distribution

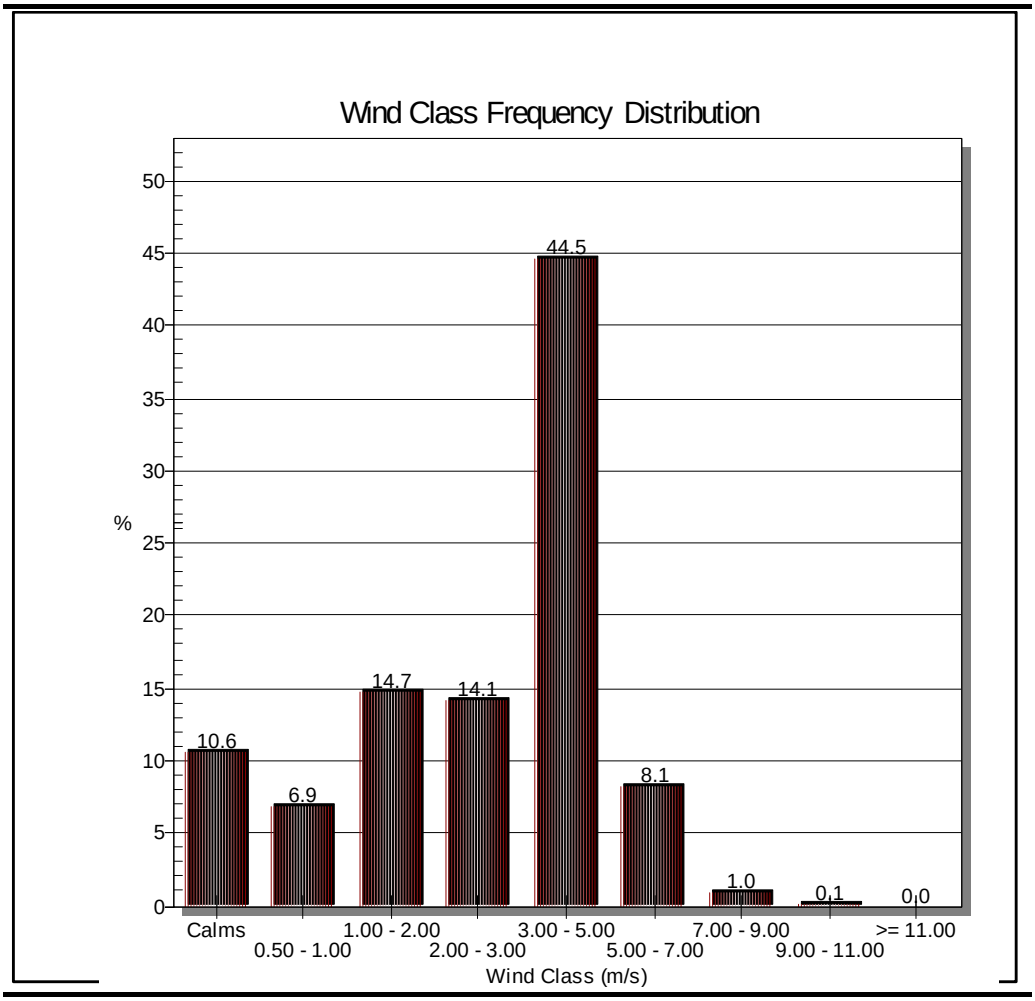
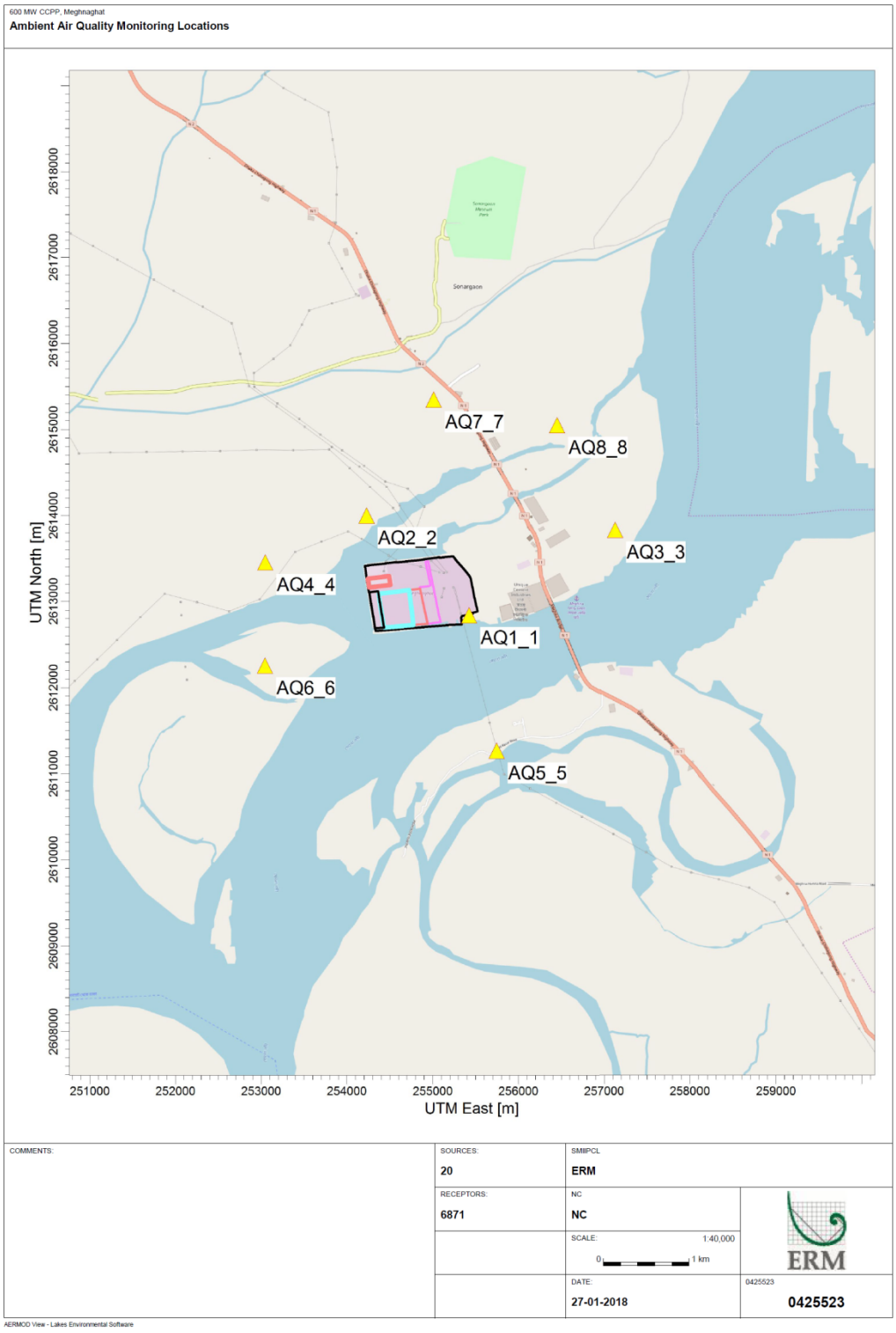


Figure 6.6 Ambient Air Quality monitoring Locations with respect to Project Site



Modelling Results

Predicted maximum ground level concentrations within the Project AOI with natural gas and HSD as fuel are presented in Table 6.25. While conducting the air dispersion modelling with HSD as fuel, the worst case scenario of 100% load as well as other loads (i.e. 80%, 60% and 40%) are considered. Isopleths of ground level concentration for different averaging periods of the criteria

pollutants (NOx, SO_2 and PM_{10}) with natural gas and HSD as fuel are presented in Figure 6.7 to Figure 6.11.

Impact Significance

It is evident from Table 6.25 that the maximum ground level concentration due to operation of Summit M2 project for different averaging periods with both the fuels were predicted much below the applicable ambient air quality standard for the project. Exceedance in PM_{10} concentrations are primarily due to the existing baseline conditions in the study area because of other air polluting industries, construction activities in national highway, vehicular movement etc. The project contributions in particulate matter maximum ground level concentration (with both the fuel options) are well below 3% of the applicable standard. In case of NOx and SO2, the project contribution varies from 2.4% for NOx and about 8% for SO2, which are also well below 25% of the applicable standard for non-degraded airshed and below 10% of the applicable standard for degraded airshed (refer to Table 6.23). Therefore, the impact significance due to the operation of Summit M-2 project using natural gas or HSD as fuel is assessed to be minor to negligible.

Impact	*Ambient Air Quality (by use of Natural Gas or HSD as fuel for power generation)*			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent
Impact Extent	Local	Regional	International	
Impact Scale	Maximum impact zone within 2 km from project boundary in the downwind direction			
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High	
Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is considered **minor** to **negligible.**			

Mitigation Measures

To ensure compliance with the air emission criteria for flue gas stacks, the following measures will be implemented during operations:

- The use of continuous emission monitoring system (CEMS) equipment for the measurement of air emission levels in the exhaust stack of HRSG. CEMS will be undertaken for PM, NO_x, SO_2, CO and O_2;
- $PM_{2.5}$ will be monitored periodically, to ensure that these emissions are not occurring as a result of the incomplete burning of the natural gas fuel and use of HSD as fuel.
- The stack will be provided with safe access to sampling points for CEMS sample probes as well as manual stack monitoring.
- HSD shall be used only for peak generation during shortage/ disruption of natural gas supply.

Table 6.25 Predicted Concentrations at Receptors due to Operation of Summit M2 with Gas and HSD as Fuel

Scenario	Pollutant	Average	Maximum Predicted Concentration (µg/m³)									Max. Background Concentration (µg/m³)*									Total Concentration (Predicted + Background) (µg/m3)									*Bangladesh Standard* (µg/m³)
			Max	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8	Max	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8	Max	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8	
Summit M2 Operation with Natural Gas as Fuel	NO_x	1-hourly	16.56	7.38	8.61	8.97	11.91	6.81	4.82	8.68	12.94	154.8	150.0	132.0	154.8	140.8	150.0	124.8	154.4	146.4	171.4	157.4	140.6	163.8	152.7	156.8	129.6	163.1	159.3	-
		24-hourly	4.14	1.48	1.68	1.15	1.20	0.79	1.01	1.45	1.01	38.7	37.5	33.0	38.7	35.2	37.5	31.2	38.6	36.6	42.8	39.0	34.7	39.9	36.4	38.3	32.2	40.1	37.6	-
		Annual	0.78	0.24	0.44	0.12	0.16	0.12	0.16	0.39	0.18	7.3	7.1	6.2	7.3	6.6	7.1	5.9	7.3	6.9	8.1	7.3	6.7	7.4	6.8	7.2	6.0	7.7	7.1	***100***
	PM10	1-hourly	2.85	1.31	1.40	1.54	1.57	1.18	0.76	1.37	2.33	1205.8	1205.8	653.3	1008.5	666.5	947.1	627.0	802.4	627.0	1208.6	1207.1	654.7	1010.0	668.0	948.3	627.8	803.8	629.3	-
		24-hourly	0.65	0.25	0.28	0.20	0.19	0.15	0.18	0.25	0.18	275.0	275.0	149.0	230.0	152.0	216.0	143.0	183.0	143.0	275.7	275.3	149.3	230.2	152.2	216.2	143.2	183.3	143.2	***150***
		Annual	0.13	0.04	0.07	0.02	0.03	0.02	0.03	0.07	0.03	55.0	55.0	29.8	46.0	30.4	43.2	28.6	36.6	28.6	55.1	55.0	29.9	46.0	30.4	43.2	28.6	36.7	28.6	***50***
Summit M2 Operation with HSD as Fuel (at 100% load)	NO_x	1-hourly	50.47	22.48	26.23	27.35	36.31	20.76	14.69	26.44	39.43	154.8	150.0	132.0	154.8	140.8	150.0	124.8	154.4	146.4	205.3	172.5	158.2	182.2	177.1	170.8	139.5	180.8	185.8	---
		24-hourly	12.63	4.50	5.11	3.51	3.66	2.39	3.07	4.41	3.07	38.7	37.5	33.0	38.7	35.2	37.5	31.2	38.6	36.6	51.3	42.0	38.1	42.2	38.9	39.9	34.3	43.0	39.7	---
		Annual	2.37	0.73	1.35	0.37	0.47	0.36	0.47	1.18	0.55	7.3	7.1	6.2	7.3	6.6	7.1	5.9	7.3	6.9	9.7	7.8	7.6	7.7	7.1	7.4	6.3	8.5	7.4	***100***
	SO_2	1-hourly	115.78	51.57	60.18	62.75	83.30	47.64	33.70	60.68	90.47	36.8	36.8	28.8	32.8	28.8	34.0	28.8	34.0	30.4	152.5	88.3	89.0	95.5	112.1	81.6	62.5	94.7	120.8	-
		24-hourly	28.97	10.33	11.73	8.05	8.40	5.49	7.03	10.11	7.04	9.2	9.2	7.2	8.2	7.2	8.5	7.2	8.5	7.6	38.2	19.5	18.9	16.3	15.6	14.0	14.2	18.6	14.6	***365***
		Annual	5.43	1.67	3.09	0.84	1.08	0.82	1.09	2.72	1.26	1.7	1.7	1.3	1.5	1.3	1.6	1.3	1.6	1.4	7.2	3.4	4.4	2.4	2.4	2.4	2.4	4.3	2.7	***80***
	PM10	1-hourly	14.65	6.73	7.19	7.91	8.08	6.04	3.90	7.05	11.98	1213.5	1213.5	657.5	1014.9	670.7	953.1	631.0	807.5	631.0	1228.1	1220.2	664.7	1022.8	678.8	959.2	634.9	814.6	643.0	-
		24-hourly	3.32	1.29	1.44	1.02	0.98	0.75	0.94	1.28	0.91	275.0	275.0	149.0	230.0	152.0	216.0	143.0	183.0	143.0	278.3	276.3	150.4	231.0	153.0	216.8	143.9	184.3	143.9	***150***
		Annual	0.64	0.20	0.38	0.11	0.14	0.11	0.14	0.35	0.17	55.0	55.0	29.8	46.0	30.4	43.2	28.6	36.6	28.6	55.6	55.2	30.2	46.1	30.5	43.3	28.7	37.0	28.8	***50***
Summit M2 Operation with HSD as Fuel (at 80% load)	SO_2	1-hourly	94.84	41.96	49.27	51.42	68.28	39.02	27.62	49.75	74.14	36.8	36.8	28.8	32.8	28.8	34.0	28.8	34.0	30.4	131.6	78.7	78.0	84.2	97.1	73.0	56.4	83.7	104.5	-
		24-hourly	23.31	8.45	9.54	6.57	6.86	4.50	5.76	8.26	5.76	9.2	9.2	7.2	8.2	7.2	8.5	7.2	8.5	7.6	32.5	17.7	16.7	14.8	14.1	13.0	13.0	16.8	13.4	***365***
		Annual	4.39	1.37	2.52	0.70	0.89	0.67	0.89	2.22	1.04	1.7	1.7	1.3	1.5	1.3	1.6	1.3	1.6	1.4	6.1	3.1	3.9	2.2	2.2	2.3	2.2	3.8	2.5	***80***
Summit M2 Operation with HSD as Fuel (at 60% load)	SO_2	1-hourly	75.19	33.26	39.05	40.76	54.12	30.93	21.89	39.44	58.77	36.8	36.8	28.8	32.8	28.8	34.0	28.8	34.0	30.4	112.0	70.0	67.8	73.5	82.9	64.9	50.7	73.4	89.1	-
		24-hourly	18.47	6.69	7.56	5.21	5.44	3.57	4.57	6.55	4.57	9.2	9.2	7.2	8.2	7.2	8.5	7.2	8.5	7.6	27.7	15.9	14.8	13.4	12.6	12.1	11.8	15.1	12.2	***365***
		Annual	3.48	1.08	2.00	0.55	0.70	0.53	0.71	1.77	0.82	1.7	1.7	1.3	1.5	1.3	1.6	1.3	1.6	1.4	5.2	2.8	3.3	2.1	2.0	2.1	2.1	3.4	2.2	***80***
Summit M2 Operation with HSD as Fuel (at 40% load)	SO_2	1-hourly	54.94	24.31	28.54	29.78	39.55	22.60	15.99	28.82	42.94	36.8	36.8	28.8	32.8	28.8	34.0	28.8	34.0	30.4	91.7	61.1	57.3	62.6	68.3	56.6	44.8	62.8	73.3	-
		24-hourly	13.50	4.89	5.53	3.81	3.97	2.61	3.34	4.78	3.34	9.2	9.2	7.2	8.2	7.2	8.5	7.2	8.5	7.6	22.7	14.1	12.7	12.0	11.2	11.1	10.5	13.3	10.9	***365***
		Annual	2.54	0.79	1.46	0.40	0.51	0.39	0.52	1.29	0.60	1.7	1.7	1.3	1.5	1.3	1.6	1.3	1.6	1.4	4.3	2.5	2.8	1.9	1.9	2.0	1.9	2.9	2.0	***80***

Note:

Highlighted cells indicate calculated background concentrations for 1 hourly and annual averages. Baseline monitoring data was available for 1 month at the time of this analysis with 24 hourly averages. Therefore, in order to provide 1-hourly maximum and annual average concentrations, conversions are done using the power law relationship given below:

$C_{long} = C_{short}(t_{short}/t_{long})^p$

where:

C_{long}= *the concentration for the longer averaging time*

C_{short}= *the concentration for the shorter averaging time*

T_{short}= *the shorter averaging time (in minutes)*

T_{long} = *the longer averaging time (in minutes)*

p = the power law exponent

For ambient air assessments p value was calculated based on exponent p from predicted results for 1-hourly and annual averages for each pollutant. This methodology is deemed to give conservative estimates and thus is deemed appropriate for this case.

Figure 6.7 NOx Isopleths - 1 Hourly Maximum Ground Level Concentrations (Summit M2 Operation with Natural Gas as Fuel)

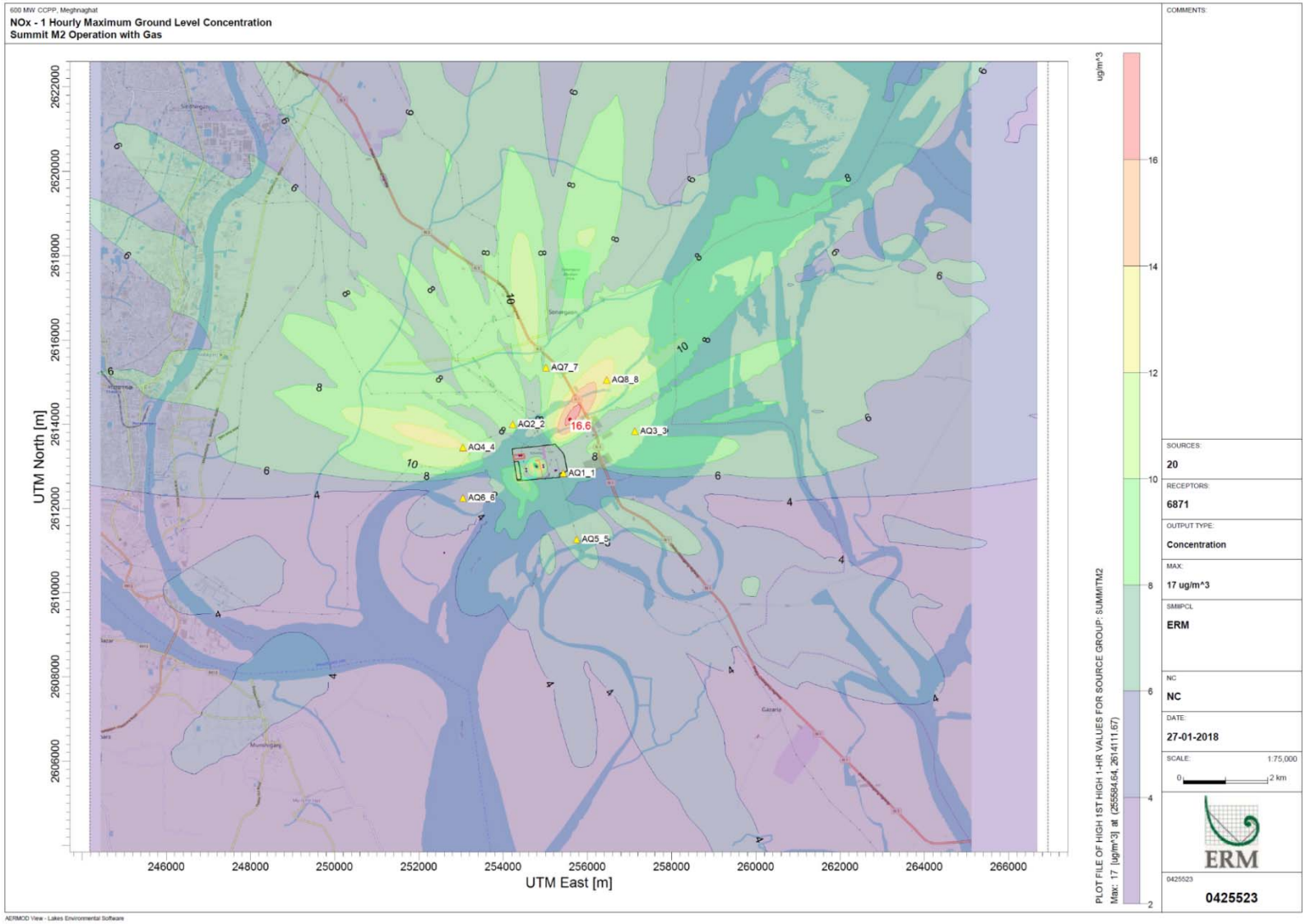


Figure 6.8 NOx Isopleths - 1 Hourly Maximum Ground Level Concentrations (Summit M2 Operation with HSD as Fuel)

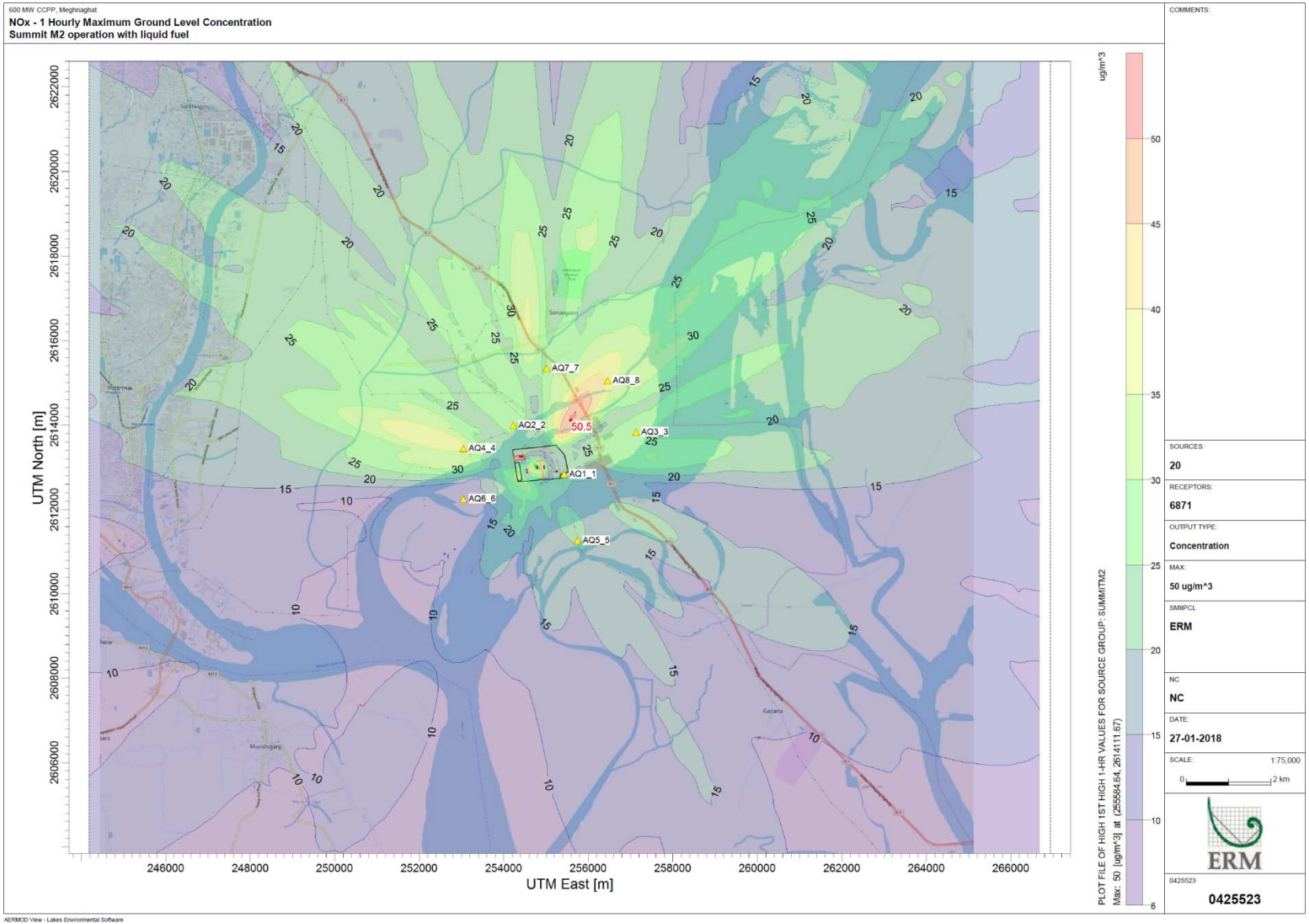


Figure 6.9 SO_2 Isopleths - 24 Hourly Maximum Ground Level Concentrations (Summit M2 Operation with HSD as Fuel)

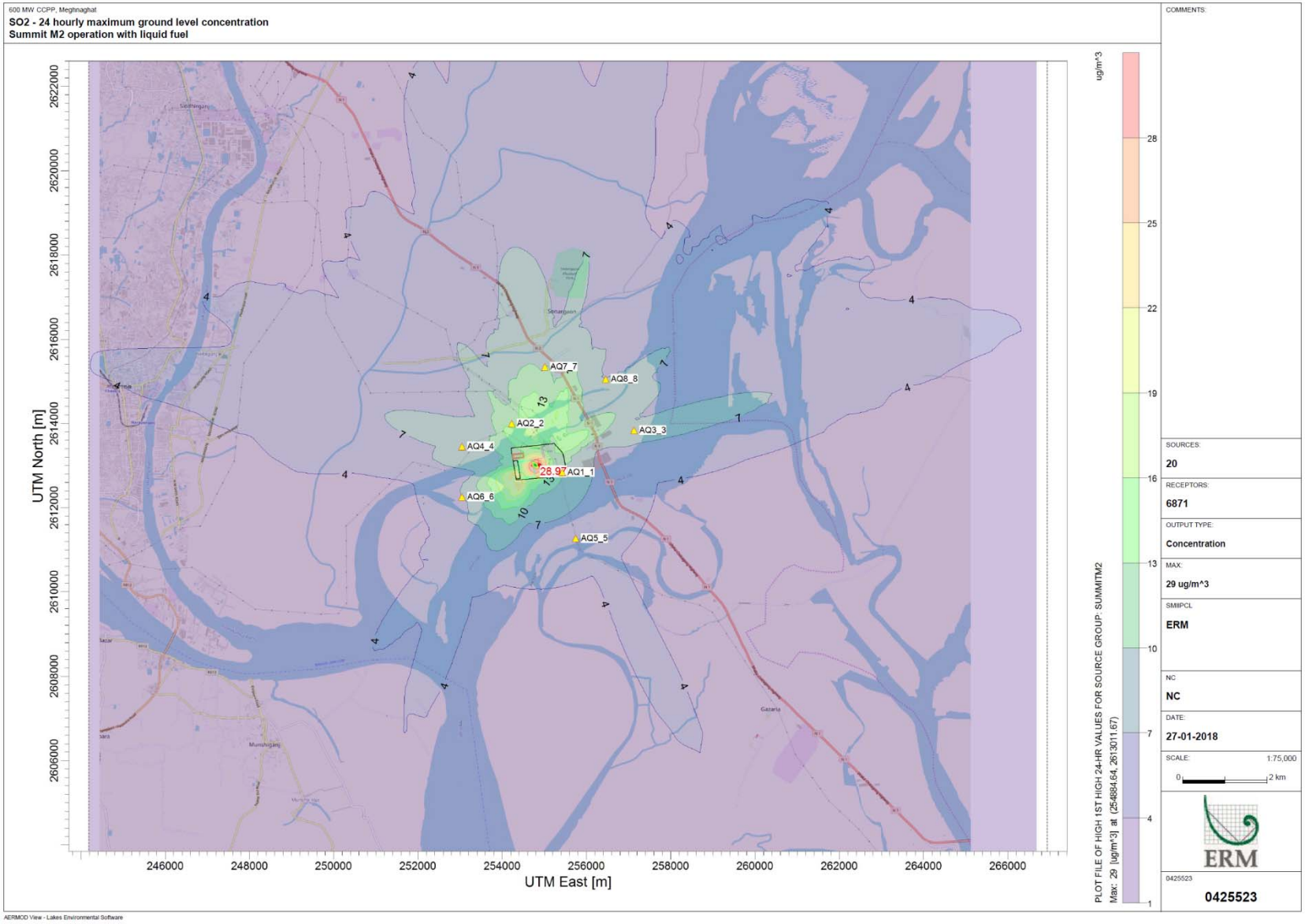


Figure 6.10 PM_{10} Isopleths – 24 hourly Maximum Ground Level Concentrations (Summit M2 Operation with Natural Gas as Fuel)

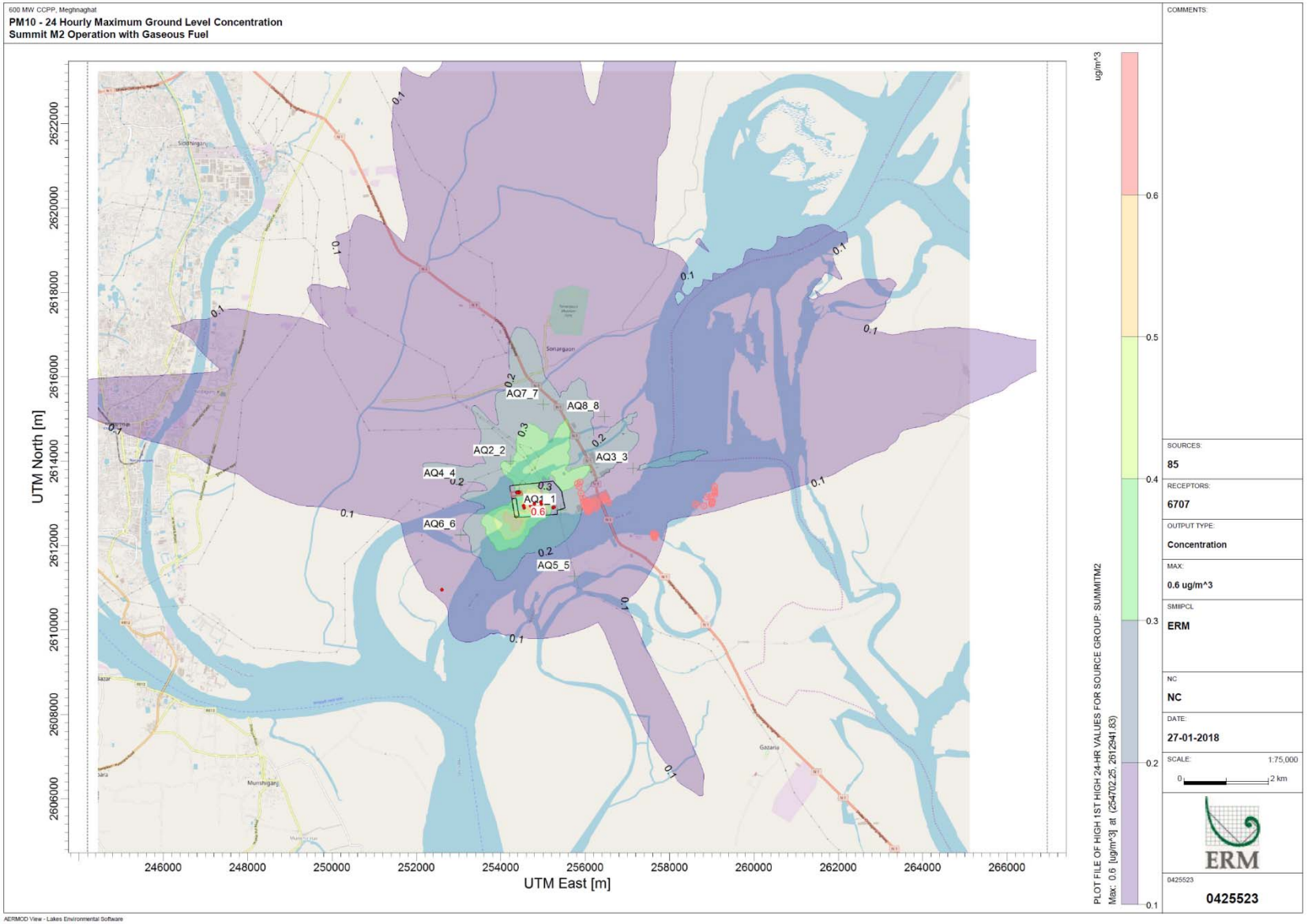
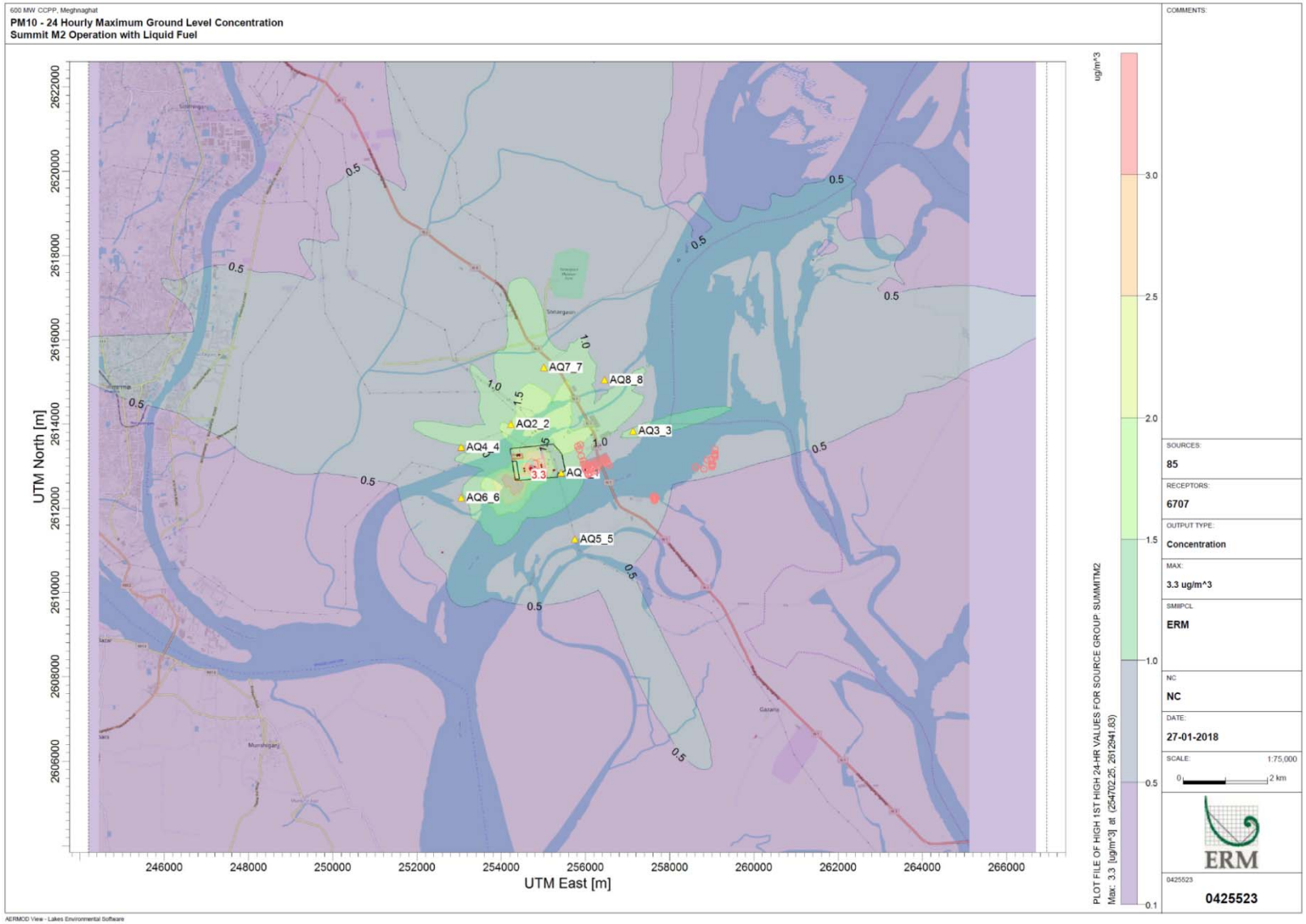


Figure 6.11 PM_{10} Isopleths – 24 Hourly Maximum Ground Level Concentrations (Summit M2 Operation with HSD as Fuel)



Since the ambient air quality monitoring was in progress at the time of this report preparation and data of December month only as available and hence, overall impact on air quality with background air quality could not be completed. However, in order to ascertain the impacts due to major air polluting industries within the industrial area as well as proposed power projects in the study area, attempt was made to develop emission inventory of these sources and air dispersion modelling study was carried out to assess overall impacts on the air quality of study area. Key industries included in this study are as follows:

- Existing sources: Summit Meghnaghat, Meghnaghat Power, Orion HFO Plant, Tiger Cement (Unit 1&2), Holcim Cement (Unit 1&2), Fresh Cement (Unique Cement), Anwar Cement, New Cement Plant, which included both the point sources (i.e. stacks); area and volume sources including storage and handling of material, loading and unloading activities, etc.
- Proposed sources: Summit Meghnaghat 2 Plant, Reliance Power Plant and Orion Coal based power plant at Char Balaki (stack emissions).

The predicted results with different source groups and fuel use are presented in Table 6.26 and Table 6.27. Isopleths of ground level concentrations are presented from Figure 6.12 to Figure 6.16 for different pollutants and scenarios.

Prediction results for PM_{10} show high ground level concentrations particularly close to the sources in different cement mills The 24 hourly maximum isopleths indicate that the higher concentrations of PM_{10} are limited to the industrial area and close to the sources, whereas beyond industrial area, the levels reduce drastically and reach to levels of 60 $\mu g/m^3$. Also, higher SO_2 ground level concentrations in existing scenario are primarily due to HFO based power plant (running with higher sulphur content in fuel) and lower stack heights (~30 m).

Maximum ground level concentration due to proposed power plants operations (worst case scenario) and ambient air quality monitoring data of monitoring locations has been used to calculate overall cumulative impact in the study area. The results are presented in Table 6.26 and Table 6.27. It is evident these tables that the gaseous pollutant will be well within the applicable standards at all locations, whereas, PM_{10} will be slightly higher at two locations, where the baseline data also indicated exceedance with respect to applicable standards. These locations are located close to cement plants within the industrial area.

Therefore, the impact magnitude due to the operation of proposed power projects is assessed to be small.

Table 6.26 Maximum Predicted Concentrations due to Operation various industries in the neighbourhood with Summit M1 and M2 using Natural Gas

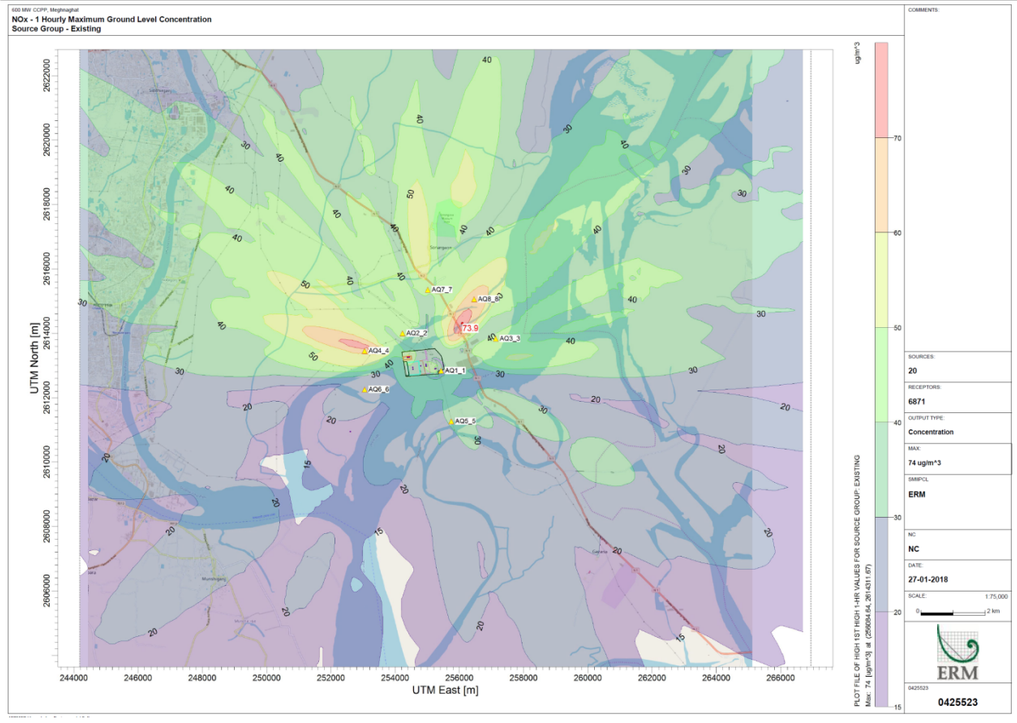
Pollutant	Average	Predicted Concentration (µg/m³)				*Background Concentration* (µg/m³)	*Total Concentration* (µg/m³)	*Bangladesh Standard* (µg/m³)
		Existing Sources only	Proposed Sources Only	Summit M2 Only	All Sources			
NO_x	1-hourly	73.94	148.96	16.56	161.9	*98.0*	*259.9*	*-*
	24-hourly	17.44	26.04	4.14	36.64	*24.5*	*61.1*	*-*
	Annual	3.71	5.77	0.78	9.18	*4.6*	*13.8*	*100*
SO2	1-hourly	434.86	170.66	0	468.01	*24.0*	*492.0*	*-*
	24-hourly	143.63	27.68	0	144.05	*6.0*	*150.1*	*365*
	Annual	22.42	6.06	0	25.73	*1.1*	*26.9*	*80*
PM10	1-hourly	2156.88	16.03	2.85	2156.88	*326.5*	*2483.4*	*-*
	24-hourly	301.61	3.44	0.65	302.62	*74.0*	*376.6*	*150*
	Annual	41.23	0.83	0.13	41.52	*14.3*	*55.8*	*50*

Table 6.27 Maximum Predicted Concentrations due to Operation various industries in the neighbourhood with Summit M1 and M2 using HSD as fuel

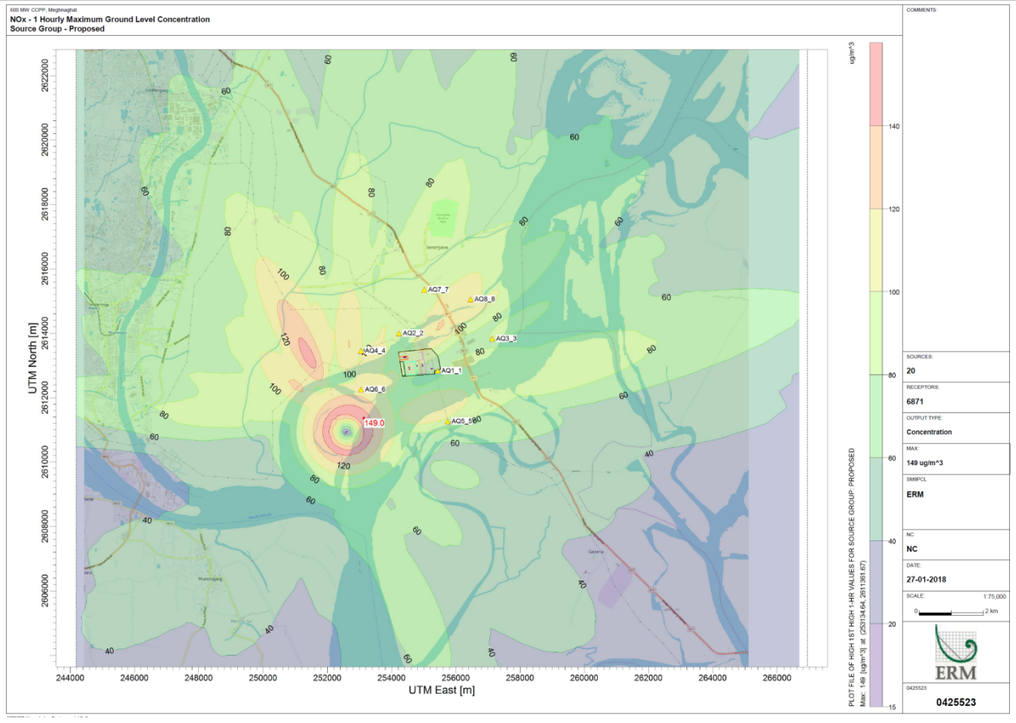
Pollutant	Average	Predicted Concentration (µg/m³)				*Background Concentration* (µg/m³)	*Total Concentration* (µg/m³)	*Bangladesh Standard* (µg/m³)
		Existing Sources only	Proposed Sources Only	Summit M2 Only	All Sources			
NO_x	1-hourly	141.93	154.46	50.47	235.99	*98.0*	*334.0*	*---*
	24-hourly	33.61	31.07	12.63	57.65	*24.5*	*82.2*	*---*
	Annual	6.96	7.1	2.37	13.46	*4.6*	*18.1*	*100*
SO_2	1-hourly	447.68	176.51	115.78	508.67	*24.0*	*532.6*	*---*
	24-hourly	143.8	38.67	28.97	160.77	*6.0*	*166.8*	*365*
	Annual	23.77	8.32	5.43	30.31	*1.1*	*31.4*	*80*
PM10	1-hourly	2156.88	25.04	14.65	2156.88	*324.5*	*2481.3*	*---*
	24-hourly	302.56	6.11	3.32	303.98	*74.0*	*378.0*	*150*

Pollutant	Average	Predicted Concentration (µg/m³)				*Background Concentration* (µg/m³)	*Total Concentration* (µg/m³)	*Bangladesh Standard* (µg/m³)
		Existing Sources only	**Proposed Sources Only**	**Summit M2 Only**	**All Sources**			
	Annual	41.51	1.31	0.64	41.91	***14.8***	***56.7***	***50***

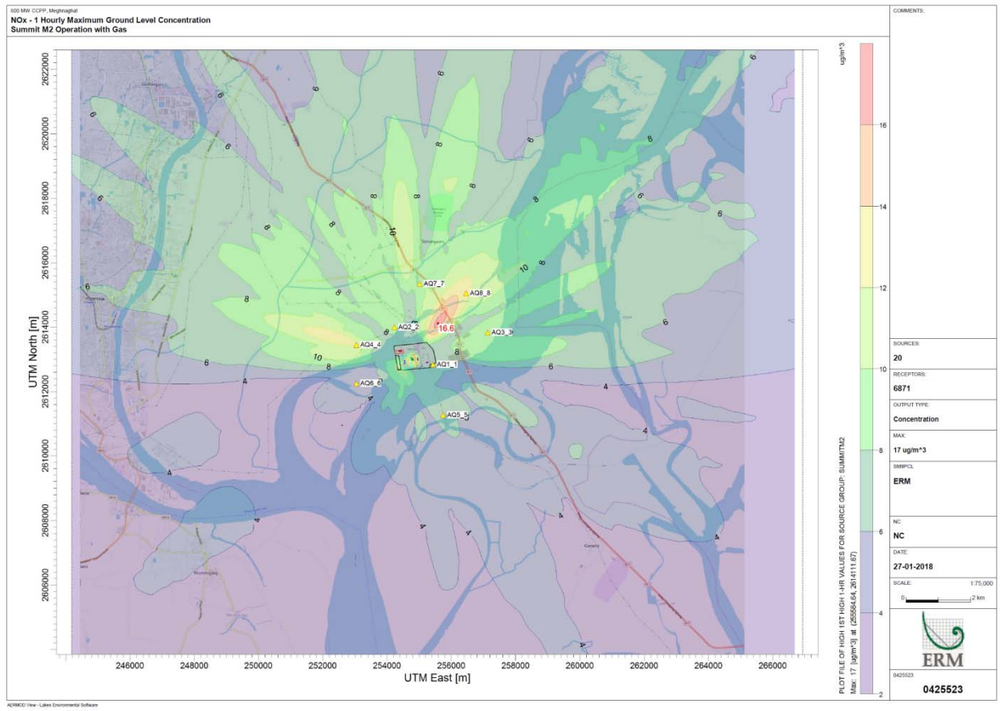
Figure 6.12 NOx - 1 Hourly Maximum Ground Level Concentrations with CCPPs using Natural Gas as Fuel



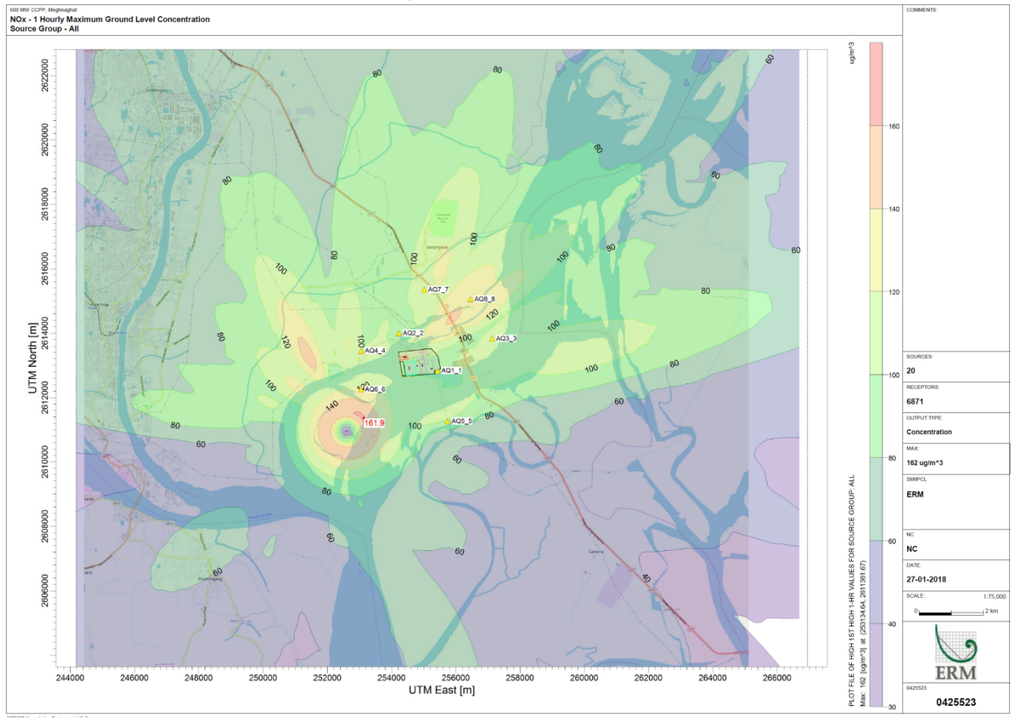
Existing Sources



Proposed Sources

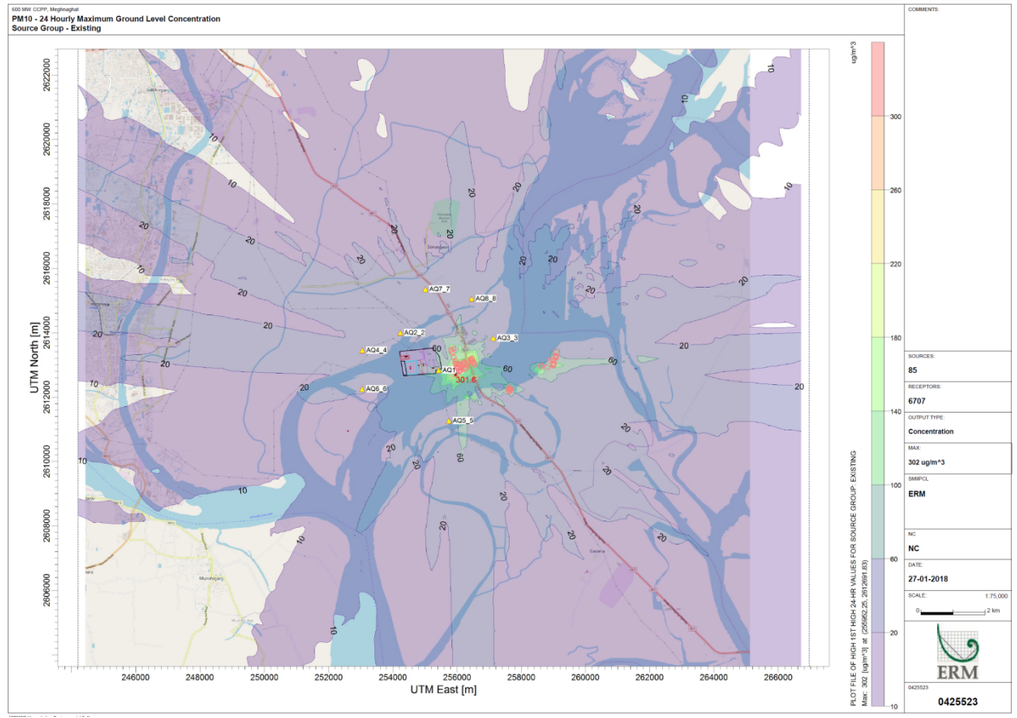


Summit M2

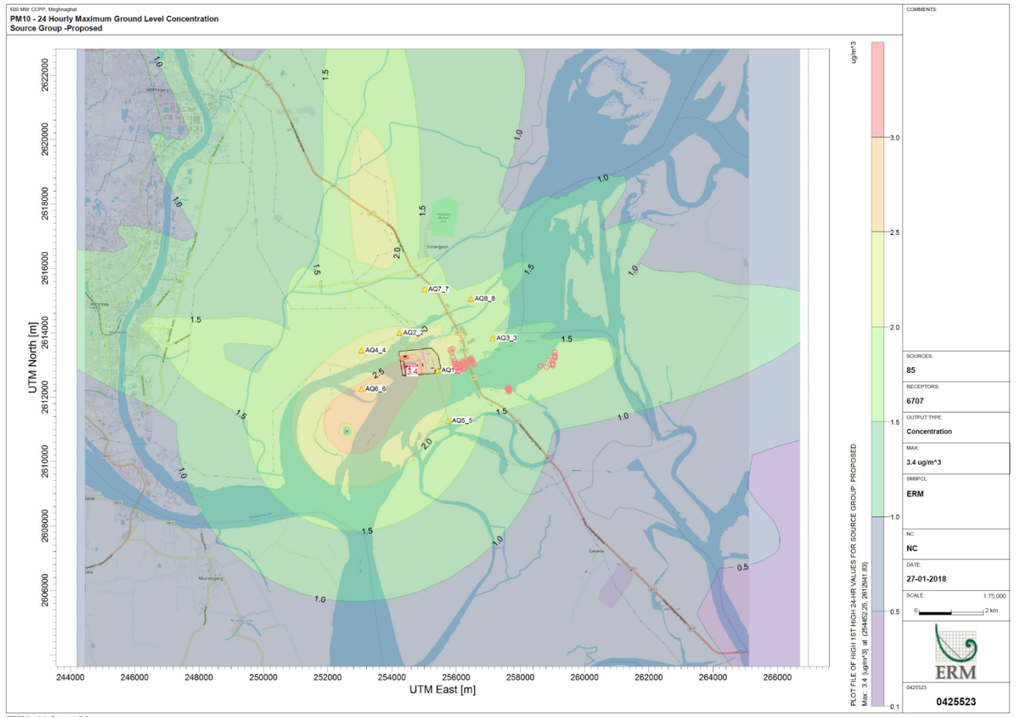


All Sources

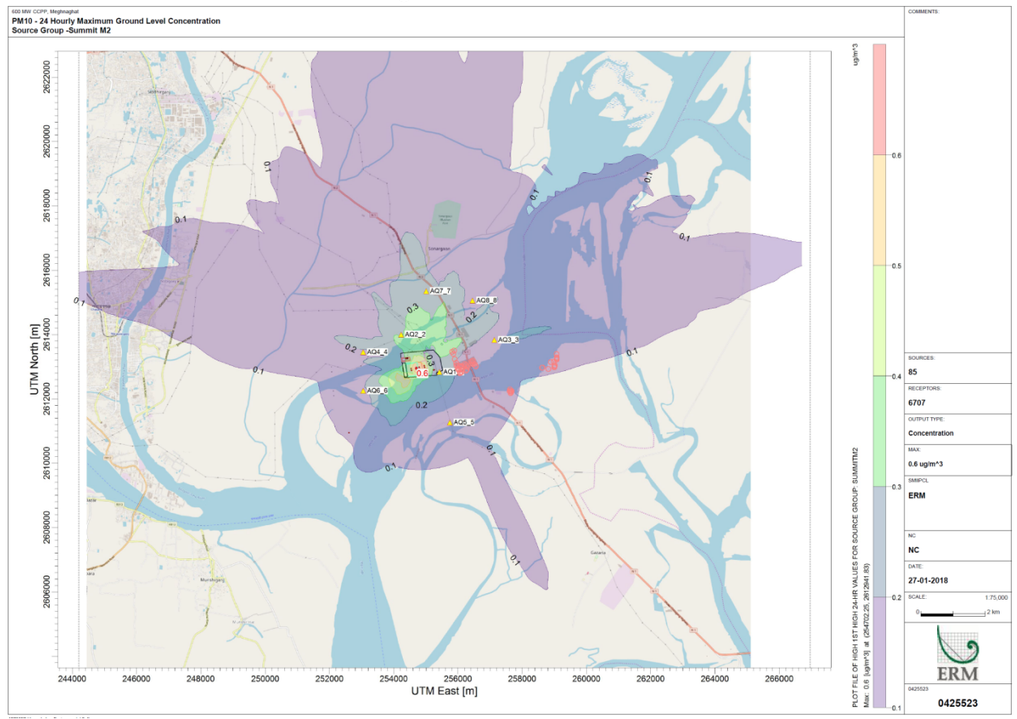
Figure 6.13 PM10 - 24 Hourly Maximum Ground Level Concentrations with CCPPs using Natural Gas as Fuel



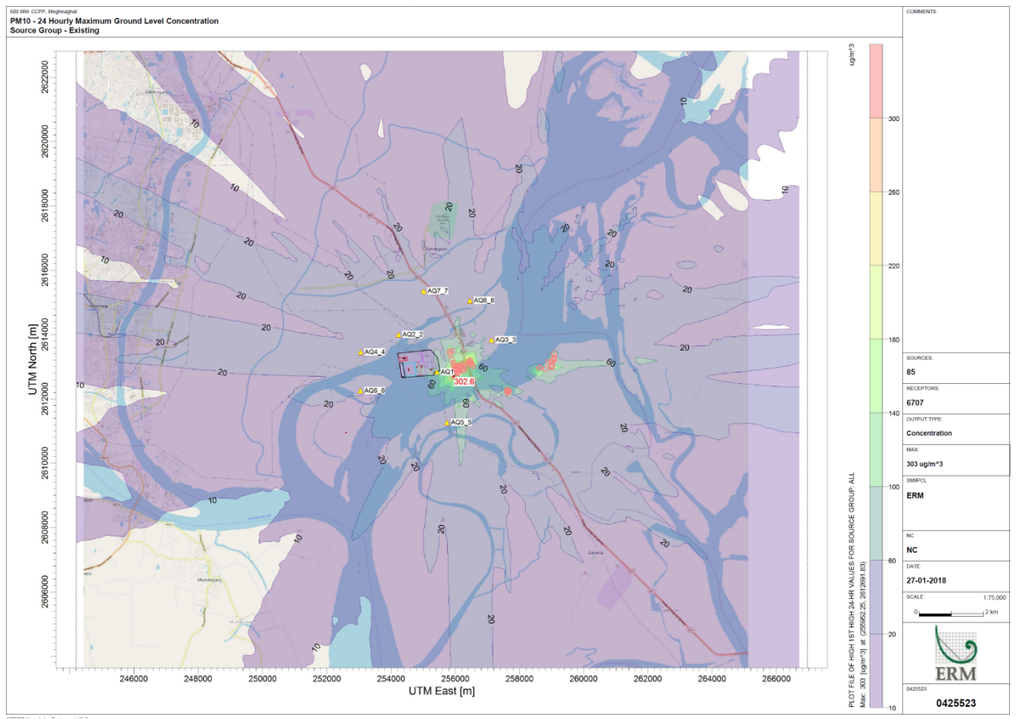
Existing Sources



Proposed Sources

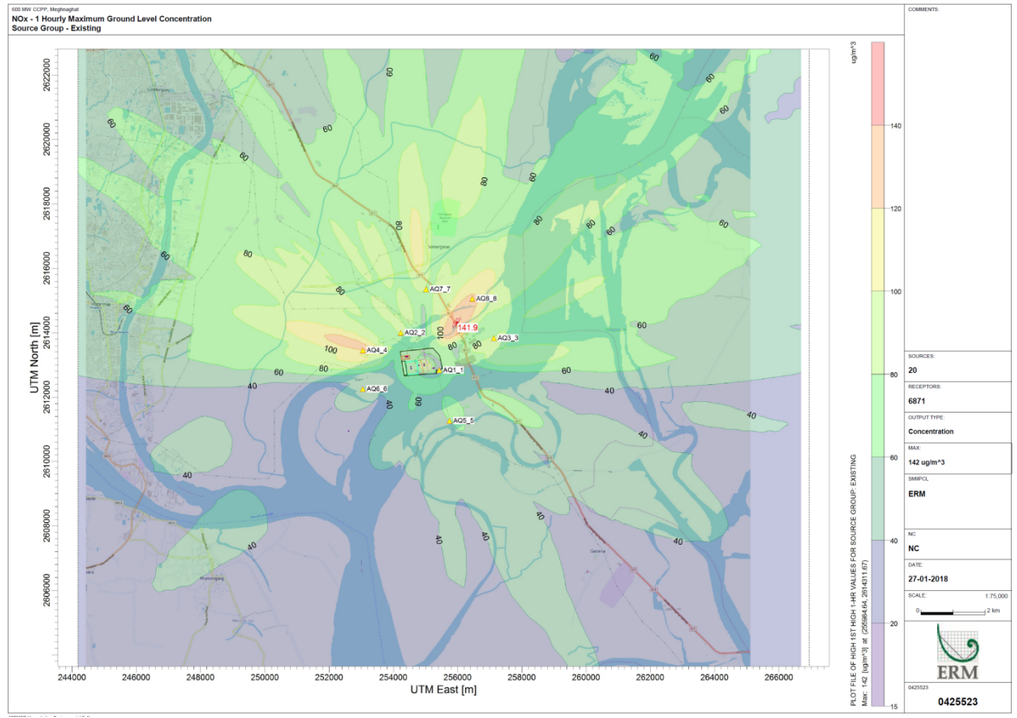


Summit M2

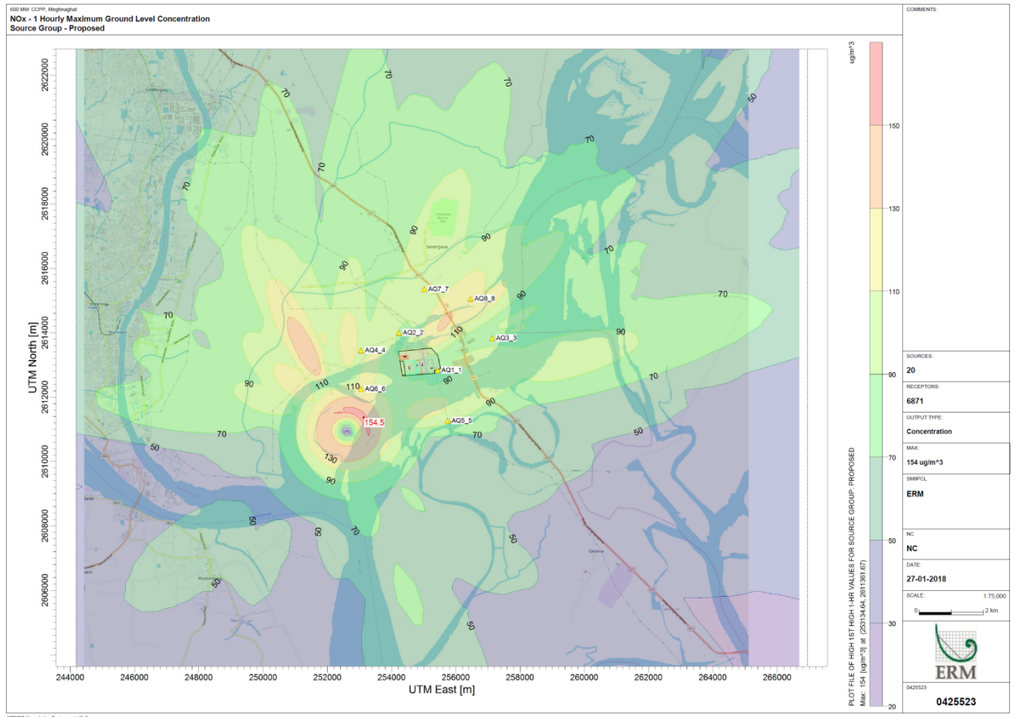


All Sources

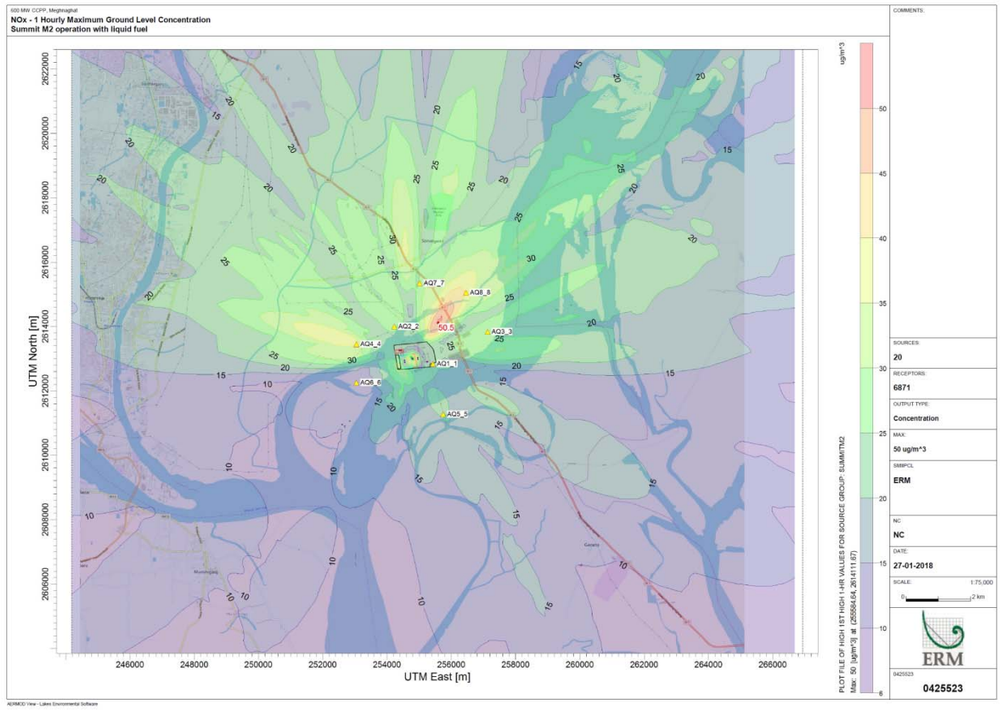
Figure 6.14 NOx - 1 Hourly Maximum Ground Level Concentrations with Summit M1 and M2 using HSD as Fuel



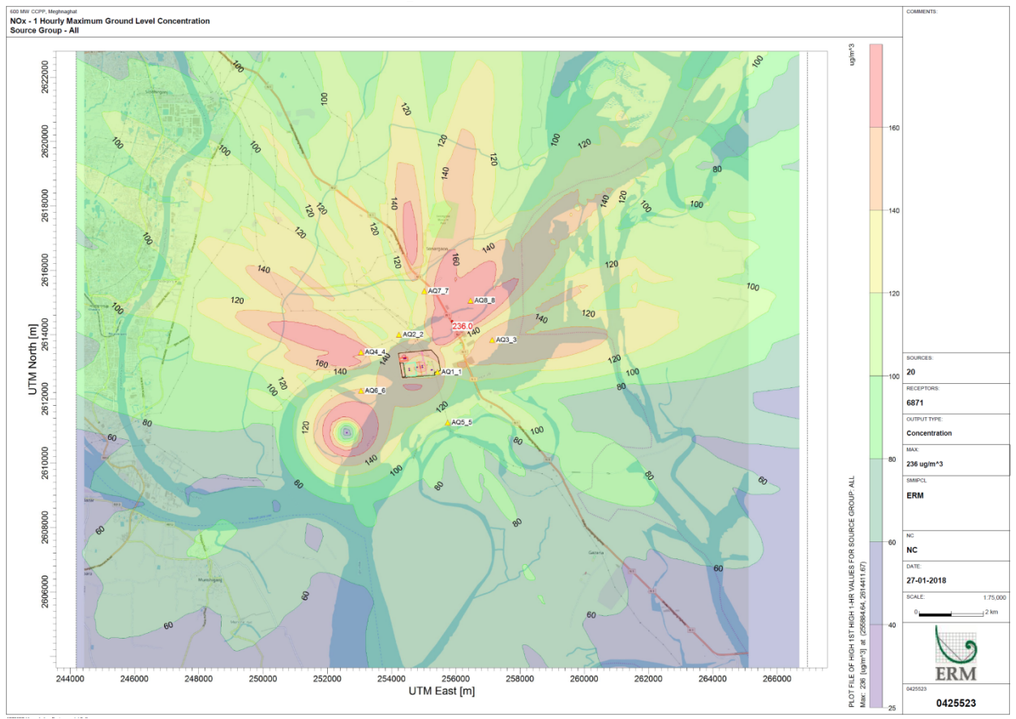
Existing Sources



Proposed Sources

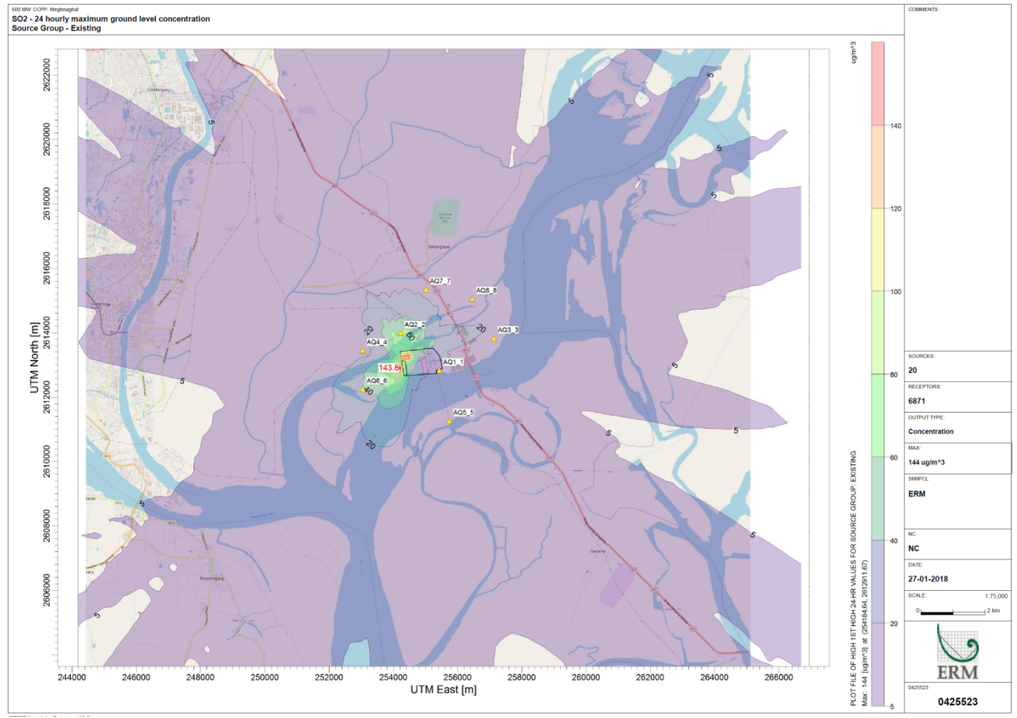


Summit M2

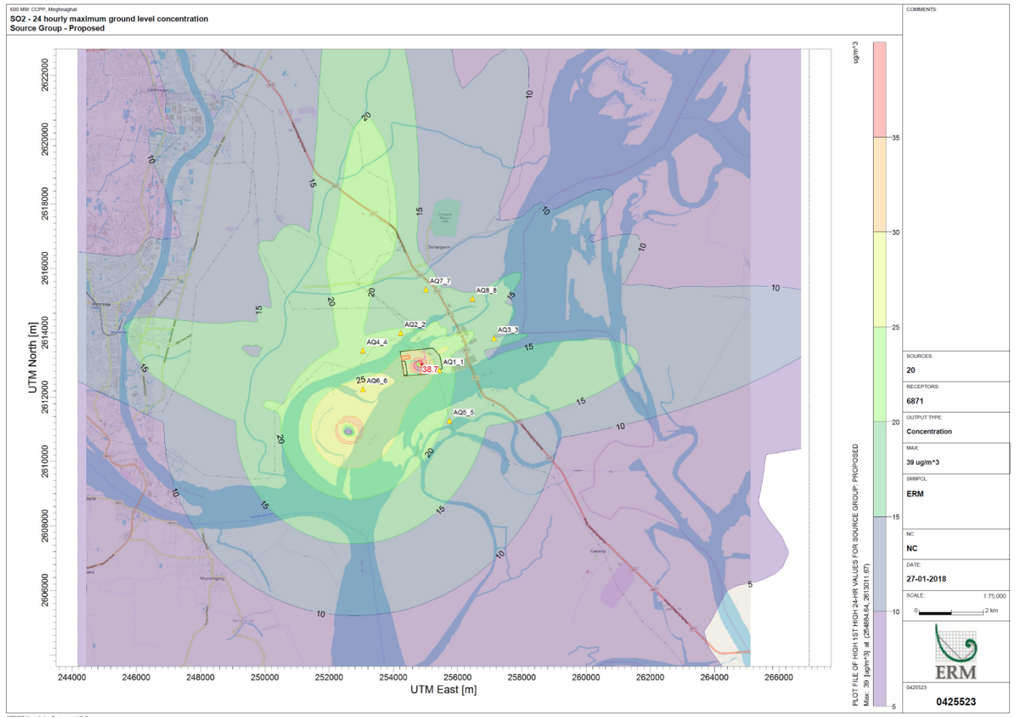


All Sources

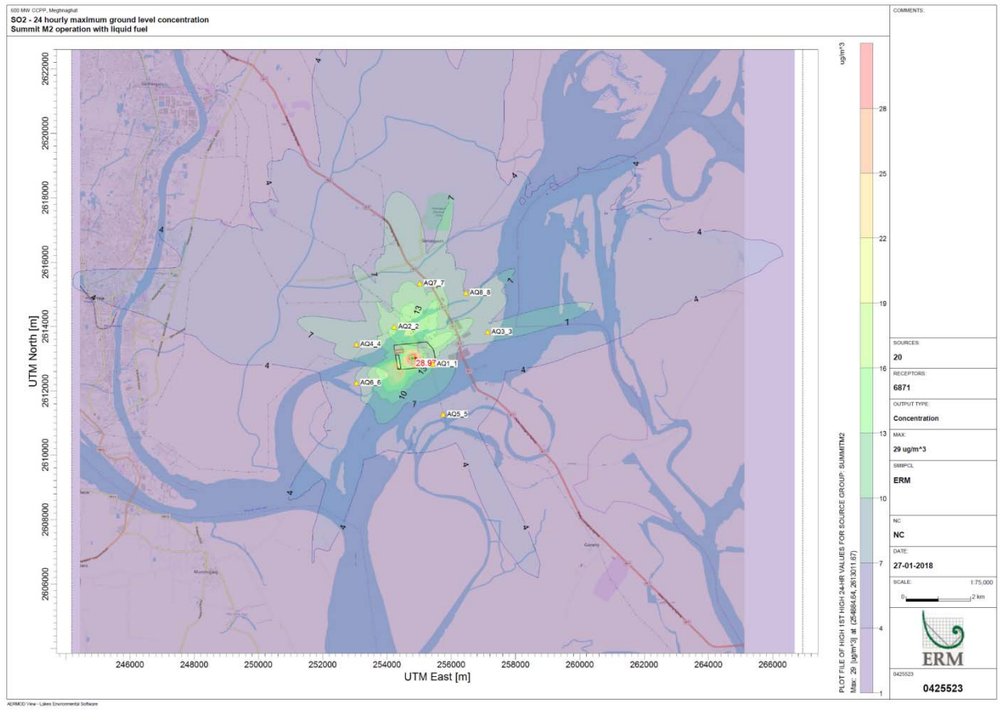
Figure 6.15 SO2 – 24 Hourly Maximum Ground Level Concentrations with Summit M1 and M2 using HSD as Fuel



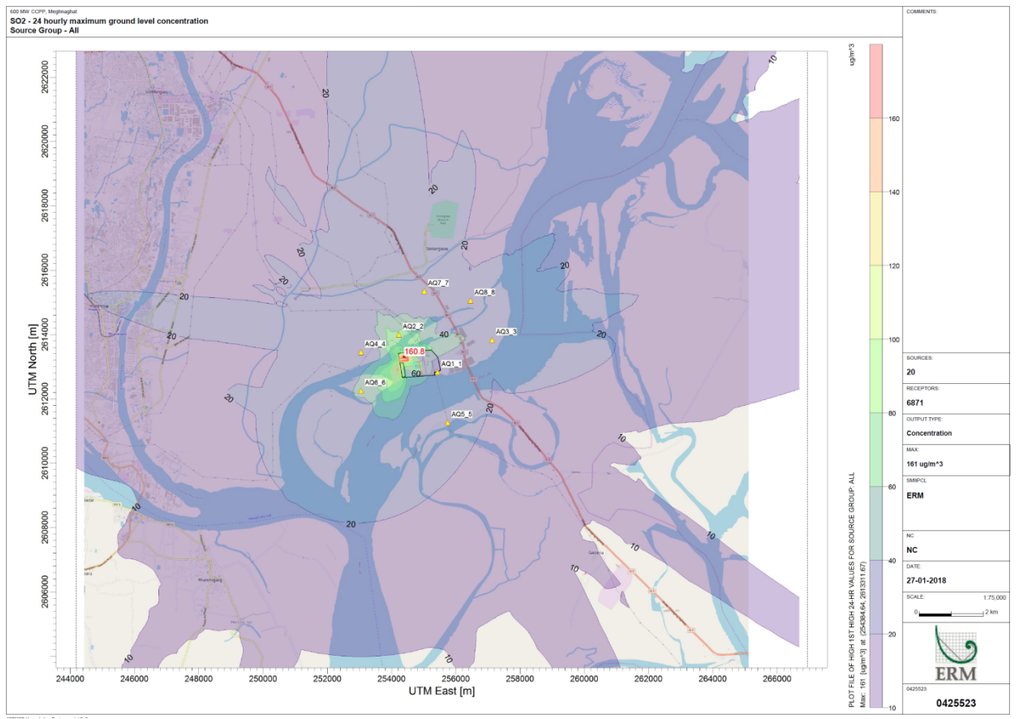
Existing Sources



Proposed Sources

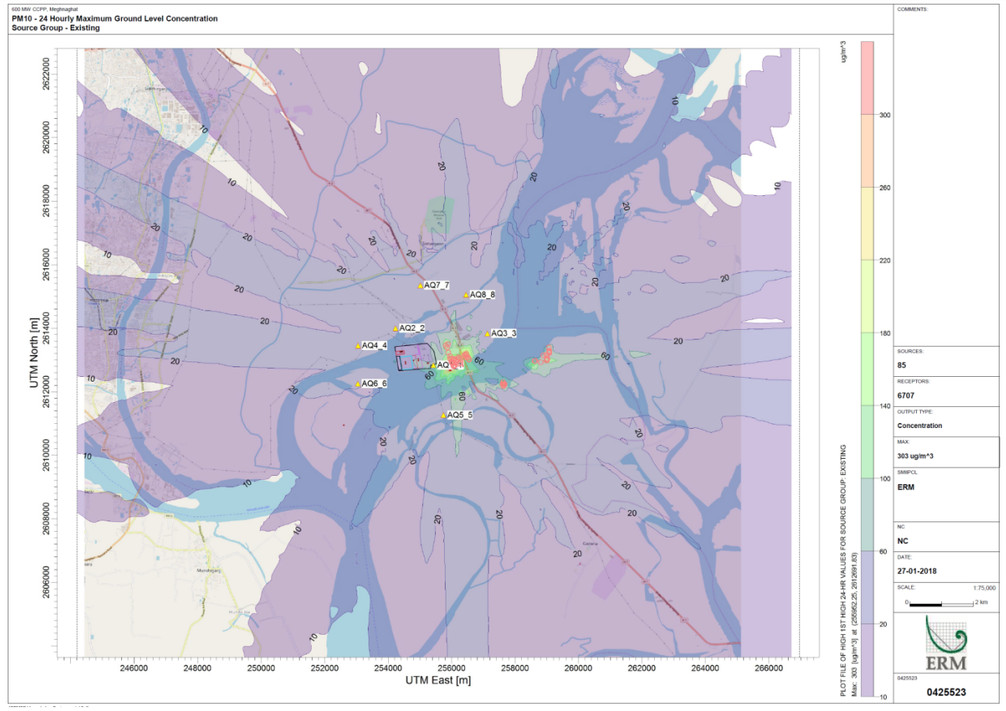


Summit M2

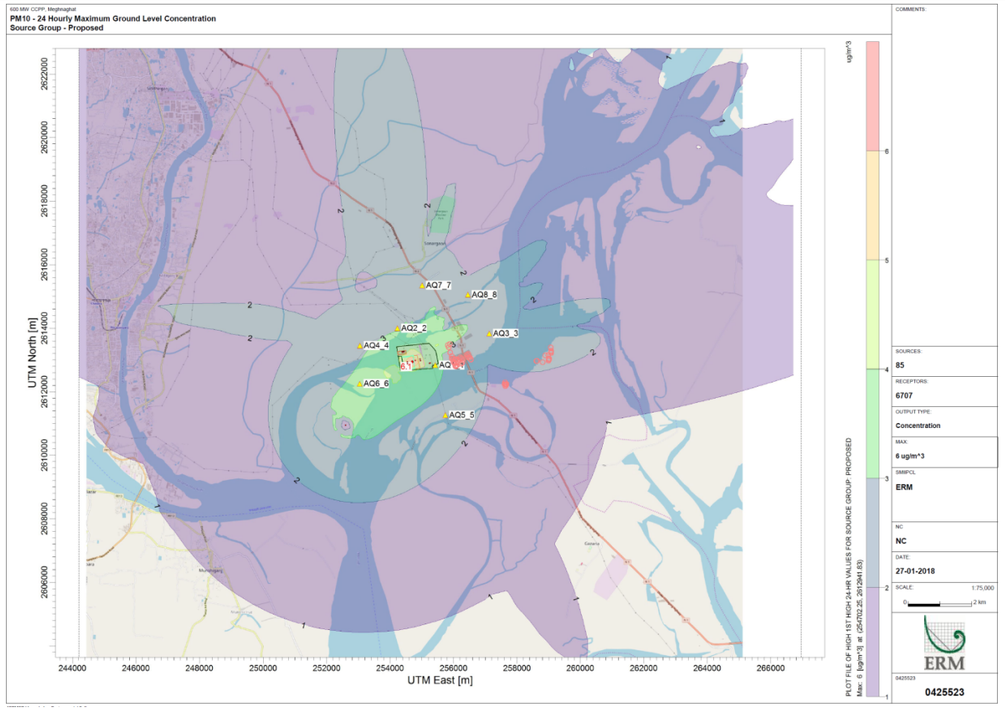


All Sources

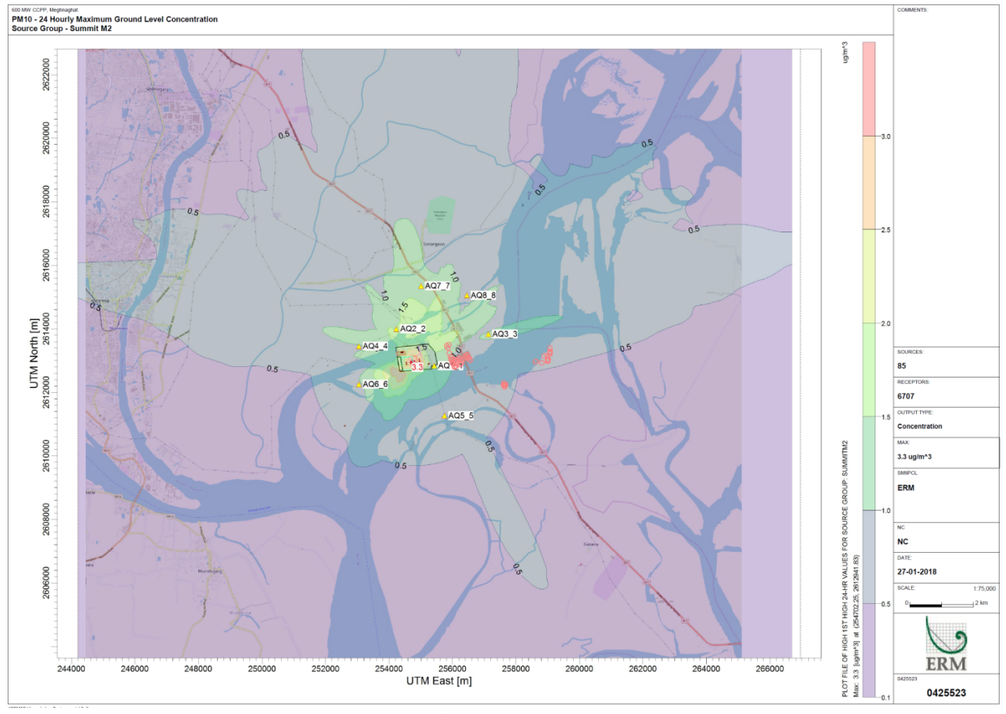
Figure 6.16 PM10- 24 Hourly Maximum Ground Level Concentrations with Summit M1 and M2 using HSD as Fuel



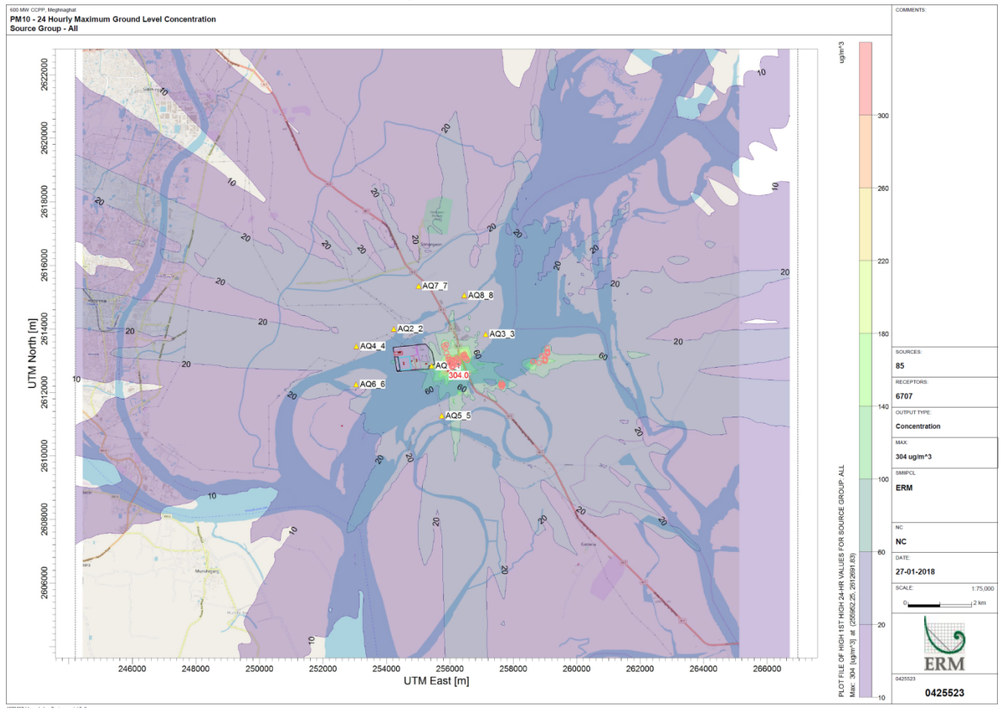
Existing Sources



Proposed Sources



Summit M2



All Sources

The analysis of isopleths and annual average concentrations for different scenarios indicate that overall, the air quality in the region is meeting the national ambient air quality standards for gaseous and particulate emissions, except within the industrial area for PM_{10}. Furthermore, the gaseous pollutants concentrations are always well within the applicable standards.

Percentage contribution of maximum ground level concentration of Summit M2 with respect to overall ground level concentrations for different fuel options are presented below.

Table 6.28 ***Percentage Contribution of Summit M2 Project in Overall GLC and applicable standards***

Scenario	Pollutant	Average	% Contribution Summit M2 Project in Overall GLC	% Contribution Summit M2 Project w.r.t. applicable standard
Summit M2 Operation with Natural Gas as Fuel	**NO_x**	**1-hourly**	14.21	NA
		24-hourly	11.30	NA
		Annual	8.50	0.78
	PM_{10}	**1-hourly**	0.13	NA
		24-hourly	0.21	0.43
		Annual	0.31	0.26
Summit M2 Operation with HSD as Fuel	**NO_x**	**1-hourly**	21.39	NA
		24-hourly	21.91	NA
		Annual	17.61	2.37
	SO_2	**1-hourly**	22.76	NA
		24-hourly	18.02	7.94
		Annual	17.91	6.79
	PM_{10}	**1-hourly**	0.68	NA
		24-hourly	1.09	2.21
		Annual	1.53	1.28

*NA – not applicable

It is evident from this table that the contribution of Summit M2 project with respect to NOx 0.78% to 2.37% of applicable standards with natural gas and liquid fuel, respectively. For SO2, the project contribution is less than 8% of applicable standards, whereas for PM10, project contribution is less than 3%.

On this basis, the potential air quality impacts due to the operation of the Plant by using natural gas or HSD as fuel are predicted to be ***minor to negligible.***

Impact	*Ambient Air Quality (by use of natural gas and HSD as fuel for power generation)*			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent
Impact Extent	Local	Regional	International	

mpact Scale	Maximum impact zone within 2 km from project boundary in the downwind direction				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low		Medium	High	
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **minor to negligible.**				

6.5.4 *Green House Gas Emissions*

The Kyoto Protocol – United Nations Framework Convention on Climate Change nominates the following GHGs:

- Carbon dioxide (CO_2);
- Methane (CH_4);
- Nitrous Oxide (N_2O);
- Hydrofluorocarbons (HFCs); and
- Perfluorocarbons (PFCs).

Inventories of GHG emissions can be calculated using published emission factors. Different gases have different greenhouse warming effects (referred to as warming potentials) and emission factors take into account the global warming potentials of the gases created during combustion.

Typically, greenhouse gas emissions are reported in units of carbon dioxide equivalent (CO_2e). Gases are converted to CO_2e by multiplying by the gas' global warming potential (GWP). The GWP of gases are as follows[1]:

- GWP for CO_2 = 1
- GWP for CH_4 = 21
- GWP for N_2O = 310

When the global warming potentials are applied to the estimated emissions then the resulting estimate is referred in terms of CO_2-equivalent (CO_2e) emissions.

Operation of Summit M2 Project

GHG Estimation and Impact

The combustion of natural gas/HSD produces GHGs. The amount of GHGs emitted by a power plant is a measure of its contribution to global warming and can be estimated based on fuel consumption. In order to estimate GHG emissions, the IFC recommended Carbon Emission Estimation Tool (CEET model – Version February 2014)[2] has been used as set out below.

(1) [1] Source: Intergovernmental Panel on Climate Change (IPCC) (1995), Second Assessment Report

[2] http://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/CB_Home/Measuring+Reporting/

Table 6.29 Estimated GHG Emissions from the Plant

SN	Particular	Value	Unit
Using Natural Gas as Fuel			
A*	Net Heat Rate (Natural Gas in Combined Cycle)	5,952	KJ/KWH
B*	Gross Generation Capacity (Combined Cycle)	6,00,000	KW
C	Operating Days	330	days
D	Daily Operating Hours	24	Hours/day
E	Total Annual Output (= B x C x D)	4,75,20,00,000	KWH
F	Annual Fuel Consumption (= E x A)	2.83E+13	KJ
		28,283.90	TJ
G****	GHG Emission Rates		
	CO_2	56.1	tCO_2/TJ
	CH_4	5.418	tCO_2/TJ
	N_2O	0	tCO_2/TJ
H	**Annual GHG Emission in Combined Cycle**	**17,39,969**	**tCO_2e/year**
Using HSD as Fuel			
A	Net Heat Rate (HSD in Combined Cycle)**	6,751	KJ/KWH
B	Gross Generation Capacity (Combined Cycle)	5,50,000	KW
C	Operating Days***	181.5	days
D	Daily Operating Hours	24	Hours/day
E	Total Annual Output (= B x C x D)	2,39,58,00,000	KWH
F	Annual Fuel Consumption (= E x A)	1.22E+13	KJ
		12,200.00	TJ
G****	GHG Emission Rates		
	CO_2	74.1	tCO_2/TJ
	CH_4	0.063	tCO_2/TJ
	N_2O	0.186	tCO_2/TJ
H	**Annual GHG Emission in Combined Cycle**	**9,07,058**	**tCO_2e/year**

* Using 100% load and based on natural gas specification provided by SMIIPCL.
** As per information provided by SMIIPCL, with HSD, the plant will function as peak power generation and would run maximum 20% time with 100% load, 10% time with 80% load, 10% time with 60% load and 15% time with 40% load. The average net heat rate is calculated accordingly.
*** Considered
**** Based on GHG emission factors provided in CEET

It is evident from ***Table 6.29*** that the estimated GHG emissions from the Plant while using natural gas as primary fuel will exceed the threshold of ADB SPS (100,000 tons CO_2e per year) and of IFC PS3 (25,000 tons CO_2e per year) that define them as significant GHG emission sources. Therefore, the Project is required to report annual GHG emissions.

As per the latest report (26 December 2012) of GHG emission submitted by Bangladesh to the United Nations Framework Convention on Climate Change (UNFCCC)[1], electricity generation sector contribution to GHG emission in year 2005 was 1.192×10^7 tons CO_2e and projection of aggregate GHG emissions using LEAP modelling program indicates that the annual GHG emissions from this sector in year 2020 and 2030 will be 2.752×10^7 tons CO_2e and 5.9168×10^7 tons CO_2e, respectively. Taking this into consideration, GHG emission contribution of the proposed Project in the year 2020 will be 6.32% and 3.30% of the electricity generation sector in Bangladesh depending upon

[1] **http://unfccc.int/resource/docs/natc/bgdnc2.pdf**

use of natural gas and HSD as fuel for power generation. Considering this fact, the GHG emission impact will be **moderate**.

Impact	*GHG emissions from operation of Summit M2 project*				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	National		
Impact Scale	Impact zone will be regional/ national				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **moderate.**				

Mitigation Measures

The following mitigation measures will minimise GHG emissions to ALARP levels:

- Continuous monitoring and recording of CO_2 emission from the stacks through CEMS.
- Ensure that all equipment and machinery is maintained in accordance with manufacturer's specifications;
- Higher efficiency steam turbine blade design; and
- Improved efficiency of auxiliary drives.

6.5.5 Noise

Operation of Summit M2 Project

Sources of Impact

For gas/oil-fired power plants, the major noise sources during base load operation are the air-cooled condenser (ACC) or cooling tower, steam turbine generator (STG), combustion inlet filter house, and the exhaust stack or heat recovery steam generator (HRSG). During start-up or other transient conditions in combined cycle configurations, the high-pressure steam piping and condenser is a major noise producer, with steam bypassing the STG. The combustion turbine and generator (CTG) are typically housed in acoustical enclosures, thereby dropping their respective noise source ranking. Other balance-of-plant (BOP) equipment also generates noise. The cumulative effects of fuel gas compressors, air compressor skids, boiler feed water pumps, lube oil coolers, and other equipment may affect far-field noise levels.

Noise and vibration from the Project will be mitigated through engineering control and wherever possible high noise equipment will be enclosed in noise-proofed buildings that effectively contain the noise. The engineering noise control measures with respect to key project components are specified below:

Combustion Turbine: High noise levels originate in the air inlet and flue gas exhaust. Strong pure tonal components are associated with the inlet while the exhaust results in high levels of low frequency noise. Specially designed silencers are provided to control such noise emissions to acceptable levels.

HRSG: Venting of steam will occur during HRSG start up and blowdowns. This is routinely controlled by suitable silencers. Boiler safety valves are tested on an annual basis. Outside of such testing, operation of safety valves will occur for very short periods under fault conditions. They will be fitted with silencers but will be audible outside the plant. Owing to their safety function it is not possible to totally abate noise from such high temperature/high volume sources.

Steam Turbine: The steam turbine, together with a range of auxiliary plant, much of which contains rotating or reciprocating machines, is a source of noise. This is attenuated by acoustic lagging and enclosure and by the acoustic design of the turbine house.

Gas Release: When it is required to purge the gas pipelines and gas compressor, gas will be vented to the atmosphere. This will last for a short period and may result in slightly increased noise levels.

Transformers: Fans on generator and other large transformers are provided for cooling purposes. The transformers themselves may emit noise at multiples of the power line frequency (50 Hz) but are treated to minimise noise emission and will be inaudible at the site boundary.

Substation and Transmission Lines: Transmission lines can also generate a small amount of sound energy (a crackling or humming sound) as a result of corona[1]. It becomes more noticeable at higher voltages (345 kV and higher).

Criteria

It is planned that the Project will meet the noise emission criteria specified in the GOB ECR, 1997 and the WB/IFC EHS Guidelines, as presented in Table 3.10. Furthermore, for the assessment of ambient noise, the sensitivity and magnitude criteria outlined in Table 6.13 and Table 6.14, respectively have been used:

Table 6.30 Noise Emission Criteria

Location	Noise Level Limit (dB(A)	
	Daytime (0600 – 2100 hrs)	Night-time (2100 – 0600 hrs)
Equipment (1m from source)	85	85
Plant Boundary	70	70
Nearest Residential Area	55	45

[1] Corona is the partial electrical breakdown of the insulating properties of air around the conductors of a transmission line. In a small volume near the surface of the conductors, energy and heat are dissipated. Part of this energy is in the form of small local pressure changes that result in audible noise.

Receptors

Baseline noise monitoring was carried out at 10 locations (Figure 6.17). The results of baseline monitoring indicated that ambient noise levels at residential areas were high compared to the applicable standards. The nearest mixed landuse receptor (Islampur) is located at about 650 m from the project boundary and about 50 m from the Meghnaghat Power Hub boundary, which will be exposed to noise from plant operations.

As can be referred from Table 6.13 and above discussion, the residential receptors were assessed to be of medium sensitivity, whereas the industrial land use receptors and ecological receptors were assessed to be of Low sensitivity.

Prediction of Impacts

Methodology: The environmental noise prediction model SoundPLAN 7.2 was used for modelling noise emissions from the use of power plant equipment and vehicular movement in the access road. It has been assumed that all the plant equipment will adhere to the equipment noise emission criteria of 85 dB(A) noise level at a distance of 1 m from the source. Operation of equipment with 100% usage scenario was modelled to cover the operation phase of the Project. Major plant components with higher noise generation considered in this study include GTG, STG, HRSG, Auxiliary Boiler, Cooling Tower, CW Pump House, Emergency DG, Water Treatment Facility, Pump House, RMS, and Gas Booster and Conditioning Station. As a conservative approach to the assessment, atmospheric absorption during sound transmission was not included in the assessment. In addition, to represent a worst-case scenario for the assessment, all equipment was assumed to be operating simultaneously.

Predicted Noise Levels at Receptors: The predicted noise levels within the Project AOI during day time are presented in Figure 6.18. Predicted noise levels at 10 receptors (where baseline noise levels were also monitored, which include 4 receptors within or just outside the boundary of the power complex) have been presented in Table 6.31.

Figure 6.17 Noise Sources and Receptors Locations

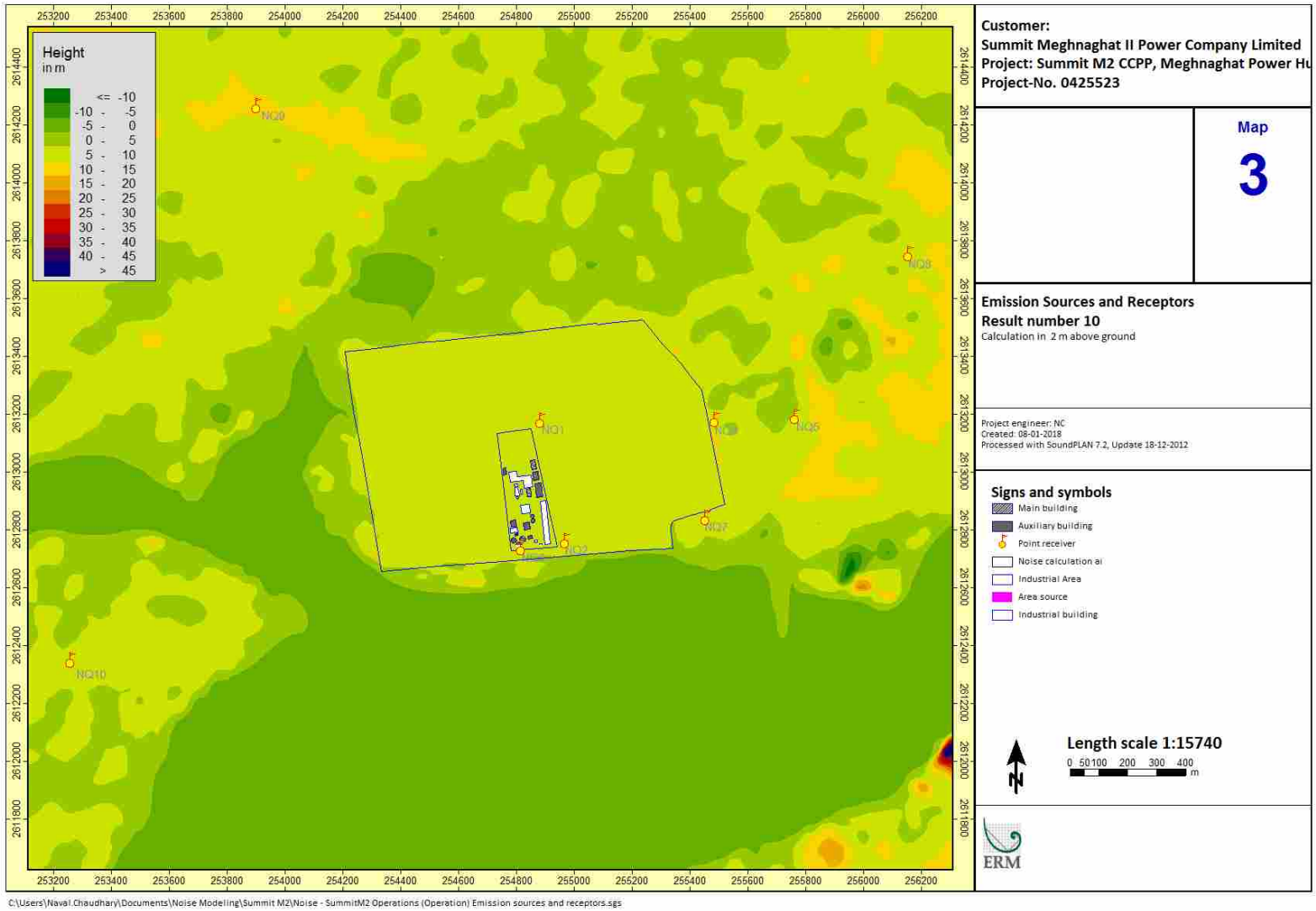


Figure 6.18 Predicted Operation Phase Noise Levels of Summit M2 Project during Daytime (Leq $_{day}$)

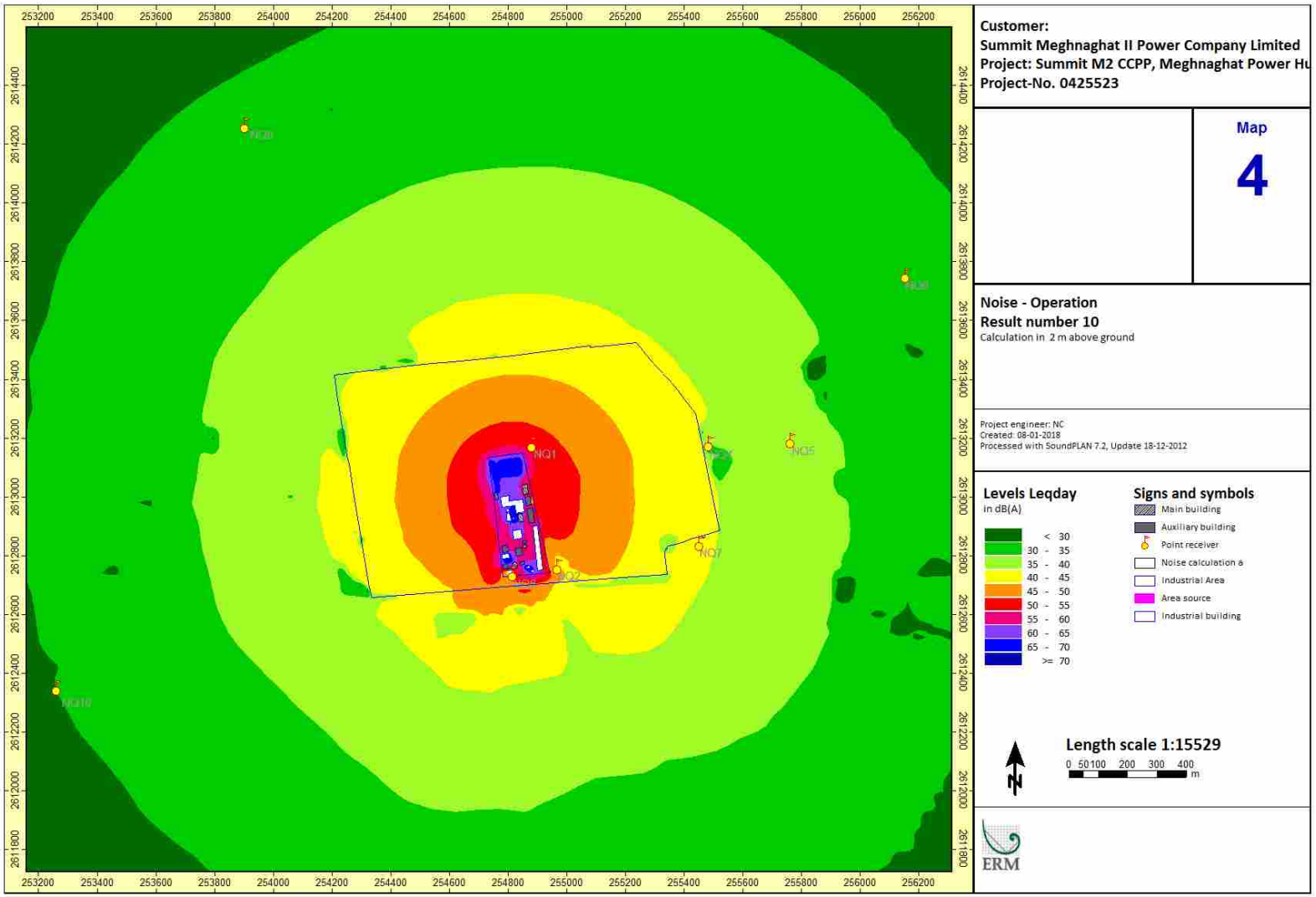


Table 6.31 Predicted Noise Levels at Noise Receptors during Operation Phase of Summit M2 Project

Receptor Code	Sampling Location	Approximate Distance to Power complex Boundary (m) and Direction from Project Site	Baseline Sound Pressure Levels at Receptors, Leq (dBA)[1]		Predicted Sound Pressure Levels at Receptors, Leq (dBA)		Total Sound Pressure Level (Baseline + Predicted), Leq (dBA)		Applicable Standard (dB(A))[2] [3] as per Landuse	
			Leq $_d$*	Leq $_n$*	Leq $_d$	Leq $_n$	Leq $_d$	Leq $_n$	Leq $_d$	Leq $_n$
NQ1	Northern side of Project Area; near GTCL	Within	66.1	58.0	53.4	53.4	**66.3**	**59.3**	***75***	***70***
NQ2	Northern side of Project Area; Near Summit Watch Tower	Within	71.2	64.6	47.0	47.0	**71.2**	**64.7**	***75***	***70***
NQ3	Mugrapara	3 km (NW)	57.5	48.3	21.6	21.6	**57.5**	**48.3**	***55***	***45***
NQ4	Ganganagar	At boundary (E)	58.2	48.7	30.0	30.0	**58.2**	**48.8**	***75***	***70***
NQ5	Eastern side of Power Hub	300 m (E)	59.4	53.4	36.8	36.8	**59.4**	**53.5**	***75***	***70***
NQ6	Southern Side of the Power Hub	At boundary (S)	65.5	59.8	50.4	50.4	**65.6**	**60.3**	***75***	***70***
NQ7	Islampur Village	50 m (SE)	61.3	49.7	40.8	40.8	**61.3**	**50.2**	***60***	***50***
NQ8	New Town	900 m (ENE)	69.8	60.9	32.1	32.1	**69.8**	**60.9**	***60***	***50***
NQ9	Mongoler Gaon/ Dudhghata	1000 m (NW)	59.5	46.9	31.2	31.2	**59.5**	**47.0**	***55***	***45***
NQ10	Charbalaki village	1000 m (WSW)	57.8	48.3	29.6	29.6	**57.8**	**48.4**	***55***	***45***

[1] Ambient noise levels as monitored during the baseline survey

[2] Environmental Conservation Rules, 1997 (Schedule 4) amended September 7, 2006

[3] IFC/WB EHS Guidelines: Noise Management dated April 30, 2007 gives, Noise level guidelines for Residential; institutional and educational receptors in daytime (07:22:00) and night time (22:00-7:00) as 55 and 45 one hour Leq dBA respectively. For industrial and commercial receptors it is 70 one hour Leq dBA for both night and day time.

[4] All operations have been considered as continuous and hence there is no change in the day and night time prediction results.

It is evident from Table 6.31 that ambient noise levels due to operation of Summit M2 project will be well within the applicable standard during day and night time at 5 receptors, out of total 10 receptors considered in the study. All the exceedances are due to already higher baseline noise levels during day and night time, whereas predicted noise levels were found to be meeting applicable standards with respect to land use criteria. The results clearly indicate that the incremental noise due to Summit M2 operations at the nearest receptor will be less than 3 dB(A). Therefore, the noise impact significance from Summit M2 operation during day time is expected to be **negligible** to **minor**. Higher noise levels at NQ8 are due to its proximity to Dhaka – Chittagong Highway and not directly linked with Meghnaghat Power Hub. Furthermore, noise levels at night time will be slightly higher than the applicable standard (with < 5 dBA increase from the applicable standard) at 5 locations. Due to this the noise impact from Summit M2 operation during night time is expected to be **negligible** to **minor.**

Impact	*Noise from Operation of Plant (Daytime and Night time)*				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Maximum impact zone within 100 m from the Power Hub boundary				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible to minor.**				

Mitigation Measures

To mitigate operational noise impacts the detailed design specifications will have the following measures in place:

- Selection of equipment with lower sound power levels (< 85 dB);
- Installation of mufflers on engine exhausts and compressor components;
- Installation of acoustic enclosures for equipment (e.g. gas turbine, compressor) casing radiating noise;
- Buildings will be designed with improved acoustic performance and sound insulation will be provided;
- Installation of acoustic barriers without gaps and with a continuous minimum surface density in order to minimize the transmission of sound through the barriers;
- Barriers will be located as close to the source ,as far as practicable, to be effective;
- Installation of vibration isolation for mechanical equipment; and
- A noise analysis of all major plant components will be carried out during commissioning of the plant to ensure compliance with the specification

and guaranteed performance as well as ambient noise levels at the receptors located in the surroundings.

Residual Impacts

Criterion	Rating pre mitigation	Rating post mitigation	Comment
Change in Ambient Noise Levels during day and night time			
Residual Impact	Negligible to Minor	Negligible to Minor	With implementation of the precautionary and the mitigation measures mentioned for prevention/reduction in noise generation at source impacts would be negligible.

6.5.6 Electric and Magnetic Field (EMF)

Sources of Impact

An electric field is said to exist in a region of space if an electrical charge, at rest in that space, experiences a force of electrical origin (i.e., electric fields cause free charges to move). The electric field will be created by a the sub-station and 400 kV high-voltage transmission line which extends from the energised conductors to other conducting objects such as the ground, towers, vegetation, buildings, etc.

Magnetic fields can be characterized by the force they exert on a moving charge or on an electrical current. As with the electric field, the magnetic field is a vector quantity characterized by both magnitude and direction. Electrical currents generate magnetic fields. In the case of sub-station and transmission lines the 60-Hz electric current flowing in the conductors generates a time varying, 60-Hz magnetic field in the vicinity of these sources.

Prediction of Impact

Short-term effects from transmission-line electric fields are associated with perception of induced currents and voltages or perception of the field. Induced current or spark discharge shocks can be experienced under certain conditions when a person contacts objects in an electric field. Such effects occur in the fields associated with transmission lines that have voltages of 230-kV or higher. These effects could occur infrequently under the existing 230 kV transmission line. It is understood that potential impacts of electric fields are being mitigated through grounding policies and adherence to the regulatory requirements.

Magnetic fields associated with transmission and distribution systems can induce voltage and current in long conducting objects that are parallel to the transmission line. As with electric-field induction, these induced voltages and currents are a potential source of shocks. A fence, irrigation pipe, pipeline, electrical distribution line, or telephone line forms a conducting loop when it is grounded at both ends. The earth forms the other portion of the loop. The

magnetic field from a transmission line can induce a current to flow in such a loop if it is oriented parallel to the line. If only one end of the fence is grounded, then an induced voltage appears across the open end of the loop. The possibility for a shock exists if a person closes the loop at the open end by contacting both the ground and the conductor. The magnitude of this potential shock depends on the following factors: the magnitude of the field; the length of the object (the longer the object, the larger the induced voltage); the orientation of the object with respect to the transmission line (parallel as opposed to perpendicular, where no induction would occur); and the amount of electrical resistance in the loop (high resistance limits the current flow). Knowledge of the phenomenon, grounding practices, and the availability of mitigation measures mean that magnetic-induction effects from the existing 400-kV transmission line would be minimal.

Mitigation

Occupational health and safety EMF standards in EHS guidelines on thermal power and electric transmission lines is suggested to be adhered to and referred for following the best practices.

ICNIRP Exposure limits for occupational exposure to EMF

Frequency	Electric field	Magnetic Field
50 Hz	10,000	500
60 Hz	8300	415

Source: ICNIRP (1998): "Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz).

6.6 ASSESSMENT OF ECOLOGICAL IMPACTS – OPERATION AND MAINTENANCE PHASE

6.6.1 Terrestrial Ecology

Source of Impact:

Impacts to the terrestrial habitat during operation phase may happen due to:

- Stack emission;
- Noise and light from industrial activities.

Impact Assessment:

Air Emission:

The major pollutant from the operation of gas based thermal power plant is NOx. The baseline 24 hourly NOx level varies from 24.95 µg/m^3 to 33.90 µg/m^3. The proposed project will also contribute to NOx. The predicted concentration of NOx from proposed project (baseline concentration + incremental concentration) will be 38 µg/m^3 to 44 µg/m^3, depending upon fuel use.

The atmosphere of the earth is 80% dinitrogen (N_2), which equals about 75 × 106 kg above each hectare of the earth's surface. In unpolluted conditions a small fraction (1–15 kg N/ha per year) is converted by nitrogen-fixing microorganisms to biologically more active forms of nitrogen: ammonium (NH_4^+) and nitrate (NO_3^-). The natural deposition of nitrogen containing atmospheric compounds other than N_2 is much less.

Human activities, both industrial and agricultural, have strongly increased the amount of biologically active nitrogen compounds, thereby disturbing the natural nitrogen cycle. Various forms of nitrogen pollute the air, mainly nitric oxide (NO), NO_2 and NH_3 as dry deposition, and NO_3^- and NH_4^+ as wet deposition.

Nitrogen-containing air pollutants can affect vegetation indirectly, via chemical reactions in the atmosphere, or directly after being deposited on vegetation, soil or water. The direct impact of airborne nitrogen is due to toxic effects, eutrophication and acidification. Two different types of effect threshold exist: critical levels and critical loads. The critical level (CLE) is the concentration in the atmosphere above which these is direct adverse effects on receptors, such as plants, ecosystems. The Critical Levels for NO_2 is cited in 'Effects of nitrogen containing air pollutants: critical levels; Air Quality Guidelines – Second Edition'.

Table 6.32 Critical Levels for NO_2

NO_2 Concentration ($\mu g/m^3$)	**Equivalent NOx Concentration ($\mu g/m^3$)[1]**	**Exposure Time**	**Remarks**
95	146	4 hours	The overall NO2 (or NOx level) in ambient air after proposed project clearly indicates that concentration will be below critical level. [Refer to Table 6.25]
30	46	Annual mean	
800	1230	1 hour	
60	92	Growing season	
40	61	winter	

[1] An ambient equilibrium NO_2/NOx ratio of 0.65 was used, which is based on data from the Narayanganj CAMS monitoring station of DoE.

The above table clearly indicates that proposed project may not cause to damage of the vegetation and therefore scale of impact is assessed to be low. Duration of impact will be long term and extent of impact will be regional.

Noise Emission & Illumination:

The operation of Summit M2 will contribute the existing baseline noise level. The Power Hub is located within the Meghnaghat Industrial area; the existing noise levels were found within the National Ambient Noise Standards during day time and night time for industrial area. The noise quality modelling results shows that operational noise will be attenuated within 500m from proposed site and incremental noise level will be within the National Ambient

Noise Standard for industrial area. The incremental noise level may not cause significant impact on faunal species, in terms of disturbance. The project site is located in the industrial area and illumination level is quite high. The proposed project may not cause significant alternation of existing illumination. Considering this the scale of impact will be low.

The impact potential impact of terrestrial ecology due to above mentioned activities is assessed to be **minor**.

Impact	Impact on Terrestrial Habitat due to operational activities			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Short Term	Medium Term	Long Term	
Impact Extent	Local	Regional	National	
Impact Scale	Low	Medium	High	
Impact Magnitude	Positive	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High	
Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Minor**			

6.6.2 *Aquatic Habitat*

Source of Impact:

Impacts to the aquatic habitat during operation phase may happen due to:

- The proposed project will involve water intake (1000 m^3/day) from Meghna River for use in process;
- Discharge of surface runoff water.
- Discharge of treated effluent.

Embedded Control Measures:

The project embedded control measures area as follows:

- Process effluent will be treated through the ETP.
- Domestic sewage will be treated through the STP.
- Induced draft cooling towers to reduce water intake as well as control of temperature and discharge volume.

Impact Assessment

Discharge of Effluent:

The discharge point of Summit M1 project (once through cooling system) is about 250 m upstream of the proposed Summit M2 discharge point. Summit M1 project conduct river water temperature monitoring at intake and outfall locations during morning and afternoon to check the temperature differential. The records from January 2017 to September 2017 (in which plant was

operational only between April to August), were reviewed as part of this study and the summary is presented below:

Table 6.33 River water temperature monitoring results (Summit M1 project)

S. No.	Month	Temperature Difference (maximum)	Temperture Difference (minimum)
1	January 2017	NA	NA
2	February 2017	NA	NA
3	March 2017	NA	NA
4	April 2017	2.22	2.85
5	May 2017	2.18	2.88
6	June 2017	2.30	2.86
7	July 2017	2.17	2.87
8	August 2017	2.08	2.88
9	September 2017	NA	NA

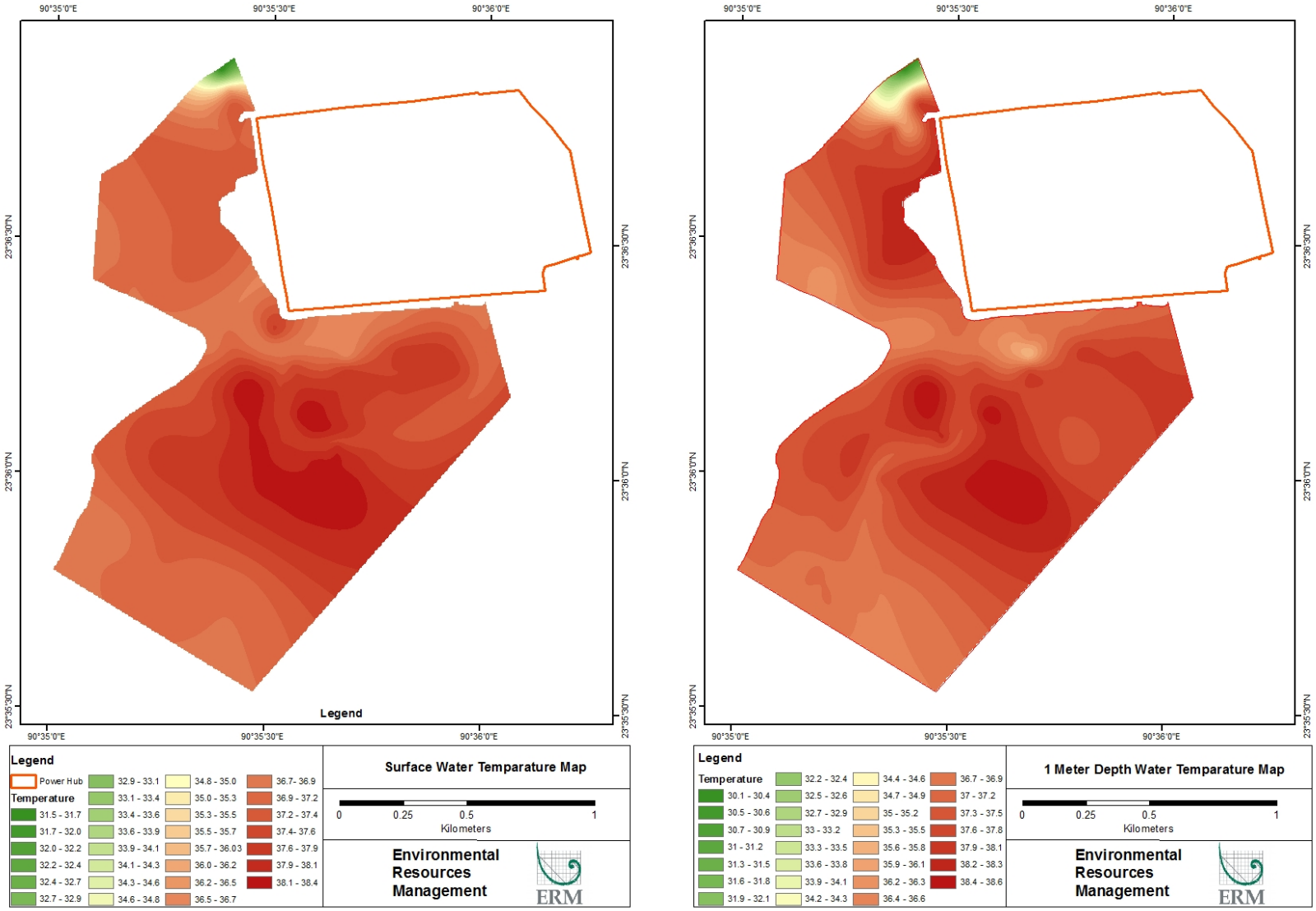
Source: SMPCL

The results indicate that with the discharge volume of about 35,000 m^3/hr, Summit M1 plant maintains the outfall temperature below 3^oC.

In order to check the current trend of river water temperature, a profiling of river water temperature at surface and at 1 m depth was conducted in December 2017. The results of the same are presented in Figure 6.19: Higher temperatures were observed in the main Meghna River in comparison of the discharge locations of both Summit M1 and Meghnaghat power project, which is also be due to the time difference in collection of samples. Temperature of river water at 1 m depth was observed more than surface water temperature in the downstream.

The degradation of water quality (physical characteristics) of river can affect the aquatic ecology of the river. However, the process effluent from Summit M2 project will be adequately treated in the ETP (mainly neutralisation and oil separators) to meet the industrial effluent discharge standards. It is also proposed to use closed cycle cooling system with COC more than 3. Therefore, discharge of hot water into the river is not envisaged. However, cooling tower blowdown and boiler blow down water will be discharge into the river after meeting the discharge norms applicable for hot water discharge into the river. The discharge of treated effluent may not cause perceptible changes in the water quality of the river as the maximum discharge will be about 250 to 300 m^3/hr and will be limited for maximum 3 to 4 hours per day. It is also to be noted that the discharge volume of Summit M2 project will be about 0.86% of Summit M1 project.

Figure 6.19 River water temperature profile (December 2017)



Considering very low quantity of discharge and embedded control systems for water quality and temperature control, no measurable changes of aquatic ecological component of the river. The scale of impact is assessed to be low. Extent of impact is assessed to be to local and duration of impact will be long term. The impact on aquatic ecology is assessed to be **minor.**

Impact	Impact on Aquatic Habitat due to operational activities			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Short Term	Medium Term	Long Term	
Impact Extent	Local	Regional	National	
Impact Scale	Low	Medium	High	
Impact Magnitude	Positive	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High	
Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact is considered **Minor**			

Mitigation Measures

The following mitigation measures are suggested to minimize the impact on river water quality;

- Daily monitoring of temperature at water intake and discharge point;
- Discharge system shutdown in event that discharge temperature of effluent exceeds standard;
- Efforts to be made to increase the cycle of concentration to reduce the volume of blow down and consequently the volume of make-up water required by the cooling tower.
- Waste water of similar nature from different units will be treated in accordance to *GOB Environment Conservation Rule (1997) Schedule 10 (Standards for Waste from Industrial Units or Project Waste)* and the applicable World Bank Group environmental requirements and World Bank/IFC guidelines.

6.7 ASSESSMENT OF SOCIO-ECONOMIC IMPACTS

The assessment of socio-economic impacts has been undertaken with respect to the receptors across natural capital, human capital, social capital, economic capital and physical capital to have a significant interaction with the activities linked to the project across its lifecycle. The existence of the three existing power plants as well as many large and medium scale industries in the Meghnaghat Industrial Area is also an important aspect of the socio-economic baseline, especially in view of the local community's perceptions towards the employment and business opportunities, community health & safety and land-use change.

6.7.1 Potential Impact on Land Acquisition

As discussed earlier, the project does not involve fresh acquisition of private land. As the project does not propose to acquire any private land, there will be no physical or economic displacement. Therefore, no adverse impact on land acquisition is envisaged.

The land for establishing the Industrial Area was acquired long back in 1997-98 and handed over to BPDB. The land acquisition was done for establishing the power-hub in the Meghnaghat region. A part of land area, particularly char land (land on the banks of river which is prone to river erosion) was reportedly used for agriculture during the dry season. Most of them did not have a legal title to cultivate land. The details of the extent of the private land acquired for the power hub by BPDB is not available, though it was learnt some private land belonging to the Union Parishad Pirijpur was involved. As a long period is passed since then, it was not possible to trace the affected families and assess if there is any residual or legacy issue linked to the land acquisition in the past.

6.7.2 Impact on Livelihood of Local Wage Labours

Baseline information of the study area shows that considerable number of the local population is associated with the agriculture, fishing activities and daily wage earnings (as unskilled workers). They mainly work as agricultural labourers or daily labourers at the local industries. The project is expected to provide opportunity to unskilled wage labours in the locality. The wage earning will supplement their earnings from agriculture, fishing and household industries. Hence, the project is expected to impact livelihood of the local unskilled labourers positively.

6.7.3 Potential Impact on Fishing Activity

The consultations revealed that there are around 40-50 fisherman families in Char Balaki and around 150 fishermen in the core area (i.e. within 2 km). It was also noted that fishermen from Char Balaki, Pachani and Dudghata do fishing in the Meghna River channel. It was reported that there are fishermen community along the banks of Meghna River, who do fishing in the Meghna River. During focus group discussions with the fishermen community it was reported that due to the waste discharge by the chemical industries located upstream of Meghna River, the river water gets polluted affecting the aquatic habitat and thus impacting the fishing activity. This occurs once or twice a year. As result the fishermen sail down south of the river almost near the confluence (river and ocean) or sometimes to the sea to catch fish. This has been happening for several years now.

Construction Phase

A small section of local fishermen population is engaged into kata fishing practise in that area of Meghna River, especially in the post monsoon season.

They practice kata fishing, especially in the channels of the Meghna River, south-west of proposed plot. During the construction period a temporary jetty will be set up on the south-wester part of the power hub, beside the jetty of the Orion Power Plant. It is reported that barges coming to the Orion Power Plant jetty follow a particular path to avoid any impact on the kata fishing nets. Movement of the barges during the construction phase may put the kata fishing activities of the local fishermen at risk. This may potentially impact the kata fishing practice during construction phase.

Impact	Impact on Kata Fishing Activity			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent
Impact Extent	Local	Regional	International	
Impact Scale	Low	Medium	High	
Frequency	During the construction phase of the project			
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High	
Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact will be **minor**			

Mitigation Measures:

- The barges brining in construction materials for the proposed project should follow the path followed by the barges of Orrion Power Plant.
- The management of Summit II Power Plant should in discussion with the Orrion Power decide on the schedule of the barge movements, such that it does not impact the kata fishing zone.
- Try and avoid to the extent possible the season of kata fishing.
- Involve the local community fishermen and daily wage earners to the extent possible as unskilled workers during the construction of the project.
- A study may be commissioned for understanding the fishing practices, changing fishing locations as per seasonality and other dependence on the river.

Residual Impact:

Considering the above mentioned mitigation measures the residual impact will remain same, ie. **minor**.

Operation Phase

The proposed power plant will discharge cooling tower blowdown along with treated effluent from the plant into Meghna River through a pipeline of length 0.5 km. However, the temperature of the discharge water will be reduced as it will be cooled. The project will provide the facility of cooling towers, both to reduce the temperature of the discharge water and to reduce the water requirement for the Plant and the blow down will be about 1/5th of the total

water intake. Hence, impact on fishing activity due to thermal discharge from the power plant is assessed to be low. The impacts of discharge from power plant on aquatic habitat are already discussed above in ***Section 6.6.2***. In addition to that during the operation phase for transport of HSD (as required), the jetty of Summit M1 will be used, which is located on the main River and hence avoid any disturbance on this channel.

6.7.4 Potential Impact due to Labour Influx

The proposed project will result in influx of workers and labourers to the area because of construction activities, and hence potential employment and contract opportunities will be created. This will involve skilled workers and staffs (national and expatriates) who would live or stay in the locality for varied length of time.

Impact Assessment:

Labour influx may result in putting stress on the local resources in absence of proper planning for the drinking water and sanitation facilities of the workers. Strain on local resources and infrastructure may be also related to medical facilities, electricity, food and provisions in the local markets. This may also result in an increase in the overall price of essential commodities in the area.

The provision of sanitation facilities will also have to take into account the proximity of the rivers and channels. It is to be ensured that that the presence of the labour camps does not result in increased risks in terms of polluting the river water. The scale of impact can be minimised through proper sanitation arrangements at labour camps during the construction phase. This may be dismantled during the operational phase.

Impact	Labour Influx during Construction Phase				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Low	Medium	High		
Frequency	Restricted to Construction Phase only. The labour camps are going to be dismantled during the operation phase of the project				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **minor.**				

Mitigation Measures:

- Project proponent to ensure proper and adequate provisions of drinking water facility at the labour camps should be available so that the labourers do not have to depend on the community recourses.

- Construction of septic tanks to prevent contamination of water resources from sanitary effluents generated from labour camps will be implemented. Number of sanitary units should be sufficient for all the labours in order to prevent any interface with the local community.
- Create awareness among the labours on proper hygiene practices.

Residual Impact:
Considering the above mentioned mitigation measures the residual impact will remain same, ie. **minor**.

6.7.5 *Community and Occupational Health & Safety*

Possible sources of impacts to community health and safety during the construction phase are:
- Changes in environmental quality due to construction activities;
- Increased prevalence of disease arising from the influx of construction workers; and
- Heavy traffic movement

Baseline surveys and consultations revealed that the most common diseases in the Project area are bacillary dysentery, diarrhoea, typhoid, peptic ulcers
For the operations phase, the risk accidents may pose a potential threat to the workers of the plant. The greatest incidence is of food and water borne diseases, arising from contamination by faecal elements, pests and vectors and due to lack of sanitation facilities. Such diseases will be of special concern during the monsoon season.

Impact	Community and Occupational Health & Safety			
Impact Nature	Negative	Positive	Neutral	
Impact Type	Direct	Indirect	Induced	
Impact Duration	Temporary	Short-term	Long-term	Permanent
Impact Extent	Local	Regional	International	
Impact Scale	Low	Medium	High	
Frequency	Both during the construction and operation phase of the project			
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High	
Impact Significance	Negligible	Minor	Moderate	Major
	Significance of impact will be **moderate.**			

Mitigation Measures:
Measures such as proper collection, storage and disposal of wastes, construction of septic tanks to prevent contamination of water resources from sanitary effluents generated from labour camps will be implemented. Mitigation measures will be implemented to reduce the likelihood of contamination of surface and groundwater from sanitary effluents generated during construction.

For occupational hazards the project proponent shall keep adequate arrangements for potential emergency response and preparedness scenarios.

Residual Impact: Taking these measures into account, the impact significance to community and occupational health and safety is evaluated to be of **moderate**.

6.7.6 Local Economic Benefits

Employment Generation

Employment generation will be a significant contribution of the project, especially considering that the employment scenario in project area during the construction phase. The project is expected to employ at least about 500 un-skilled and semi-skilled labours during the construction phase and additional 40-50 local persons for the operations phase through contractors. The potential impacts due to the employment generation are considered to be positive.

Benefits of Local Enterprise

The construction phase influx is likely to provide a stimulus to the local economy. Influx and in-migration and the flurry of construction work is likely to raise wage levels and may also result into localized inflation of the prices for basic goods during a temporary period where demand of consumables may exceed supply. This also includes agricultural produce, demand for meat and poultry as well as fish. Thus large farmers will have a ready market to supply their produce.

Local enterprises, particularly those involved in the production and sale of construction materials, are potential benefactors of the civil works involved in the project. Brick-making provides employment to a large number of local un-skilled labours. Similarly, stone crushers, sand suppliers and local transporters of these materials will also benefit from the project. Also food suppliers who provide raw food materials to the labour camps and construction and commissioning workers' canteens will benefit from the project. There has already been a precedence of the same during the development of the BPDB Power Plant.

It is anticipated that with time, the potential exists for local /and regional businesses to develop and grow to meet at least some of the procurement needs of the proposed Project, especially during operations. Procurement locally will assist in creating income and building a more stable and diverse economy. As the proposed Project develops, the increased demand for goods and services should create commercial opportunities for local businesses (those opportunities are likely to be focused on the production and transformation of food products). In addition, the influx of migrant jobseekers will bring people with different experiences, knowledge and demands that will supplement the existing economic and livelihood activities and offer additional activities that will serve to diversify the local economy.

Increments in cost of living

The presence of a salaried working class population will bring in greater cash income in project area. Hence, the spending capability of this population will be higher than the local population which depends on agriculture or household based small scale industries. The spending capacity, in turn will increase local consumption thereby increasing demand for a range of commodities in daily life. This often results in price rises for these regularly consumed items. Hence, the cost of living in the project area may experience an incremental rise.

Opportunity for local transporters

The project operation will require a number of transportation services including regular requirement for commuting short term visitors and industrial provisioning of a range of materials. Hence, this would create business opportunity for local transporters.

Demobilization and transition to the Operations phase

Construction-related work opportunities will last only in the medium term of 3 years, after which there will be demobilization of construction phase activities due to the requirement of a significantly smaller manpower during the operations phase. The reduction in the workforce will result in the outmigration of workers as they leave to seek job opportunities elsewhere. This may result in the depression of the local economy as the market for local goods and services declines. It may even cause an out-migration of local people who may also leave in search of better economic opportunities elsewhere. Given the limited working opportunities during Project operations, it will be challenging to meet the expectations of the local construction employees.

Transition into operations will involve large scale downscaling and retrenchment of the workforce over a number of years. By that time a large number of local professionals will have worked on the proposed Project, and will constitute a reserve of trained workforce. Demobilization will have a considerable impact on the women and youth, as they will be in the prime of their working lives, with significant earning potential and large demands on their income (i.e., young families).

This positive impact will be enhanced by training received through on-the-job and more formal training courses related to skill development for production and Health and Safety and Environment (HSE) standards required for the proposed Project. This positive impact will include suppliers and Contractor staff, who will have to meet particular production, operational, and quality standards as required by SMIIPCL.

For those national and local companies that have the opportunity to be part of the proposed Project's supply chain, long lasting and sustained benefits to the businesses and their employees can be expected, in the form of enhanced work experience, delivery capacity and training, particularly in having to meet stringent international standards of quality, health, safety and environmental management.

Impact Significance

Overall the local economic impacts are likely to be positive.

Impact	Impacts on the local economy and skills development				
Impact Nature	Negative		Positive		Neutral
Impact Type	Direct		Indirect		Induced
	While certain impacts are linked to project activities, ancillary developments in the area of influence may also influence the impact.				
Impact Duration	Temporary	Short-term		Long-term	Permanent
Impact Extent	Site-specific	Local		Regional	International
Impact Scale	The impact represents a major change from the present local economic and skills development scenario.				
Frequency	Routine or continuous impact linked to project activities and procurement requirments with a phase of depression linked to the demobilization.				
Impact Magnitude	Positive	Negligible	Small	Medium	Large

6.8 CUMULATIVE IMPACTS DUE TO OPERATION OF PROPOSED POWER PLANTS

6.8.1 Air Quality

Cumulative Impacts on Air Quality – Operation of three proposed power projects

Sources of Impact

The three proposed power projects within study area include Summit M2 (dual fuel fired), Reliance Power (RLNG based) and Orion Power (coal based). Emission parameters in combined cycle mode from the four projects are presented in Table 6.34.

Table 6.34 Summary of Emissions for the Proposed Power Plants for Separate stacks in the study area

Fuel	Stack	Stack Height (m)	Stack Internal Diameter (m)	Flue Gas Exit Velocity (m/s)	Flue Gas Temperature (°C)	Volumetric Flow Rate (Nm^3/s)	Emission Concentration			Emission Rate		
							NOx	SO_2	PM_{10}	NOx	SO_2	PM_{10}
							mg/Nm^3	mg/Nm^3	mg/Nm^3	(g/s)	(g/s)	(g/s)
NG	Summit M2 Main Stack	75	4.85	20	373	295	51	-	10	15.0	-	2.95
	Reliance Main Stack 1	70	6.3	25	363	639	51	-	10	32.6	-	6.39
	Reliance Main Stack 2	70	6.3	25	363	639	51	-	10	32.6	-	6.39
HSD	Summit M2 Main Stack	70	4.85	20	373	295	152	348	50	44.8	102.8	14.8
Coal	Orion Main Stack	275	7.5	20	348	756	510	600	50	385.7	453.7	37.8

* UTM Zone – 46

** * Stack parameters are as provided by the Client for Summit M2. Reliance stack data has been taken from the ESIA study of the project, whereas Orion data has been assumed based applicable requirements in Bangladesh and of a similar project in Bangladesh.

Criteria

For the assessment of air quality, the sensitivity and magnitude criteria outlined in Table 6.11 and Table 6.12, respectively have been used. The standards considered for assessment of potential impacts to air quality, are *Schedule 11 ECR, 1997 of the GOB*.

Receptors

From the landuse analysis and field study, it is clear that most of the land surrounding the Project site, as well as eastern and southern side is industrial land. Nearest settlement from the site is Islampur, which is at a distance of about 600 m from the site. Other settlements in the northern and western side of the project are located at about 1 km distance. Meghna River on the southern side is having more than 1.5 km width and after that there is industrial area on the bank of the Meghna River. As can be referred from Table 6.11 and above discussion, the human receptors were assessed to be of Medium sensitivity, whereas ecological receptors were considered as of Low sensitivity.

Prediction of Impacts

Impact on ambient air quality due to the proposed three power projects was evaluated by using air dispersion modelling. Predicted maximum criteria pollutant concentrations due to the Project in the Project AOI with different fuel combinations of Summit M2 project with the other two projects have been presented in Table 6.35. Representative ground level concentration isopleths are presented from Figure 6.20 to Figure 6.23.

Table 6.35 Predicted Concentrations at Receptors due to Operation of Proposed Power Plants and Overall Cumulative Impacts

Scenario	Pollutant	Average	Maximum Predicted Concentration (µg/m³)									Max. Background Concentration (µg/m³)*									Total Concentration (Predicted + Background) (µg/m3)									*Bangladesh Standard* (µg/m³)
			Max	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8	Max	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8	Max	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8	
Operation of Summit M2 (NG), Reliance (NG), Orion (Coal)	NO_x	1-hourly	148.96	70.5	87.63	80.22	96.52	93.74	112.32	94.3	106.99	154.8	150.0	132.0	154.8	140.8	150.0	124.8	154.4	146.4	303.8	220.5	219.6	235.0	237.3	243.7	237.1	248.7	253.4	-
		24-hourly	26.04	17.2	16.33	11.16	17.87	15.66	21.98	12.89	12.5	38.7	37.5	33.0	38.7	35.2	37.5	31.2	38.6	36.6	64.7	54.7	49.3	49.9	53.1	53.2	53.2	51.5	49.1	-
		Annual	5.77	2.82	5.48	1.91	5.47	2.24	4.9	4.1	2.41	7.3	7.1	6.2	7.3	6.6	7.1	5.9	7.3	6.9	13.1	9.9	11.7	9.2	12.1	9.3	10.8	11.4	9.3	***100***
	PM10	1-hourly	16.03	9.75	8.87	10.14	9.51	9.41	12.37	12.33	13.45	1205.8	1205.8	653.3	1008.5	666.5	947.1	627.0	802.4	627.0	1221.8	1215.5	662.2	1018.6	676.0	956.5	639.4	814.7	640.5	-
		24-hourly	3.44	2.23	2.1	1.58	2.17	1.9	2.57	1.71	1.64	275.0	275.0	149.0	230.0	152.0	216.0	143.0	183.0	143.0	278.4	277.2	151.1	231.6	154.2	217.9	145.6	184.7	144.6	***150***
		Annual	0.83	0.36	0.76	0.24	0.61	0.27	0.56	0.56	0.31	55.0	55.0	29.8	46.0	30.4	43.2	28.6	36.6	28.6	55.8	55.4	30.6	46.2	31.0	43.5	29.2	37.2	28.9	***50***
Operation of Summit M2 (HSD), Reliance (NG), Orion (Coal)	NO_x	1-hourly	154.46	83.74	88.3	87.99	96.75	94.7	114.87	104.63	120.13	154.8	150.0	132.0	154.8	140.8	150.0	124.8	154.4	146.4	309.3	233.7	220.3	242.8	237.6	244.7	239.7	259.0	266.5	---
		24-hourly	31.07	20.22	18.59	13.51	19.58	17.27	23.63	14.82	14.2	38.7	37.5	33.0	38.7	35.2	37.5	31.2	38.6	36.6	69.8	57.7	51.6	52.2	54.8	54.8	54.8	53.4	50.8	---
		Annual	7.1	3.31	6.38	2.16	5.78	2.48	5.22	4.9	2.78	7.3	7.1	6.2	7.3	6.6	7.1	5.9	7.3	6.9	14.4	10.4	12.6	9.5	12.4	9.5	11.1	12.2	9.7	***100***
	SO_2	1-hourly	176.51	94.36	101.89	98.44	113.73	110.85	132.52	108.89	134.32	36.8	36.8	28.8	32.8	28.8	34.0	28.8	34.0	30.4	213.3	131.1	130.7	131.2	142.5	144.8	161.3	142.9	164.7	-
		24-hourly	38.67	23.52	20.74	14.98	21.68	19.39	26.42	16.17	15.51	9.2	9.2	7.2	8.2	7.2	8.5	7.2	8.5	7.6	47.9	32.7	27.9	23.2	28.9	27.9	33.6	24.7	23.1	***365***
		Annual	8.32	3.92	6.73	2.45	6.61	2.82	5.9	5.6	3.18	1.7	1.7	1.3	1.5	1.3	1.6	1.3	1.6	1.4	10.0	5.6	8.1	4.0	8.0	4.4	7.2	7.2	4.6	***80***
	PM10	1-hourly	25.04	15.17	13.06	14.86	11.84	10.3	14.87	16.16	20.29	1213.5	1213.5	657.5	1014.9	670.7	953.1	631.0	807.5	631.0	1238.5	1228.6	670.5	1029.8	682.6	963.4	645.9	823.7	651.3	-
		24-hourly	6.11	3.27	2.92	2.4	2.81	2.51	3.19	2.4	2.33	275.0	275.0	149.0	230.0	152.0	216.0	143.0	183.0	143.0	281.1	278.3	151.9	232.4	154.8	218.5	146.2	185.4	145.3	***150***
		Annual	2.04	0.52	1.07	0.33	0.72	0.36	0.67	0.84	0.44	55.0	55.0	29.8	46.0	30.4	43.2	28.6	36.6	28.6	57.0	55.5	30.9	46.3	31.1	43.6	29.3	37.4	29.0	***50***

Note:

Highlighted cells indicate calculated background concentrations for 1 hourly and annual averages. Baseline monitoring data was available for 2 months at the time of this analysis with 24 hourly averages. Therefore, in order to provide 1-hourly maximum and annual average concentrations, conversions are done using the power law relationship given below:

$C_{long} = C_{short}(t_{short}/t_{long})^p$

where:

C_{long} *= the concentration for the longer averaging time*

C_{short} *= the concentration for the shorter averaging time*

T_{short} *= the shorter averaging time (in minutes)*

T_{long} *= the longer averaging time (in minutes)*

p = the power law exponent

For ambient air assessments p value was calculated based on exponent p from predicted results for 1-hourly and annual averages for each pollutant. This methodology is deemed to give conservative estimates and thus is deemed appropriate for this case.

It is evident from *Table 6.35* that the maximum ground level concentration (maximum baseline concentration + predicted maximum concentration) in the project AOI with natural gas as fuel will be well within the applicable air quality standard. Exceedance in PM_{10} concentrations are primarily due to the existing baseline conditions in the study area because of other air polluting industries, construction activities in national highway, vehicular movement etc. The proposed projects contributions in particulate matter maximum ground level concentration (with both the fuel options) are well below 4% of the applicable standard. In case of NOx and SO_2, the project contribution varies from 6% for NOx and about 10% for SO_2, which are also well below 25% of the applicable standard for non-degraded airshed and below 10% of the applicable standard for degraded airshed (refer to Table 6.23).

Using the determination of magnitude criteria (Table 6.12), impact magnitude due to operation of these power projects with is assessed to be negligible to small.

Impact	*Ambient Air Quality (Cumulative impact due to operation of proposed three power projects)*				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Maximum impact zone within 2 km from project boundary in the downwind direction				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **minor** to **negligible.**				

Figure 6.20 *NOx Isopleths – Cumulative 1 Hourly Maximum Ground Level Concentrations from Proposed Power Plants (with Summit M2 using Natural Gas)*

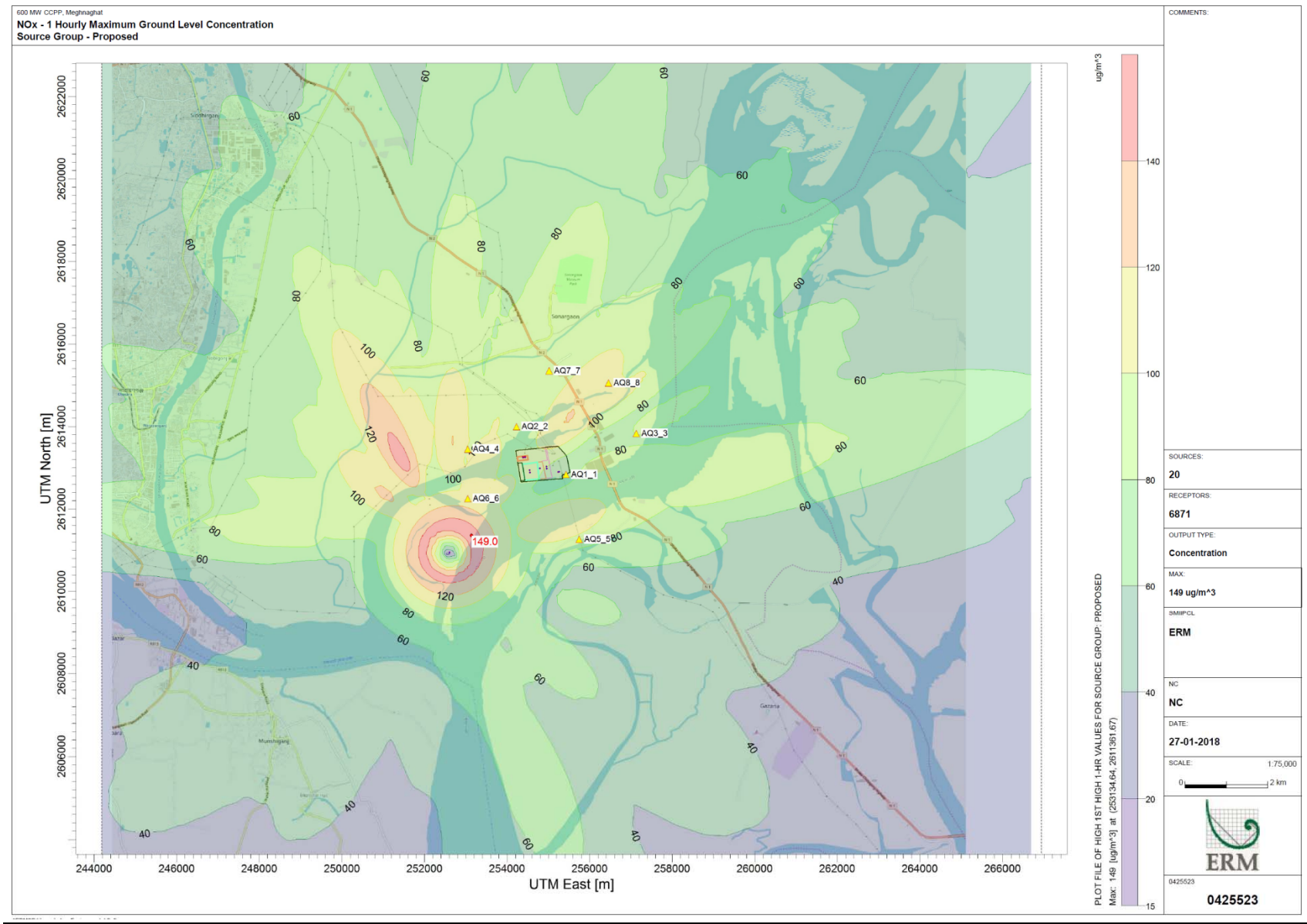


Figure 6.21 *NOx Isopleths – Cumulative 1 Hourly Maximum Ground Level Concentrations from Proposed Power Plants (with Summit M2 using Liquid Fuel)*

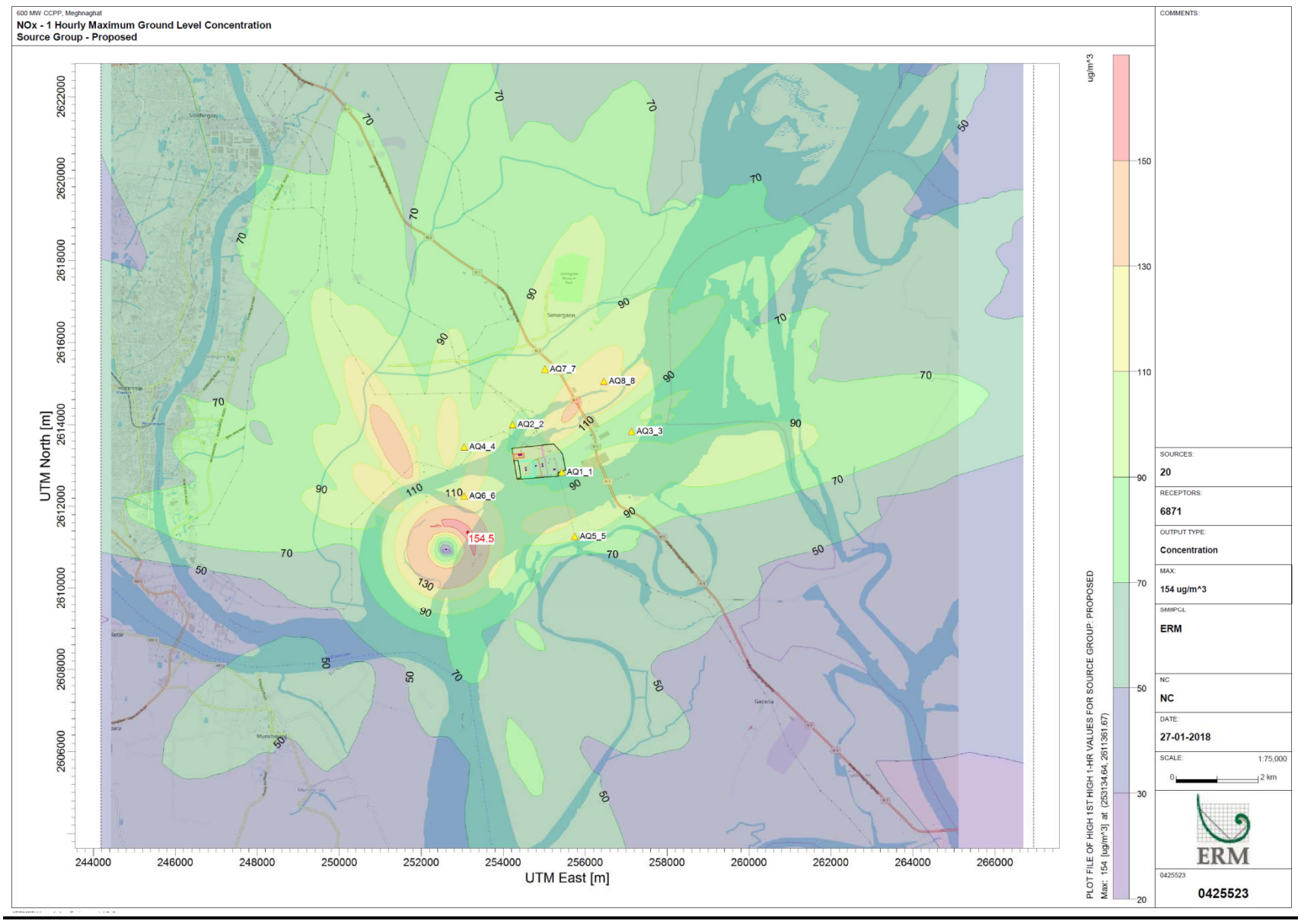


Figure 6.22 *SO_2 Isopleths – Cumulative 24 Hourly Maximum Ground Level Concentrations from Proposed Power Plants (with Summit M2 using Liquid Fuel)*

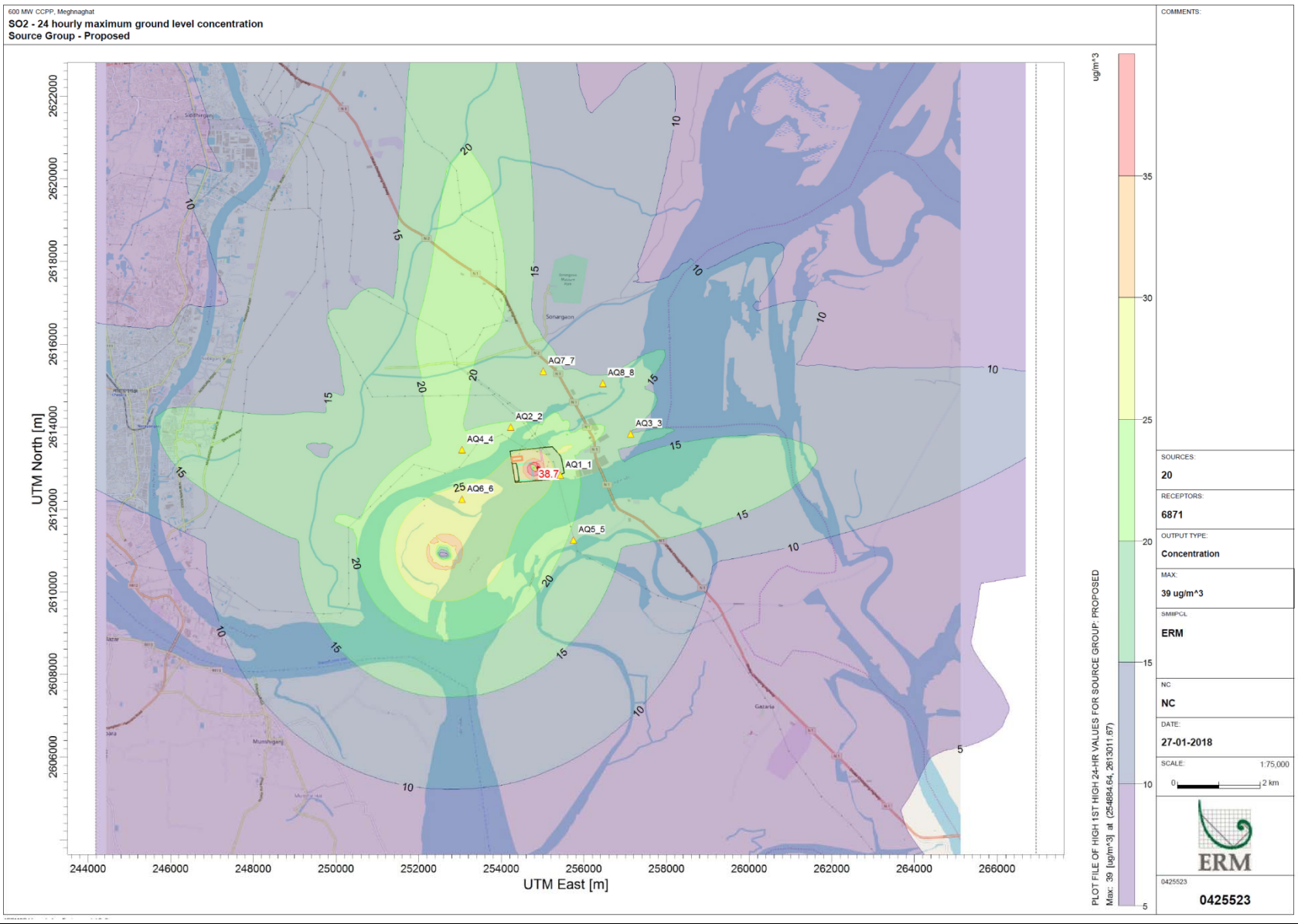
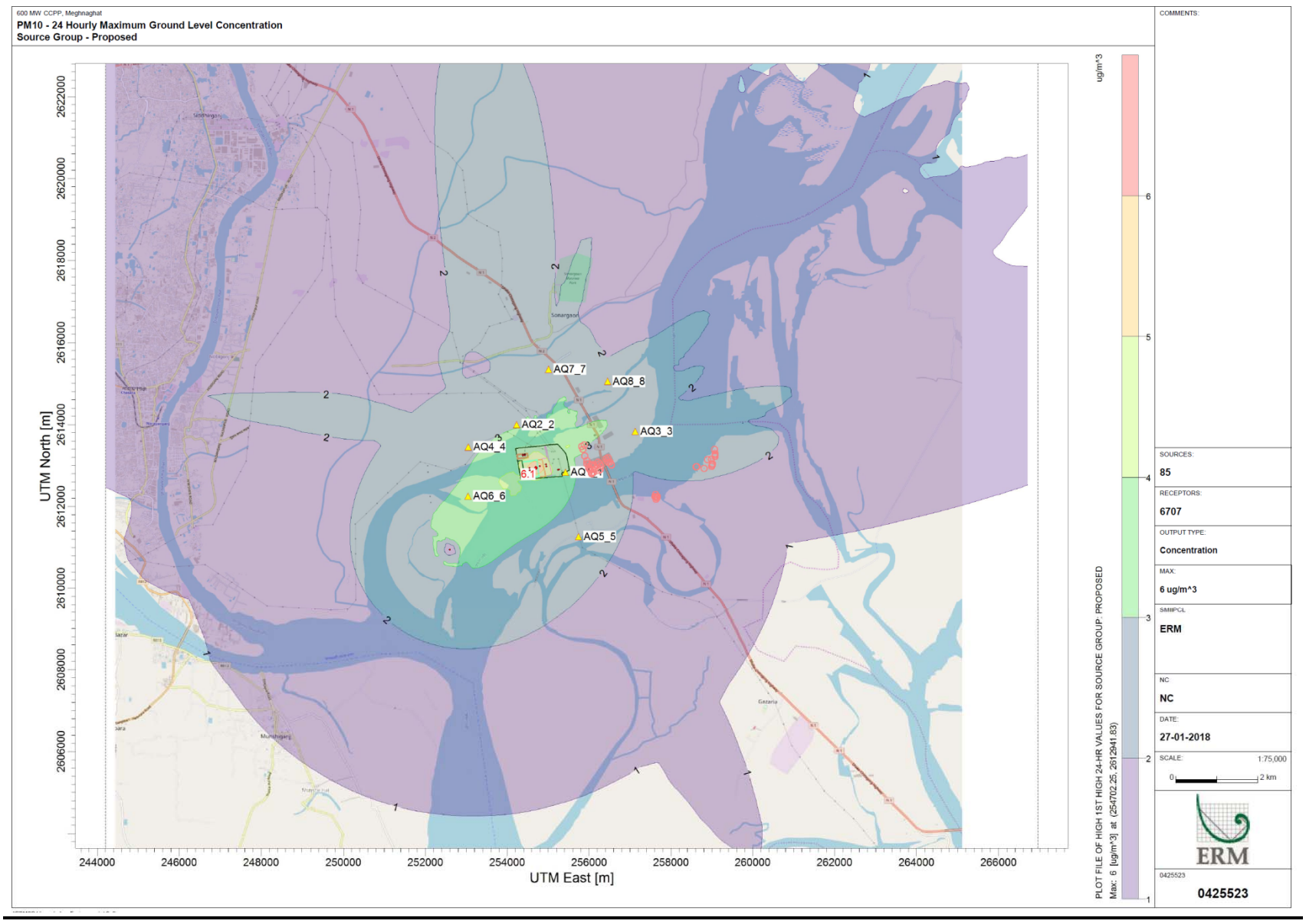


Figure 6.23 *PM_{10} Isopleths – Cumulative 24 hourly Maximum Ground Level Concentrations from Proposed Power Plants (with Summit M2 using Liquid Fuel)*



6.8.2 Noise

Cumulative Noise Impacts

Impact on ambient noise levels due to the operation of proposed Summit M2 and Reliance Power projects within the Meghnaghat Power Hub were also evaluated by using noise prediction model. Proposed coal power project at Char Balaki was not considered in this study, since the plant location is more than 3 km away from the Meghnaghat Power Hub boundary.

Criteria

It is planned that the Project will meet the noise emission criteria specified in the GOB ECR, 1997 and the WB/IFC EHS Guidelines, as presented in Table 3.10. Furthermore, for the assessment of ambient noise, the sensitivity and magnitude criteria outlined in Table 6.13 and Table 6.14, respectively have been used:

Receptors

Baseline noise monitoring was carried out at 10 locations (Figure 6.17). The results of baseline monitoring indicated that ambient noise levels at residential areas were high compared to the applicable standards. The nearest mixed landuse receptor (Islampur) is located at about 50 m from the Meghnaghat Power Hub boundary, which will be exposed to noise from construction activities. Apart from this the settlements located close to the access road will also be affected due to the movement of vehicles.

As can be referred from Table 6.13 and above discussion, the residential receptors were assessed to be of medium sensitivity, whereas the industrial land use receptors and ecological receptors were assessed to be of Low sensitivity.

Methodology: The environmental noise prediction model SoundPLAN 7.2 was used for modelling noise emissions from the use of power plant equipment. It has been assumed that all the plant equipment of Summit M2 and Reliance Power projects will adhere the equipment noise emission criteria of 85 dB(A) noise levels at a distance of 1 m from the source. Major plant components with higher noise generation considered in this study include GTG, STG, HRSG, Auxiliary Boiler, Cooling Tower, CW Pump House, Emergency DG, Water Treatment Facility, Pump House, RMS, and Gas Booster and Conditioning Station of all the three projects. Operation of equipment with 100% usage scenario was modelled to cover the operation phase of the projects. As a conservative approach to the assessment, atmospheric absorption during sound transmission was not included in the assessment. In addition, to represent a worst-case scenario for the assessment, all equipment were assumed to be operating simultaneously.

Predicted Noise Levels at Receptors: The predicted noise levels within the Project AOI during day time are presented in Table 6.36. Predicted noise levels at nine receptors (where baseline noise levels were also monitored, which include four receptors within or just outside the boundary of the complex) have been presented in Figure 6.24.

Figure 6.24 Predicted Operation Phase Noise Levels of Summit M2 and Reliance Power Projects during Night-time (Leq $_{day}$)

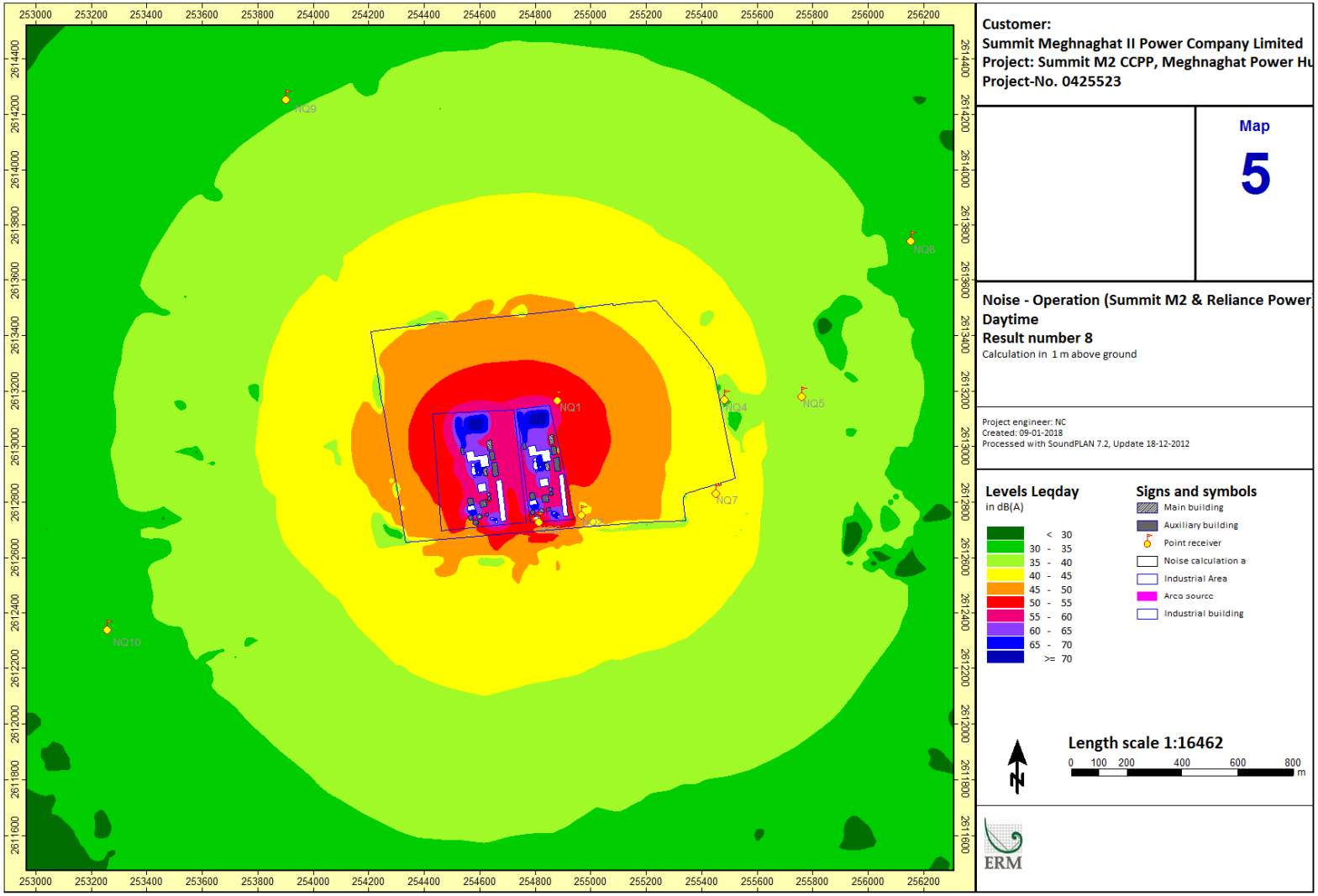


Table 6.36 Predicted Noise Levels at Noise Receptors during Operation Phase of Summit M2 and Reliance Power Projects

Receptor Code	Sampling Location	Approximate Distance to Power complex Boundary (m) and Direction from Project Site	Baseline Sound Pressure Levels at Receptors, Leq (dBA)(1)		Predicted Sound Pressure Levels at Receptors, Leq (dBA)		Total Sound Pressure Level (Baseline + Predicted), Leq (dBA)		Applicable Standard (dB(A))(2) (3) as per Landuse	
			Leq $_d$*	Leq $_n$*	Leq $_d$	Leq $_n$	Leq $_d$	Leq $_n$	Leq $_d$	Leq $_n$
NQ1	Northern side of Project Area; near GTCL	Within	66.1	58.0	54.3	54.3	**66.4**	**59.5**	*75*	*70*
NQ2	Northern side of Project Area; Near Summit Watch Tower	Within	71.2	64.6	47.2	47.2	**71.2**	**64.7**	*75*	*70*
NQ3	Mugrapara	3 km (NW)	57.5	48.3	24.9	24.9	**57.5**	**48.3**	*55*	*45*
NQ4	Ganganagar	At boundary (E)	58.2	48.7	32.1	32.1	**58.2**	**48.8**	*75*	*70*
NQ5	Eastern side of Power Hub	300 m (E)	59.4	53.4	38.8	38.8	**59.4**	**53.5**	*75*	*70*
NQ6	Southern Side of the Power Hub	At boundary (S)	65.5	59.8	52.0	52.0	**65.7**	**60.5**	*75*	*70*
NQ7	Islampur Village	50 m (SE)	61.3	49.7	42.3	42.3	**61.4**	**50.4**	*60*	*50*
NQ8	New Town	900 m (ENE)	69.8	60.9	34.3	34.3	**69.8**	**60.9**	*60*	*50*
NQ9	Mongoler Gaon/ Dudhghata	1000 m (NW)	59.5	46.9	34.6	34.6	**59.5**	**47.1**	*55*	*45*
NQ10	Charbalaki village	1000 m (WSW)	57.8	48.3	33.1	33.1	**57.8**	**48.4**	*55*	*45*

(1) Ambient noise levels as monitored during the baseline survey

(2) Environmental Conservation Rules, 1997 (Schedule 4) amended September 7, 2006

(3) (4) All operations have been considered as continuous and hence there is no change in the day and night time prediction results.

It is evident from Table 6.36 that that ambient noise levels due to operation of both the projects will be well within the applicable standard during day and night time at 5 receptors, out of total 10 receptors considered in the study. All the exceedances are due to already higher baseline noise levels during day and night time, whereas predicted noise levels were found to be meeting applicable standards with respect to land use criteria. The noise impact from operation of both the projects during day time is expected to be **negligible** to **minor**. Higher noise levels at NQ8 are due to its proximity to Dhaka – Chittagong Highway and not directly linked with Meghnaghat Power Hub. Furthermore, noise levels at night time will be slightly higher than the applicable standard (with < 5 dBA increase from the applicable standard) at 5 locations. Due to this the noise impact from Summit M2 operation during night time is expected to be **negligible** to **minor.**

Impact	*Cumulative noise from Operation of Plants (Daytime and Night time)*				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Maximum impact zone within 100 m from project boundary				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource/ Receptor Sensitivity	Low	Medium	High		
Impact Significance	Negligible	Minor	Moderate	Major	
	Significance of impact is considered **negligible to minor.**				

Mitigation Measures

- Installation of vibration isolation for mechanical noise control;
- The current assessment of cumulative noise impact due to the projects operation is based on mathematical modelling. Once both the plants are operational, periodic ambient noise monitoring is suggested as part of the EMP to monitor the noise levels. This will be done to ensure compliance with the specification and guaranteed performance at noise generating sources as well as ambient noise levels at the receptors located in the surroundings.
- Review of noise guarantees and supporting data of all equipment suppliers with interim noise reports from EPC contractor/s in order to demonstrate compliance with the applicable noise emission criteria at source/s. In case of exceedence from the specified noise limits, adequate corrective actions as may be required shall be implemented by the specific project.

Criterion	Rating pre mitigation	Rating post mitigation	Comment
Change in Ambient Noise Levels during day and night time			
Residual Impact	Negligible to Minor	Negligible to Minor	With implementation of the mitigation measures mentioned for minimizing

			the noise generation at source and providing barriers wherever feasible, the night time noise residual impacts would be negligible.

The Environment and Social Management Plan (ESMP) for the Project has been developed with an aim to avoid, reduce, mitigate, or compensate for adverse environmental and social impacts/risks and to propose enhancement measures. This includes:

- mitigation of potentially adverse impacts;
- monitoring of impacts and mitigation measures during different Project phases of implementation and operation;
- integration of the ESMP with Project planning, design, construction and operation;
- institutional capacity building and training; and
- Compliance to statutory requirements.

It is to be noted that environmental and social sustainability is embedded in the Project Sponsor's (SCL) business decisions and processes through a Group level EHS&S Management System. Environment, Health & Safety and Social Policies of the company are presented in ***Annex G***. SMIIPCL will also align with the requirements of the corporate policies and procedures and ensure that the environmental and social performance of the project is implemented concurrently. SCL is also having an Environmental and Social Management System (ESMS), which provides process and procedures for its power vertical. These will be applicable to Summit M2 project as well. It is also planned that SMIIPCL will develop its own ESMS in line with the requirements of Corporate policies and procedures.

7.1 MITIGATION MEASURES

Key environmental and social impacts have been identified and reported in ***Chapter 6*** along with mitigation measures. A summary of mitigation measures for environmental, ecological receptors and socio-economic conditions is identified for the construction[1] and an operation phase of the Project is presented in ***Table 7.1***. This also identifies lead responsibility for implementing the mitigation measures and sources of funds for such implementation. Many of the mitigation measures suggested during the construction phase of the Project are associated with good construction and housekeeping practices and will need to be included within the bid document and final contract agreement with the EPC and equipment contractors. Most of the mitigation measures for the operation phase (such as those for air emissions and noise generation) of the Project are already incorporated into the Project design specifications as embedded control measures.

(1) [1] Social impacts associated with the planning phase of the Project have also been covered under the construction phase.

The construction phase of the Project is anticipated to last approximately 30 months, whereas the operation phase of the Project is 22 years, as per the LOI received from the BPDB. However, the design life of the Project is 30 years and SMIIPCL will be responsible for ensuring that the mitigation measures in the ESMP are implemented throughout the life span of the Project.

Table 7.1 Environmental, Ecological and Social Management Plan of the Project

S. No.	Affected Aspect	Project Activity /affected area	Potential Impacts	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Approximate cost and Mitigation Cost Source
A	*Environmental Issues Associated with Site Preparation and Construction*							
1.1	Soil Quality	Site clearing, and site preparation, Laying of gas pipeline, use of heavy loaders from the temporary jetty site	Soil erosion and compaction	• Demarcation of routes for movement of heavy vehicles especially near the temporary jetty; • Building small bunds in areas with slope to prevent soil erosion.	Appointed EPC Contractor	On site Project Management team of SMIIPCL	Route plans submitted to HSE and Project Management team of SMIIPCL	• EPC Contractor Cost
1.2	Soil and sediment Quality	• Fuelling and operation of heavy machinery and transport vehicles, • Unloading and loading activities near the temporary jetty • Storage and handling of chemicals	Soil and sediment contamination through spills and leaks	• Fuel tanks and chemical storage areas to be sited on sealed areas and provided with locks to prevent unauthorized entry; • Preparation of guidelines and procedures for immediate clean-up actions following any spillages of oil, fuel or chemicals; • Development of a site specific Emergency Response Plan for soil clean-up and decontamination; • Implementation of a training program to familiarise staff and workers with emergency procedures and practices related to contamination events; • Storage areas for oil, fuel and chemicals to be surrounded by bunds or other containment devices to prevent any spilled oil, fuel or chemicals from contaminating soils, sediment, water or groundwater; • Use of spill or drip trays to contain spills and leaks, and use of spill control kits to clean small spills and leaks; and • Installation of oil/water separators to treat surface run-off from bunded areas prior to discharge to the storm water system.	Appointed EPC Contractor	HSE Team of SMIIPCL and on site Project Management team	Plans submitted to HSE Team for approval and monthly reports to SMIIPCL	• EPC Contractor Cost
1.3	Soil Quality	Storage, handling and disposal of construction waste	Soil contamination	• Provide dedicated storage areas for construction materials to minimise the potential for damage or contamination of the materials; • Training labourers for waste disposal in designated areas and use of sanitation facilities; • Implement a construction materials inventory management system to minimise over-supply of the construction materials, which may lead to disposal of the surplus materials at the end of the construction period; • Segregate hazardous and non-hazardous waste and provide appropriate containers for the waste types generated (e.g. enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimise odour nuisance); • Store wastes in closed containers away from direct sunlight, wind and rain; • Provide enough space to allow for inspection between waste containers so as to identify any leaks or spills; • Ensure storage areas have impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest waste container; • Storage of inert concrete waste in a laydown area near the concrete batching plant and reuse of these wastes under floors or roads; and • Dispose of hazardous waste including bitumen by licensed contractors.	Appointed EPC Contractor	HSE Team of SMIIPCL and on site Project Management team	Monthly report to SMIIPCL	• EPC Contractor Cost

S. No.	Affected Aspect	Project Activity /affected area	Potential Impacts	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Approximate cost and Mitigation Cost Source
2.1	Surface Water Quality	• Wastewater Discharge from washing of equipment and machinery • Sanitary facilities	Surface water contamination	• Vehicle servicing areas and wash bays located within roofed and cemented areas. The drainage in these covered areas connected to oil/water separator and channelized properly to the land/inland waters ; • Oil leakage or spillage contained and cleaned up immediately. Waste oil to be collected and stored for recycling or disposal; • Oil and grease separator shall be used for wastewater generated from cleaning activities; • Any surplus wastewater from the concrete batching to be treated to comply with discharge standards before it is discharged; • Adequate sanitary facilities, i.e. toilets and showers, provided for the construction workforce; • Workers trained in the use of designated areas/bins for waste disposal and encouraged to use toilets. • Septic tanks provided to treat sanitary wastewater; and all sewage and liquid effluent treated to meet the standards specified in Schedules 9 and 10 of the ECR, 1997 respectively and IFC EHS Guidelines prior to discharge to land/inland waters.	Appointed EPC Contractor	On site Project Management team and designated HSE team	Monthly report to SMIIPCL	• EPC Contractor Cost
2.2	Ground Water Quality	• Leaks and spills of oil, lubricants, fuel • Improper handling of sewage or chemical	Groundwater contamination					
	Air Quality	• Site preparation, filling and levelling; • Excavation of soil for building and equipment foundations; • Pile driving for the equipment foundation; • Concrete works • Transportation related activities	Dust generation	• Implementation of a regular and rigorous watering and sprinkling regime for dust suppression during the dry season; • As far as possible, locate the concrete batching plant away from sensitive receptors and additional net fencing/ solid barrier on section of boundary wall facing the residential receptors to reduce dust transport.; • Maintain the maximum possible distance between stockpiles and receptors; • Cover and/or water spray all stockpiles of dusty materials such as excavated spoils, loose construction material piles to avoid fugitive dust; • During construction, the access road will be regularly maintained to keep it clean, free from mud and slurry. • Material transport will be totally enclosed with impervious sheeting and wheel washing will be carried out at site. • No waste will be burnt on or around the Project site.	Appointed EPC Contractor	On site Project Management team and designated HSE team	Monthly report to SMIIPCL	• EPC Contractor Cost
3.2	Air Quality	• Operation of heavy machinery and transport vehicles • Operation of DG sets	Exhaust Emissions	• A speed limit of 20 km/hr will be enforced on the construction site/access road; • Regularly maintain all diesel-powered equipment and reduce idling time to avoid emissions of NOx, PM_{10} and SO_2; • Use of high speed diesel (HSD) with sulphur content < 0.25% in HGVs and diesel powered equipment; and • Vehicle / equipment exhausts observed to be emitting significant black smoke from their exhausts will be serviced/ replaced.	Appointed EPC Contractor	On site Project Management team and designated HSE team	Monthly report to SMIIPCL	• EPC Contractor Cost
	Noise	• Heavy machinery operations for construction works • Piling for equipment foundation • Transportation related activities	Increase in ambient noise levels	• Normal working hours of the contractor will be between 06:00 and 21:00 hours from Monday to Sunday. If work needs to be undertaken outside these hours, it should be limited to activities that do not lead to exceedance of the noise criteria at nearby NSRs; • Only well-maintained equipment should be operated on-site; • Regular maintenance of equipment including lubricating moving parts, tightening loose parts and replacing worn out components should be conducted; • The number of equipment operating simultaneously	Appointed EPC Contractor	On site Project Management team and designated HSE team	Monthly report to SMIIPCL	• EPC Contractor Cost

S. No.	Affected Aspect	Project Activity /affected area	Potential Impacts	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Approximate cost and Mitigation Cost Source
				should be reduced as far as practicable; • Equipment known to emit noise strongly in one direction should be orientated so that the noise is directed away from nearby NSRs as far as practicable; • Noisy plant (such as breakers and rollers) shall be located as far away from receptors as practicable.				
	Terrestrial Flora and Fauna	• Site preparation and related activities • Excavation for natural gas Pipeline	Habitat loss due to: • Clearance of Vegetation at natural gas pipeline • Clearance of site	• Land clearing will be kept minimum to the extent practicable for the approach road and gas pipeline; • Wherever feasible, depending upon availability of space within plant and/or along the access road, plantation activities shall be performed. • Engage with local forest department and Upazilla administration for plantation activities outside the project area. • Strict instruction should be given to the construction workers not to cut trees from the nearby areas for their fuel and timber use; • Use of LPG/ Kerosene for cooking need to be provided/ encouraged in order to reduce the impacts on vegetation from the vicinity of the Project site; • Construction workers will be given conservation and awareness training to promote sustainable resource use.	Project Management along with Appointed EPC Contractor	On site Project Management Team	Monthly report to SMIIPCL	• Project Developer and EPC Contractor Cost
5.2	Terrestrial/ Aquatic Flora and Fauna	Construction and transportation related activities	Habitat disturbance	• The ideal time to enter the Channel by vessels from main River should be preferably mid-afternoon as during this time the faunal activity reduces; • Adequate precaution should be taken during vessel navigation towards the temporary jetty to avoid any damage to *Katta fishing*. • Avoid any discharges on the river near temporary jetty area from the vessels/ barges.	Project Management along with Appointed EPC Contractor	On site Project Management Team and Designated HSE team on site	Survey report/s and monthly report to SMIIPCL	• Project Developer Cost and EPC Contractor Cost
	Transportation	• Transportation of personnel and use of road network	Disturbance to existing road users through increase in road traffic	• Avoiding peak hours for heavy vehicles movement where possible; • Speed limit within access road shall be less than 20 km/hr; • Training and awareness amongst driver's to encourage systematic parking, following traffic rules, preventing unnecessary stoppages and overtaking.	SMIIPCL and Appointed EPC Contractor	On site Project Management team and designated HSE team	Monthly report to SMIIPCL	• EPC Contractor Cost
	Community Health and Safety	• General construction activities • Influx of construction workers	• Health Impacts due to Changes in environmental conditions • Increased prevalence of disease	• Barriers will be provided to prevent ingress of persons into the construction site and also to protect public exposure to hazards associated with construction activities; • Screening, surveillance and treatment of workers, through the provision of medical facilities and, where required, immunization programmes; • Undertaking health awareness and education initiatives among workers; • Implementation of a vector control programme in labour camps and surrounding areas; • Avoiding formation of stagnant water pools in and around the site; • Prevention of larval and adult mosquito propagation through sanitary improvements and elimination of breeding habitats close to human settlements in the close vicinity of Project site; • Educating area residents and workers on risks, prevention, and available treatment for vector-borne diseases.	Appointed EPC Contractor along with Project Management	On site Project Management Team and Designated HSE team on site	Monthly Report to SMIIPCL	• EPC Contractor Cost
7.2	Community Health and Safety	Heavy traffic movement	Traffic safety	• Emphasizing safety aspects among drivers, particularly with regard to the speed limit of 20 km/hr that will be	Appointed EPC Contractor	On site Project Management	Monthly Report to SMIIPCL	• EPC Contractor Cost

S. No.	Affected Aspect	Project Activity /affected area	Potential Impacts	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Approximate cost and Mitigation Cost Source
				enforced; • Ensuring that only licensed drivers are employed by the Project; • Avoiding peak hours for heavy vehicles movement where possible; • Periodic check of vehicle fitness certificates; • Regular maintenance of vehicles and use of manufacturer approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure; • Collaboration with local communities and responsible authorities to improve signage (e.g. pedestrian crossings, speed limits etc.), visibility and awareness of traffic and pedestrian safety; and • Coordination with emergency responders to ensure that appropriate first aid is provided in the event of accidents.		Team and Designated HSE team on site		
7.3	Occupational Health and Safety	Construction activities	• Risks of accidents and fatalities to workers	• Development and implementation of site specific health and safety plan; • On job training for the workers shall be carried out; • Work permit system shall be followed; • PPE shall be provided and use of PPEs shall be enforced; • SOPs need to be developed for construction and related activities of the Plant;	HSE Team of Appointed EPC Contractor and on-site project management team	Designated Team comprising of representation from HSE /HR/ Administration of SMIIPCL	Relevant Records maintained and monthly internal report to senior management.	• EPC Contractor Cost
B	***Environmental Issues Associated with the Operation Phase***							
1.1	Soil and Sediment Quality	Waste generated from • Office and Canteens; • WTP, ETP and STP; • Gas Turbines; • Laboratories; • GT Compressors; • Lube oil systems; • DG sets; • Power house; • Workshop area; and • Infirmary	• Contamination of soil and sediment from wastes	• Wastes shall be stored in a manner that will prevent contact between incompatible wastes i.e. post compatibility checks, • Proper labelling of hazardous wastes; • Special care shall be taken in the storage areas to prevent any spillage of hazardous wastes and restrict access (except for trained staff) to such areas; • Periodic audits shall be carried out for such areas and containers; also on the segregation and collection systems and the findings will be documented and appropriate action taken against irregularities; • A spill response plan and emergency plan shall be prepared to address accidental spillages or release of hazardous wastes; and • A proper manifest record shall be maintained of waste travelling/ removed from the site; and • Disposal of hazardous waste by engaging DOE approved waste management agencies.	Project Developer/Plant Management/ Plant HSE Team	Designated Team comprising of representation from relevant departments as HSE, Operations, Administration and HR.	Monthly internal reports to top management and reporting to regulatory authorities/lenders as required.	• Plant O&M Cost
2.1	Water Resources	Wastewater discharge	• Impact on aquatic flora and fauna • Contamination of soil and sediment	• Monitoring of temperature at the discharge point at a frequency of every 15 days; • Discharge system shutdown in event that discharge temperature of effluent exceeds standard; • Storm water drainage and waste water of similar nature from different units will be treated in accordance to GOB Environment Conservation Rule (1997) Schedule 10 (Standards for Waste from Industrial Units or Project Waste) and the applicable World Bank Group environmental requirements and World Bank/IFC guidelines.	Project Design Team to implement design phase mitigation measures. Operations and Plant HSE Team to implement O&M Phase Mitigation Measures	HSE department and Operations. Study by 3rd Party agency /experts.	Records maintained and Monthly internal reports to top management and reporting to regulatory authorities/lenders as required.	• Included in Project Capital and Plant O&M Cost as mentioned above
2.2	Water Resources	Surface water abstraction	• Impact on surface	• Efforts to be made to increase the cycle of concentration	Operations team	Designated Team	Records maintained and	• Included in Project

S. No.	Affected Aspect	Project Activity /affected area	Potential Impacts	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Approximate cost and Mitigation Cost Source
			water availability	to reduce the volume of blow down and consequently the volume of make-up water required by the cooling tower.		comprising of representation from HSE and Operations	Monthly internal reports to top management	Capital and Plant O&M Cost as mentioned above
2.3	Water Resources	Storage and handling of Fuel, Oil and chemicals	• Impact on soil and ground water environment • Storm water runoff carrying contaminants to nearby low lying areas and adjoining Channel	• For minimising use of antifouling and corrosion inhibiting chemicals appropriate depth of water intake will be maintained and use of screens will be ensured; • Minimum required quantities of chlorinated biocides or alternatively intermittent shot dosing of chlorine will be practised rather than continuous low level feed; • Waste storage areas will be equipped with secondary containment and spill control measures (similar to the hazardous material storage areas) to limit impact to ground; • Liquid wastes such as waste oil, etc. will be collected and stored for recycling in cemented areas; and • All drainage/tanks, etc. will be positioned on concrete hard standing to prevent any seepage into ground.	Operations and Plant HSE Team	Designated Team comprising of representation from HSE and Operations	Records maintained and Monthly internal reports to top management	• Included in Project Capital and Plant O&M Cost as mentioned above
3.1	Air Quality	Stack emissions	• Impact on ambient air quality	• The use of continuous emission monitoring system (CEMS) equipment for the measurement of air emission levels in the exhaust stack of HRSG. CEMs will be undertaken for NOx, SO2, CO and O2; • Periodic calibration of CEMS to ensure quality data; • PM2.5 and VOCs will be monitored periodically, to ensure that these emissions are not occurring as a result of the incomplete burning of the natural gas fuel and use of HSD as fuel. • The stack shall be provided with safe access to sampling points for CEMS sampling probe as well as manual stack sampling. • HSD shall be used only during shortage of natural gas supply.	Plant HSE Team and Operations	Designated Team comprising of representation from HSE and Operations	Relevant Records maintained. Monthly internal reports to top management and reports to regulatory authorities/lenders as required.	Included in Project Capital and Plant O&M Cost
3.2	Air quality	Stack emissions	• GHG emissions	• Ensure that all equipment and machinery is maintained in accordance with manufacturer's specifications; • Higher efficiency steam turbine blade design; • Improved efficiency of auxiliary drives. Provision of CO2 emission monitoring in CEMS;	Plant HSE Team and Operations	Designated Team comprising of representation from HSE and Operations	Relevant Records maintained. Monthly internal reports to top management.	Plant O&M Cost as above
4.1	Noise	Plant operations	• Increased noise levels	• Selection of equipment with lower sound power levels (< 85 dB); • Installation of mufflers on engine exhausts and compressor components; • Installation of acoustic enclosures for equipment (e.g. gas turbine, compressor) casing radiating noise; • Buildings will be designed with improved acoustic performance and sound insulation will be provided; • Installation of acoustic barriers without gaps and with a continuous minimum surface density in order to minimize the transmission of sound through the barriers; • Barriers will be located as close to the source ,as far as practicable, to be effective; • Installation of vibration isolation for mechanical equipment; and • A noise analysis of all major plant components will be carried out during commissioning of the plant to ensure	Plant HSE Team and Operations	Designated Team comprising of representation from HSE, Operations and Grievance Redress Committee	Relevant Records maintained. Monthly internal reports to top management and reports to regulatory authorities/lenders as required.	Included in Project Capital and Plant O&M

S. No.	Affected Aspect	Project Activity /affected area	Potential Impacts	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Approximate cost and Mitigation Cost Source
				compliance with the specification and guaranteed performance as well as ambient noise levels at the receptors located in the surroundings.				
5.1	EMF	Magnetic fields associated with transmission and distribution systems	• Potential source of Shocks	• Occupational health and safety EMF standards in EHS guidelines on thermal power and electric transmission lines shall be adhered to	Plant Operations	Designated Team comprising of representation from HSE, Operations	Relevant Records maintained. Monthly internal reports to top management.	Plant O&M Cost
6.1	Aquatic ecology	Plant Operations	• Surface water abstraction	• The water intake structure should have multiple size screen barriers to avoid impingement or entrainment of aquatic organism; • Usage of barrier nets (seasonal or year-round), fish handling and return systems, fine mesh screens, and wedge-wire screens, and aquatic filter barrier systems should be explored in the water intake system.	Plant HSE Team and Operations	Designated Team comprising of representation from HSE /Operations	Relevant Records maintained and internal report to senior management.	Plant O&M Cost
6.2	Aquatic Ecology	Plant operations	• Discharge of cooling water	• Options for discharging water should use multiple port diffusers instead of the single point discharge should be explored; • Usage of biocides should be reduced and kept to the extent required. Monitoring of the same in waste water discharge is suggested before reaching the Meghna River; • Daily monitoring of temperature at intake and discharge points; • Discharge system shutdown in the event that effluent temperature difference exceeds 3°C; • Maintain the cooling water chemistry at more than 3 cycles of concentration (COC) to reduce the volume of blow down and consequently the volume of make-up water required by the cooling tower. • Storm water drainage and waste water of similar nature from different units will be treated in accordance to GOB Environment Conservation Rule (1997) Schedule 10 (Standards for Waste from Industrial Units or Project Waste) and the applicable World Bank Group environmental requirements and World Bank/IFC guidelines. Treated wastewater will be discharged along with cooling water on land.	Plant HSE Team and Operations	Designated Team comprising of representation from HSE /Operations	Relevant Records maintained and monthly internal report to senior management and report to regulatory authorities as required.	Plant O&M Cost
9.1	Community Health and Safety	Plant operations	• Health associated risks from air emissions and wastewater release	• Same as given in 2.2, 2.2 and 2.3 and 3.1 and 3.2 (Operation Phase)	Plant HSE Team and Administration	Designated Team comprising of representation from HSE /logistics team and GRC	Relevant Records maintained and monthly internal report to senior management.	Plant O&M Cost
9.2	Occupational Health and Safety	Plant operations	• Risks of accidents and fatalities to workers	• On job training for the workers shall be carried out; • Work permit system shall be followed; • PPE shall be provided and use of PPEs shall be enforced; • SOPs need to be developed for operation and maintenance of the Plant;	Plant HSE Team and HR and Administration	Designated Team comprising of representation from HSE /HR/Administration	Relevant Records maintained and monthly internal report to senior management.	Plant O&M Cost
D	***Cumulative Impacts***							
1.1	Air Quality	Operations of all plants	• Impact on Air Quality	• Refer Section 3.1 and 3.2 (Operation Phase)				
2.1	Noise	Operations of all plants	• Increased noise levels	• Installation of vibration isolation for mechanical noise control; • Once both the plants are operational, periodic ambient	Operations Team and Plant HSE Team	Designated Team comprising of representation	Relevant Records maintained. Monthly internal reports to top	Plant O&M Cost

S. No.	Affected Aspect	Project Activity /affected area	Potential Impacts	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Approximate cost and Mitigation Cost Source
				noise monitoring is to monitor the noise levels to ensure compliance with the specification and guaranteed performance at noise generating sources as well as ambient noise levels at the receptors located in the surroundings. • Review of noise guarantees and supporting data of all equipment suppliers with interim noise reports from EPC contractor/s in order to demonstrate compliance with the applicable noise emission criteria at source/s. In case of exceedence from the specified noise limits, adequate corrective actions as may be required shall be implemented by the specific project.		from HSE, Operations and GRC	management and reports to regulatory authorities/lenders as required.	
E	***Socio-economic Impacts***							
1.1	Fishing Livelihoods	Habitat Disturbance during construction and operations phase	• Potential reduction in fishing resources and thereby a marginal reduction in come from fishing	• Monitor and disallow unregulated fishing; • Undertake monitoring of fishing livelihoods in the project's area of influence in the construction phase; • Consultations with the fishing households should be done before dredging and other site improvement activities are carried out at the Jetty location. Alternative anchorage areas should be identified and safe anchorage of their boats to be facilitated. • The reduction in fish catch for these fishing households should be compensated through cash payment during the period for which jetty is used; • Discharge water should be treated before release so that the river water does not get polluted and also the temperature of the discharge water should be maintained so that fish catch in the channel does not get reduced; and • Good management practices for compensation of fishermen in case of damage to equipment and/or any spillage.	SMIIPCL	External Third-Party	• Number of fishermen; • Adaptation in gear; • Fishing trips and income; • Fish catch Monthly reporting	Project Cost
1.2	Influx and In-migration	Construction and potential local procurement opportunities	• Local project labour requirements; • Project demand for goods and services; • Improvement in physical infrastructure; • Perception of increased economic activity	• Development of a Labour and Influx Management Plan and its implementation; • Preventing stress on local infrastructure by providing labour related infrastructure such as camps, sanitation facility, drinking water facility, etc. in accordance with local regulations as well as IFC handbook for labour accommodation; • Preparation of a detailed plan, in keeping with lender requirements, for the construction of the labour camp and the mitigation measures to be put in place • Ensure proper administrative channel to manage labour related statutory compliance, such as payment of wages, provident fund, insurance etc. as well as labour issues arising during the construction phase activities; • Manage illegal labour practices such as child labour, bounded labour or forced labour through internal vigilance mechanisms and surveillance; and • Awareness shall be generated amongst migrant labourers in maintaining congenial relations with local labourers as well as community.	EPC Contractors and HSE Department of SMIIPCL	SMIIPCL	• Number of settlements, local rents, changes in the population; • Accidents and incidents in the local community along with grievances; • Number of local workers engaged.	• Project Developer Cost and • EPC Contractor Cost
1.3	Local Economic Benefits	Execution and operation across the project lifecycle	Employment generation; Benefits of local	• SMIIPCL should develop and implement a Procurement Plan prior to the start of the construction phase	SMIIPCL	External third-party	Local indices of prices and market development	Project Cost

S. No.	Affected Aspect	Project Activity /affected area	Potential Impacts	Proposed Mitigation Measures	Responsibility for Mitigation Implementation	Responsibility for supervision of mitigation implementation	Reporting Requirements	Approximate cost and Mitigation Cost Source
			enterprise; Rent-seeking opportunities; Local stimulus; Increase in skill levels; Local community development	• Engaging closely with local NGOs to understand the key collective requirements of the surrounding community and identify one or more of the highlighted concerns which SMIIPCL will support to resolve. • Some of the collective requirements could be access to (i) clean drinking water (ii) medical consultation (iii) education, etc. • Enhance employment opportunities by maximizing utilization of the local population, as far as possible; • Communication of a clear plan of action to improve the welfare of the neighbouring community, before commencing construction works on site.			Beneficiaries of CSR Programs etc.	

7.2 *ENVIRONMENTAL MONITORING*

The environmental monitoring programme has been devised with the following objectives:

- To evaluate the effectiveness of the proposed mitigation measures and the protection of the ambient environment as per prescribed/ applicable standards for the Project;
- To identify the need for improvements in the management plans;
- To verify compliance with statutory and community obligations; and
- To allow comparison against baseline conditions and assess the changes in environmental quality in the Project AOI.

7.2.1 *Performance Indicators and Monitoring Schedule*

Physical, biological and social environmental management components of particular significance have been identified as performance indicators. A comprehensive monitoring plan for each performance indicator has been prepared for all phases of the Project and is presented in *Table 7.2*. This includes parameters to be measured, methods to be used, sampling locations, frequency of measurements, detection limits, cost and responsibilities for implementation and supervision.

7.2.2 *Reporting Mechanism for Environmental and Social Monitoring Program*

A robust reporting system will provide the Project with the necessary feedback mechanisms to ensure quality and timely implementation of the works. The reporting system will ensure regular flow of information from the Project site to the Project headquarters and, as necessary, to regulatory authorities and funding agencies. The reporting system will provide a mechanism to ensure that the measures proposed in the Project's ESMP are implemented.

Before the civil works start, the HSE Division of the Project Sponsor (SCL), in association with SMIIPCL, will finalise the format for reporting on the status and progress of environmental monitoring. The format will be designed to meet all the compliance conditions associated with the environmental clearance from the Department of Environment and the Government of Bangladesh. The contractor will be required to submit the duly filled up reporting form on a monthly basis to the Project Developer (i.e., SMIIPCL). A further report, detailing the results of pollution monitoring for air, noise, soil, and water will be submitted quarterly as envisaged in the monitoring plan. A health and safety incident/accident report will be prepared and submitted in the event of an incident or accident. Independent verification of the effectiveness of the mitigation measures by the EPC contractor during the construction phase can be done by SMIIPCL HSE team with a periodic third party audit.

During the operation phase of the Project, the Operations Manager and HSE Personnel will monitor the effectiveness of the EMP implementation. The Project Administration and Human Resources (HR) Manager will have additional responsibility of monitoring the implementation of social components of the ESMP. He/ she will also responsible for implementation of livelihood restoration and corporate social responsibility (CSR) activities to be conducted by SMIIPCL. Both Operations Manager and HR Manager will further report to the Plant Manager, who will be overall in-charge of the Plant operations and management.

The quarterly reports of the management measures will form an integral part of the Quarterly Progress Reports that can be submitted to the lenders. Additional compliance reports to the Regional Office and Head Office of the DOE required as a part of environmental clearance process shall also be prepared and submitted based on the necessary monitoring and reporting formats.

Table 7.2 Environmental Monitoring Programme (Construction and Operation Phase)

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
Site Preparation and Construction Phase							
General	Inspection of mitigation compliance	General compliance with mitigation measures presented in the ESMP and as specified in EPC Contractor Manual	Project activity areas[1] and construction workers camp	Visual inspection of all active work areas	Daily	HSE Team of EPC Contractor	EPC Contractor Cost [1 x HSSE Manager & 2 x HSSE Supervisor]
Soil	Contamination of soil and sediment	**Soil:** pH, salinity, NH_4^+, total P, heavy metals, oil & grease **Sediment:** pH, heavy metals, oil & grease, sediment oxygen demand (SOD), total organic carbon (TOC), loss of ignition (LOI), total petroleum hydrocarbon (TPH)	Construction site or laydown area or spill area, run-off	Standard analytical methods	In the event of any leakage or spillage of hazardous substances, oil, or toxic chemicals	3rd Party Environmental Consultant	BDT 200,000/ monitoring (EPC Contractor Cost)
Water	Contamination of surface water	Turbidity, pH, DO, Total dissolved solids, oil & grease, total coliform, heavy metals	Near Temporary Jetty and near water intake and outfall structures	Standard analytical methods	Monthly	3rd Party Environmental Consultant	BDT 660,000/ annum (EPC Contractor Cost)
	Ground water	Drinking water	Groundwater wells	Standard	Once every	3rd Party	BDT 1,632,000/

(1) [1] Activity areas are defined as Project site, access road, oil handling jetty, waterway and gas pipeline RoW.

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
	quality	quality parameters as per Schedule 3 of ECR 1997	to be used for drinking water supply during this phase	analytical methods	fortnight	Environmental Consultant	annum (EPC Contractor Cost)
Ambient Air Quality	Dust generation	SPM and PM_{10}	Identified ASRs within 200 m from the construction site (3 locations)	24-hour	Quarterly	3rd Party Environmental Consultant	BDT 400,000/ annum (EPC Contractor Cost)
	Vehicle exhaust	$PM_{2.5}$, NO_2, SO_2, CO	Identified ASRs within 100 m from the activity areas (2 locations)	24-hourly monitoring of PM2.5 and SO2 and 1-hourly monitoring of NO2 and CO	Quarterly	3rd Party Environmental Consultant	BDT 350,000/ annum (EPC Contractor Cost)
Noise	Increase in ambient noise levels	Noise levels in Leq, Leq day, Leq night and hourly Leq	Identified NSRs within 200 m from the activity area/s (5 locations)	24-hour	Quarterly	3rd Party Environmental Consultant/ In-house monitoring	BDT 100,000/ annum (EPC Contractor Cost)
Occupational Health and Safety	Accidents or incidents due to construction activities, workers' health	Near-misses, incidents, occupational diseases, dangerous occurrences	Project activity areas and construction workers camp	As defined in construction phase Health & Safety Plan to be prepared by EPC contractor	As defined in H&S Plan	HSE Team of EPC Contractor	EPC Contractor Cost [1 x HSSE Manager & 2 x HSSE Supervisor]
Community Health and Safety	Community disturbance and potential safety hazard due to road traffic	Accidents, incidents and complaints	Access Road connecting site	Incidents, accidents and community complaints	Based on occurrence	HSE and/or Community Liaison Officer of EPC Contractor	EPC Contractor Cost [1 x HSSE Manager; 2 x HSSE Supervisor; 1 x Liaison Officer]
	Public concerns	Complaints from community	Neighbouring communities	As per the grievance redress	Continuous	SMIIPCL	Grievance Management

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
			around the Project activity areas	mechanism			Budget of SMIIPCL
Aquatic Ecology	Impact on habitat of aquatic and riverine fauna due to spillage	Habitats and Disturbance to aquatic fauna	Near temporary jetty , transportation route, and intake structure	Identification by experts and visual inspections	Prior to start of work and Continuous visual inspection	SMIIPCL	BDT 300,000/ (EPC Contractor Cost)
	Impact on Reptiles due to trawlers and barges	Habitats and Disturbance to aquatic fauna	temporary jetty, transportation route	Visual monitoring	Continuous during unloading operations at temporary jetty area and transportation route	SMIIPCL	EPC Contractor Cost
Operation Phase							
General	Inspection of mitigation compliance	General compliance with mitigation measures presented in the ESMP and operational manual	Project activity areas	Visual inspection of all active work areas	Daily	Plant HSE Team	Included in operation and maintenance (O&M) cost
Soil	Soil and Sediment Contamination	**Soil:** pH, salinity, NH_4^+, total P, heavy metals, oil & grease **Sediment:** pH, heavy metals, oil & grease, sediment oxygen demand (SOD), total organic carbon (TOC), loss of ignition (LOI),	In waste storage area, and sediment of Meghna River, as applicable	Standard analytical methods	In case of Accidental spillage	3rd Party Environmental Consultant	BDT 200,000/ monitoring (O&M Cost)

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
		total petroleum hydrocarbon (TPH)					
Water	Ground water quality	Drinking water quality parameters as per Schedule 3 of ECR 1997	Borewell water to be used for domestic purposes	Standard analytical methods	Monthly Half yearly	In-house laboratory 3rd Party Environmental Consultant/	O&M Cost BDT 50,000/ annum
	Wastewater	Temperature, chlorine, pH, BOD5, COD, oil & grease, heavy metals, total faecal coliform	Outlet of discharge channel	Standard methods	Daily Half yearly	In-house laboratory 3rd Party Environmental Consultant/	O&M Cost BDT 50,000/ annum
	Surface water quality	Temperature, conductivity, pH, DO, TDS	5 stations (at 0 m, 50 m and 100 m from the point of discharge of effluent on upstream and downstream)	Potable water quality analyser	Fortnightly Half yearly	In-house laboratory 3rd Party Environmental Consultant/	O&M Cost BDT 50,000/ annum
	Cooling water	Temperature	Intake pipeline inlet and discharge pipeline outlet	Thermistor	Continuous	In-house laboratory	Installation included in EPC Cost Monitoring and maintenance in O&M cost
Air Emissions	Stack emissions	NOx, CO, $PM_{2.5}$ and O_2	Main stack and by-pass stack	CEMS	Continuous	SMIIPCL	Installation included in EPC Cost Monitoring and maintenance in O&M cost
	Emission	CEMS validation	Main stack and by-	Standard methods	Annual	3rd Party	BDT 100,000/

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
	concentrations	for NOx, CO and $PM_{2.5}$	pass stack			Environmental Consultant	annum (O&M Cost)
	Ambient air quality	NOx, CO, PM_{10}, $PM_{2.5}$, SO_2	3 locations at the plant boundary with continuous ambient air quality monitoring stations	CAQMS	Continuous	SMIIPCL	Installation included in EPC Cost Monitoring and maintenance in O&M cost
	Ambient air quality	NOx, CO, PM_{10}, $PM_{2.5}$, SO_2	5 locations within 2 km from the Project boundary (Select from the locations where baseline ambient air quality was performed)	Standard methods	Half yearly	3rd Party Environmental Consultant	BDT 500,000/ annum
Noise	Noise generation by Plant equipment	Sound Pressure Level	1 m from the noise generating equipment (For all the noise sources greater than 70 dB(A) noise level)	Noise monitor	Monthly Annual	In-house laboratory 3rd Party Environmental Consultant	O&M Cost BDT 50,000/ annum
	Ambient noise	Ambient noise levels	At Project boundary and at nearest noise sensitive receptors in all direction from the Plant	Noise monitor with data logger (24-hour observations with hourly noise levels)	Half yearly	3rd Party Environmental Consultant	BDT 50,000/ annum
EMF	EMF	EMF standards	Transmission line		Annual	SMIIPCL	O&M Cost
GHG Emissions	Climate change	GHG production	Plant control room	CEMS records of CO2 emission and fuel consumption	Annual	SMIIPCL	No cost
Aquatic Ecology	Impact on Fishes and riverine flora and fauna	Fish count, phytoplankton's, zooplanktons numbers	Upstream , downstream of discharge point in Meghna River	Abundance of aquatic flora and fauna	Once post 2 years of commercial operation of the plant through experts	SMIIPCL by engaging Aquatic Ecology Expert/ Agency	BDT 500,000 (O & M Cost)

Project Stage/ Affected Component	Potential Impact	Parameters to be Monitored	Location	Measurements	Frequency	Responsibility	Cost
	Aquatic ecology	Visible fish kills	Water intake and outlet and downstream of Meghna River	Visual inspection and consultation with fishermen	Monthly	Plant HSE Team	O&M Cost
	Aquatic Ecology	Phytoplankton, zooplankton and benthos	Upstream , downstream of Meghna River	Abundance and species composition	Half yearly	SMIIPCL by engaging Aquatic Ecology Expert/ Agency	BDT 200,000/ annum O&M Cost
Community Health and Safety	Community disturbance and potential safety hazard due to road/ waterway traffic	Accidents, incidents and complaints	Access Road, Meghna River	Incidents, accidents and community complaints	Based on occurrence	HSE and/or Community Liaison Officer of SMIIPCL	O&M Cost
	Discharge of effluent and cooling water	Accidents, incidents and complaints	Adjoining Channel	Incidents, accidents and community complaints	Based on occurrence	HSE and/or Community Liaison Officer of SMIIPCL	O&M Cost
	Public concerns	Complaints from community	Neighbouring communities around the Project activity areas	As per the grievance redress mechanism	Continuous	Community Liaison Officer of SMIIPCL and Station Manager	O&M Cost
CSR Activities	Community Development	Activities/ Programmes and No. of beneficiaries	Vulnerable Groups around the Project activity areas	No. of beneficiaries and outcome of the activities	Periodic and need based	Admin/ HR Manager and Station Manager	CSR Budget

The ESMP (mitigation plan) will be included in the construction contract and the contractor will be responsible for implementation of the measures associated with design and construction. The Project Developer's staff, specifically the HSE Officer and Site Engineer, will monitor the implementation of these mitigation measures by the contractors at the site. These two officers will be responsible for the field level monitoring of the Project.

The roles and responsibilities of the Project Developer (SMIIPCL) and EPC Contractor for implementation and monitoring have been outlined in ***Table 7.3***. The flow diagram depicting the institutional arrangement for implementation of the ESMP is presented in ***Figure 7.1***.

Table 7.3 ***Roles and Responsibilities of Project Developer and EPC Contractor***

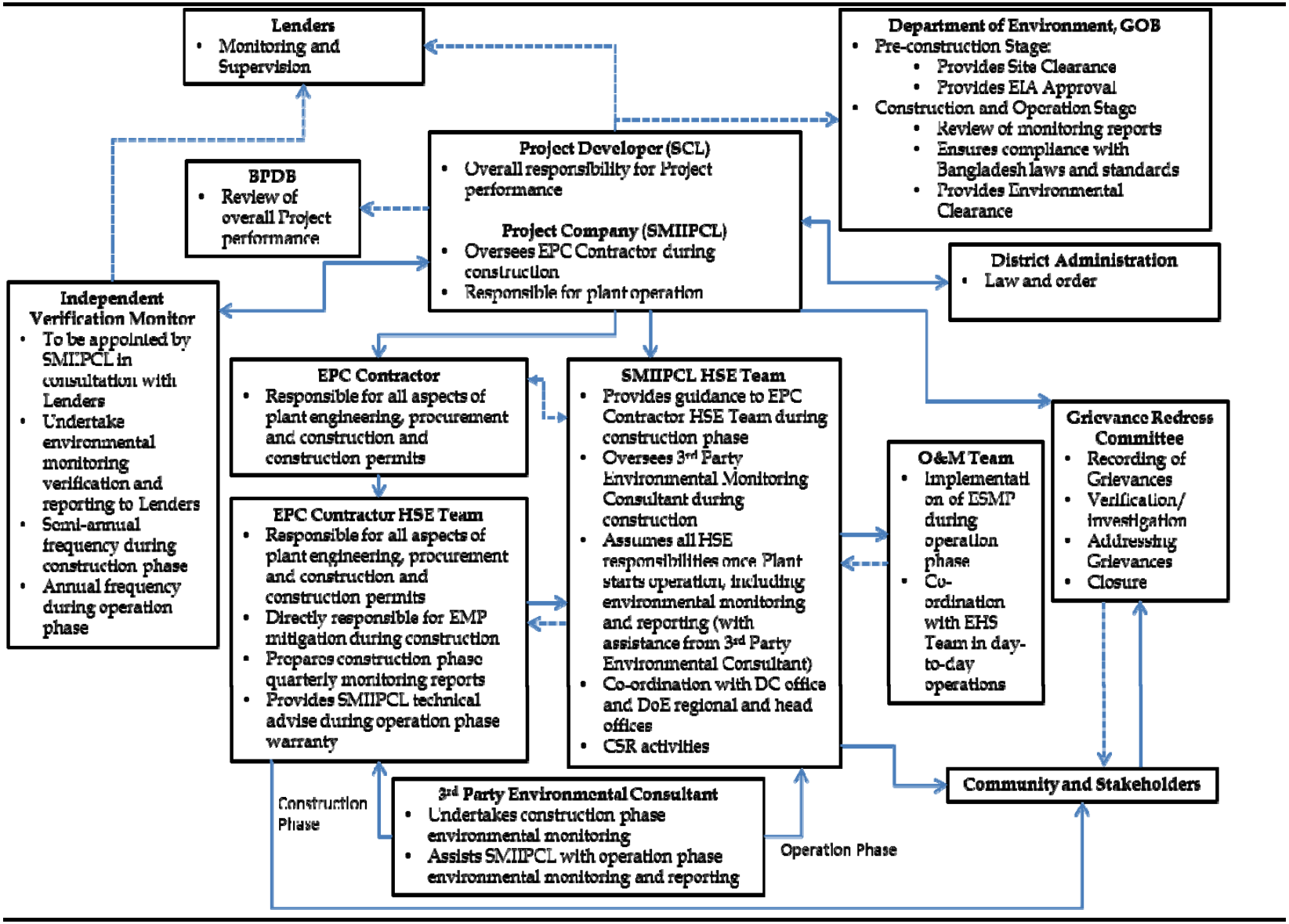
Project Developer (SMIIPCL)	EPC Contractor
Obtaining statutory clearances required during pre-construction stage of the Project	Obtaining permits required during the construction stage
Overall project co-ordination and management through EPC and supported by the third party environmental consultant/s	Joint verification with Project Developer and Third Party Environmental Consultant for review of ESMP implementation
Interaction and reporting to the respective department of GOB	Interaction with Project Developer and appointed supervision consultant, if any
Interaction and reporting to lenders	Filling of reporting formats as per the reporting schedule and submission to Project Developer
Effective implementation of ESMP and monitoring of ESMP implementation	Environmental monitoring through Third Party Environmental Laboratory
Carryout verification/ supervision exercises during the construction phase of the Project for implementation of ESMP	Preparation of various plans for effective implementation of ESMP as detailed out in the "Specification Manual" by the Project Developer
Keeping records of all permits obtained by EPC Contractor	Identification of site for labour camp, batch mix plant, laydown areas
Overall supervision of ESMP implementation	Management of labour camp and to provide drinking water, sanitation facility
Approval of plans prepared by EPC Contractor	
Addressing grievances of local community and information dissemination	
Environmental monitoring through laboratory	

While the contractor or a particular party is responsible for physical implementation of the mitigating measures, the whole implementation process requires supervision, checking, documentation and verification so that problems are identified and properly addressed before they get out of hand. In order to ensure proper execution of the ESMP, implementation reviews will be conducted by the project engineer such as the weekly construction meetings, construction log book, monthly and other construction reports etc.

Records of these minutes of the weekly meeting, monthly reports and special reports on implementation of the mitigating measures will also be maintained and available for review by the Project management.

It is suggested to identify documents and records that require templates and accordingly suitable templates shall be developed, which shall include but not limited to policies, procedures and work instructions, meeting minutes, monitoring results, training attendance records, emergency contract lists, action plans etc. Further, all these templates shall be communicated to all potential users. All these records will be archived at the Project office and will be maintained by the HSE officer. All documents and records shall be archived with a unique identifier so that they can be distinguished from any other material and can be easily retrieved. SMIIPCL will document the process for creating, allocating and approving unique identifiers and will communicate this to relevant staff.

Figure 7.1 *Organization Chart for Environmental and Social Management and Reporting Responsibilities during Construction and Operation Phase of the Project*



7.4 TRAINING

7.4.1 Construction Phase

Prior to commencement of major civil works at site, a suitably qualified in-house/ external expert will be appointed by the EPC contractor in consultation with SMIIPCL to develop and deliver a training program on implementation of the EMP, environmental monitoring and reporting in line with the applicable reference framework for the Project. The training will include the following topics:

- Environment, Health and Safety Policy of the EPC contractor;
- Environment and fundamentals of environmental pollution in relation to the Project;
- HSE management plans prepared by the EPC Contractor;
- Do's and Don'ts for the construction workers;
- Safety procedures and guidelines;
- Internal reporting and response system;
- Hazardous chemicals and waste handling;

In addition, specific training will be provided to the team involved in environmental monitoring and reporting, which will include:

- Applicable environmental guidelines and standards;
- Sampling site selection guidelines in line with environmental monitoring plan;
- Sample collection, storage, transportation and analysis procedures;
- Solid and hazardous waste management;
- Quality assurance and quality control;
- Environmental monitoring report preparation

The training will help in capacity building and implementation of the EMP during the construction phase of the Project. It will also help in ensuring internal and external monitoring and verification of the environmental performance of the Project. The reporting and verification during the construction phase will be semi-annual and the reports will be submitted to the DOE and the Lenders.

7.4.2 Operation Phase

Prior to the commencement of the Plant operation, a suitably qualified in-house/ external environmental expert will be engaged by SMIIPCL to develop and deliver a training program on operation phase environmental monitoring and reporting. The topics will be mostly same as that during the construction phase. However, it will also include following modules, which are specific to the operation phase:

- Continuous emission monitoring;

- Wastewater and thermal discharge monitoring;
- Aquatic ecology monitoring;
- Hazardous chemicals and waste management;
- Occupational health and safety programs;

The training will help in capacity building and implementation of the EMP during the operation phase of the Project. It will also help in ensuring internal and external monitoring and verification of the environmental performance of the Project. The reporting and verification during the operation phase will be annual and the reports will be submitted to the DOE and the Lenders.

7.5 PLANS FOR CONSTRUCTION AND OPERATION PHASE OF THE PROJECT

7.5.1 Construction Phase

Prior to the beginning of major land works, the EPC contractor in cooperation with Project Developer will develop the Construction Management Plan and Health and Safety Management Plan. These plans need to follow ***the Terms of Reference (ToR) defined in the Corporate ESMS of SCL***, which will also be adopted by SMIIPCL. Key requirements of these plans are presented below:

Health and Safety Plan

The EPC Contractor will prepare and implement a Health and Safety Plan prior to commencing work. This plan will include method statements for work activities, plant utilisation, construction sequence and safety arrangements. Measures will be implemented to reduce the likelihood and consequence of the following hazards:

- falling from height;
- falling into water;
- entanglement with machinery;
- tripping over permanent obstacles or temporary obstructions;
- slipping on greasy or oily walkways;
- falling objects;
- asphyxiation;
- explosion;
- contact with dangerous substances;
- electric shock;
- variable weather conditions;
- lifting excessive weights; and
- traffic operations.

Construction Environmental Management Plan

The EPC Contractor will prepare and implement a Construction Environmental Management Plan prior to commencing work to manage the construction related environmental aspects as waste management, sanitation aspects, water conservation etc.

Framework Management Plans

Following framework management plans are provided in this ESIA report for guidance to the EPC contractor and SMIIPCL to develop detailed management plans prior to start of construction activities:

- Pollution Prevention Management Plan
- Waste Management Plan
- Traffic Management Plan
- Emergency Response Plan
- Construction Labour Management Plan
- Stakeholder Engagement Plan
- Grievance Redressal Plan

During the construction stage, EPC contractor will be responsible for developing and implementing these plans, whereas SMIIPCL project management team and EHS officer/s will monitor the implementation of these plans. These framework management plans are provided in ***Annex H***.

7.5.2 Operation Phase

During the operation phase of the Project, SMIIPCL will develop the following plan/ management systems for effective operation of the Plant:

HSE and Social Management System

The Project Developer will develop and implement an HSE and Social Management System (HSE&SMS) to international guidelines for the entire Plant premises and its impact zones (project area of influence as defined under IFC PS) within two (2) years of commissioning the Plant.

Waste Management Plan

For effective segregation, handling, storage and disposal of solid and hazardous wastes generated from the Plant operations, a waste management plan will be developed by SMIIPCL.

Spill Response and Emergency Plan

The Project Developer will prepare a spill response and emergency plan to address accidental spillages or release of hazardous wastes.

Emergency Response and Disaster Management Plan

Based on the outcome of the consequence analysis as well as detailed quantitative risk assessment of the Project after finalisation of project design, an emergency response and disaster management plan will be developed by SMIIPCL. This will define protocols to be followed in the event of emergencies or disasters in order to limit the impact on the employees and the local

community. The plan will address both on-site and off-site emergency situations due to the operation of the project. The plan will disclose potential disasters and potential risks from the plant to the local community as well as the plan of action on emergency protocol in the event of any such eventuality. This will also include awareness programs for the Plant personnel, local community and local administration.

7.6 *INSPECTION, MONITORING AND AUDIT*

Inspection and monitoring of the environmental impacts of the Project activities will increase the effectiveness of ESMP. Through the process of inspection and auditing, SMIIPCL must ensure that the conditions stipulated in various permits are complied. The entire process of inspections and audits should be documented. The inspection and audit findings are to be implemented by the site in-charge in their respective areas.

7.7 *REPORTING AND DOCUMENTATION*

SMIIPCL will develop and implement a programme of reporting through all stages of the project cycle. Delegated personnel shall require to fully complying with the reporting programme in terms of both timely submissions of reports as per acceptable level of detail. Reporting will be done in form of environmental check list, incident record register, environmental and social performance reports (weekly, monthly, quarterly, half yearly, yearly etc.).

7.7.1 *External Reporting and Communication*

The EHS head is responsible for ensuring that communication with regulatory agencies and stakeholders are maintained as per the requirement. All complaints and enquiries are to be appropriately dealt with and records should be maintained in a Complaint/Enquiry Register by the delegated staff of EHS.

7.7.2 *Internal Reporting and Communication*

Inspection and audits finding along with their improvement program are to be regularly reported to the senior management for their consideration. The same are also to be communicated with the staff working on the project.
To maintain an open communication between the staff and management on EHS and social issues the followings are being used:

- Team Briefings;
- On-site work group meetings;
- Work Specific Instructions; and
- Meeting with stakeholders.

7.7.3 Documentation

Documentation is an important step in implementing ESMP. SMIIPCL will establish a documentation and record keeping system to ensure recording and updating of documents per the requirements specified in ESMP. The documents should be kept as hardcopies as well as in electronic format. Responsibilities have to be assigned to relevant personnel for ensuring that the ESMP documentation system is maintained and that document control is ensured through access by and distribution to, identified personnel in form of the following:

- Master Environment Management System document;
- Operation control procedures;
- Work instructions;
- Incident reports;
- Emergency preparedness and response procedures;
- Training records;
- Monitoring reports;
- Auditing reports; and
- Complaints register and issues attended/closed.

7.8 ESMP REVIEW AND AMENDMENTS

The ESMP acts as an environment and social management tool which needs to be reviewed periodically to address changes in the organisation, process or regulatory requirements. Following a review, the EHS head of SMIIPCL will be responsible for making the amendments in the ESMP. The amended ESMP will be communicated to all the staff.

7.9 BUDGET

The EPC Contractor and SMIIPCL will allocate separate budget for environmental and social management plan implementation, training, environmental monitoring, analysis and reporting, verification monitoring and capacity building. It should be noted that costs for many in-built mitigation measures, such as, acoustic enclosures for noise control, water and wastewater treatment, CEM, etc., are already included in the EPC contract cost estimate and/or operating cost estimates. In addition, separate budget will be allocated for CSR activities, which will be conducted by the Project Developer for community development. The budget estimate for the 3rd party monitoring and/or verification has been included in Table 7.2.

8 RISK ASSESSMENT

This section on Risk Assessment (RA) aims to provide a systematic analysis of the major risks that may arise as a result of the proposed duel fuel based (RLNG and HSD) combined cycle power plant (CCPP) in Meghnaghat Power Hub (also referred as Summit M2 Project), in Narayanganj District of Dhaka Division, Bangladesh. The RA process outlines rational evaluations of the identified risks based on their significance and provides the outline for appropriate preventive and risk mitigation measures. The output of the RA will contribute towards strengthening of the Emergency Response Plan (ERP) in order to prevent damage to personnel, infrastructure and receptors in the immediate vicinity of the plant. Additionally, the results of the RA can also provide valuable inputs for keeping risk at As Low As Reasonably Practicable (ALARP) and arriving at decisions for mitigation of high risk events.

The following section describes the objectives, methodology of the risk assessment study and an assessment for each of the potential risks separately. This includes identification of major hazards, hazard screening and ranking, frequency and consequence analysis for major hazards. The hazards have been semi-quantitatively evaluated through a criteria base risk evaluation matrix. Risk mitigation measures to reduce significant risks to acceptable levels have been recommended as a part of the risk assessment study.

8.1 RA STUDY OBJECTIVE

The primary objective of this RA with respect to the proposed project involves identification and evaluation of major risks, prioritizing risks identified based on their hazard consequences and using the outcome to guide and strengthen both onsite and offsite ERP. Hence in order to ensure effective management of any emergency situations that may arise from failure of natural gas supply pipelines, sulphuric acid and hydrogen storage[1], the following specific objectives need to be achieved.

- Identify potential hazard scenarios that may arise from storage of hydrogen, sulphuric acid and supply of natural gas via pipelines;
- Review existing information and historical databases to arrive at possible likelihood of such risk scenarios;
- Predict the consequences of such potential hazard scenarios and if consequences are observed to be high, establish the same through application of quantitative simulations; and

[1] The diesel will be delivered by barges to the existing jetty on the Meghna River of Summit M1 project and will be stored in existing tank farm of Summit M1 project. No new jetty/ tank farm is proposed for Summit M2 project hence risk related to such storage has not been considered in this report.

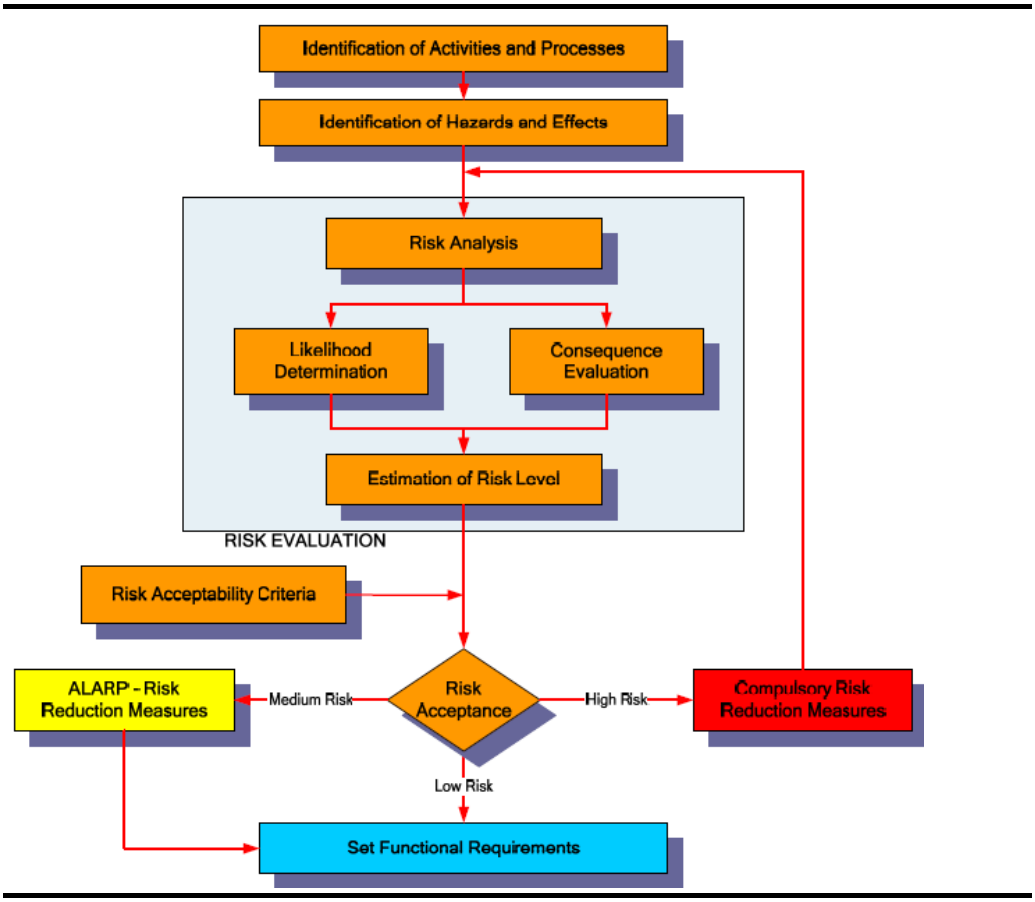
- Recommend feasible preventive and risk mitigation measures as well as provide inputs for strengthening of the project Emergency Response Plan (ERP).

8.2 RA METHODOLOGY

The risk assessment process is primarily based on likelihood of occurrence of the risks identified and their possible hazard consequences particularly being evaluated through hypothetical accident scenarios. With respect to the proposed project, major risks viz. leaks and rupture of hydrogen & sulphuric acid storage tanks, and natural gas pipelines been assessed and evaluated through a risk matrix generated to combine the risk severity and likelihood factor. Risk associated with the proposed dual fuel based power project have been determined semi-quantitatively as the product of likelihood/probability and severity/consequence by using order of magnitude data (*risk ranking = severity/consequence factor X likelihood/probability factor*). Significance of such project related risks was then established through their classification as high, medium, low, very low depending upon risk ranking.

The risk matrix is widely accepted as standardized method of risk assessment and is preferred over purely quantitative methods, given that it's inherent limitations to define a risk event is certain. Application of this tool has resulted in the prioritization of the potential risks events for the existing operations and proposed expansion thus providing the basis for drawing up risk mitigation measures and leading to formulation of plans for risk and emergency management. The overall approach is summarized below in ***Figure 8.1.***

Figure 8.1 Risk Assessment Methodology



8.3 HAZARD IDENTIFICATION

The first stage in any risk assessment is to identify the potential incidents that could lead to the release of a hazardous material from its normal containment and result in a major accident. This is achieved through a systematic review of the facilities to determine where a release of a hazardous material could occur from any part of the installation.

Major hazards can be generally categorized into one of three types: flammable, reactive and/or toxic. In this study, only flammable and toxic hazards are relevant involving leakage of natural gas pipeline or hydrogen gas storage tank containment failure or release of sulphuric acid vapour from tank failures. Flammable hazards may manifest as high thermal radiation from fires and overpressures following explosions that may cause direct damage, building collapse, etc. Flammable hazards are present throughout the facility and associated pipelines. Fires may occur if flammable materials are released to the atmosphere followed by ignition.

Based on the result of this exercise, potential hazards that may arise due to proposed project were identified and a semi-quantitative understanding of their probability and significance were obtained. Taking into account the applicability of different risk aspects the following hazards have been

identified with respect to the proposed project which has been dealt in detail in the subsequent sections.

- Accidental release of natural gas from pipelines leading to jet fire, flash fire or vapour cloud explosion (VCE);
- Accidental release of hydrogen from storage tank leading to jet fire and vapour cloud explosion (VCE); and
- Accidental release of sulphuric acid from storage tanks/pipe leaks leading to toxic vapour cloud dispersion.

8.3.1 Hazards from LNG Transportation Pipelines

LNG itself poses little danger as long as it is contained within storage tanks, piping, and equipment designed for use at LNG cryogenic conditions. However, vapours resulting from LNG as a result of an uncontrolled release can be hazardous, within the constraints of the key properties of LNG and LNG vapours – flammability range and in contact with a source of ignition.

There are a number of hazards that are present at the proposed project site that may result in injury to people or a fatality in more serious cases. This study is only concerned with 'major hazards', which are as follows:

- Jet fires associated with pipework failures;
- Vapour cloud explosions; and
- Flash fires.

Each of these hazards has been described below.

Jet Fire

Jet fires result from ignited releases of pressurized flammable gas or superheated/pressurized liquid. The momentum of the release carries the material forward in a long plume entraining air to give a flammable mixture. Jet fires only occur where the LNG is being handled under pressure or when handled in gas phase and the release is unobstructed.

Flash Fire

Vapour clouds can be formed from the release of flashing liquids of pressurized flammable material as well as from non-flashing liquid releases where vapour clouds can be formed from the evaporation of liquid pools or from an overfilling of storage tanks or vessels.

Where ignition of a release does not occur immediately, a vapour cloud is formed and moves away from the point of origin under the action of the wind. This drifting cloud may undergo delayed ignition if an ignition source is reached, resulting in a flash fire if the cloud ignites in an unconfined area or vapour cloud explosion (VCE) if within confined area.

Vapour Cloud Explosion

If the generation of heat in a fire involving a vapour-air mixture is accompanied by the generation of pressure then the resulting effect is a vapour cloud explosion (VCE). The amount of overpressure produced in a VCE is determined by the reactivity of the gas, the strength of the ignition source, the degree of confinement of the vapour cloud, the number of obstacles in and around the cloud and the location of the point of ignition with respect to the escape path of the expanding gases.

8.3.2 Hazards from Hydrogen

Hydrogen at room temperature and pressure is a colourless, odourless flammable gas that is lighter than air. Hydrogen has many characteristics that are significantly different from the conventional gaseous fuels, such as natural gas and the liquefied petroleum gases propane and butane, that potentially render it more hazardous to transport and store.

Hydrogen readily forms an explosive mixture with air. The range of hydrogen/air mixtures that will explode is wide. Mixtures from 4% v/v hydrogen, which is the lower explosive limit (LEL), up to 75% v/v, which is the upper explosive limit (UEL), may propagate a flame. The energy necessary to initiate a hydrogen/air explosion is also very small. The ignition energy for a 2:1 hydrogen/oxygen mixture is only about 0.02 mJ. This is less than one tenth that of other fuels such as methane, LPG or petrol. Even very small sparks, such as those produced by wearing certain types of clothing, are capable of igniting hydrogen/air mixtures and causing an explosion.

Hydrogen/air mixtures have a greater propensity to detonate than mixtures of air with other more common flammable fuels. Detonations cause much more damage and are far more dangerous than ordinary explosions (deflagrations). However, due to the rapid dispersal characteristics of hydrogen, this is only likely to occur in a confined or congested space.

8.3.3 Hazards of Sulphuric Acid

Sulphuric acid is a clear colourless material that may emit choking fumes when hot. The material is non-flammable but when in contact with other flammable materials may result in fires. Sulphuric acid can result in violent reactions with water and strong bases generating heat. It is not compatible with organic materials, chlorates, carbides, fulminates, and powdered metals. In contact with metal it releases flammable hydrogen gas that will explode if ignited in an enclosed area.

Sulphuric acid is hazardous in contact, inhalation or ingestion. Sulphuric acid can be corrosive to the skin, eyes, nose, mucous membranes, respiratory and gastrointestinal tracts, or any tissue with which it comes in contact. Severe burns can occur with necrosis, scarring and may result in death. Milder

exposures can cause irritation of the eyes, skin, mucous membranes and respiratory and digestive tracts. Chronic exposure may be associated with changes in pulmonary function, chronic bronchitis, conjunctivitis, and overt symptoms resembling acute viral respiratory tract infection. Discoloration and erosion of dental enamel can occur.

Typically the hazard posed by sulphuric acid will depend both on the concentration of such material in air and exposure duration as presented in ***Table 8.1*** as presented below.

Table 8.1 *EPRG Guideline for Sulphuric Acid Exposure*

Sl. No	EPRG-1		EPRG-2		EPRG-3	
	mg/m³	ppm	mg/m³	ppm	mg/m³	ppm
1	2	0.05	10	2.5	120	7.5

NOTE:
Emergency Response Planning Guidelines (ERPGs) as developed by the American Industrial Hygiene Association

ERPG-1: Is the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odour.

ERPG-2: Is the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.

ERPG-3: Is the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.

8.4 FREQUENCY ANALYSIS

The frequency analysis of the hazards identified with respect to the proposed project was undertaken to estimate the likelihood of their occurrences during the project life cycle. Hazard frequencies in relation to the proposed project were estimated based on the analysis of historical accident frequency data and professional judgment. Based on the range of probabilities arrived at for different potential hazards that may be encountered with respect to the supply and handling of natural gas, the following frequency categories and criteria have been defined (Refer***Table 8.2***).

Table 8.2 Frequency Categories and Criteria

Likelihood Ranking	Criteria Ranking (cases/year)	Frequency Class
5	Likely to occur often in the life of the project, with a probability greater than 10^{-1}	Frequent
4	Will occur several times in the life of project, with a probability of occurrence less than 10^{-1}, but greater than 10^{-2}	Probable
3	Likely to occur sometime in the life of a project, with a probability of occurrence less than 10^{-2}, but greater than 10^{-3}	Occasional/Rare
2	Unlikely but possible to occur in the life of a project, with a probability of occurrence less than 10^{-3}, but greater than 10^{-6}	Remote
1	So unlikely it can be assumed that occurrence may not be experienced, with a probability of occurrence less than 10^{-6}	Improbable

Source: Guidelines for Developing Quantitative Safety Risk Criteria – Centre for Chemical Process and Safety

8.4.1 Frequency Analysis – Pipeline

An effort has also been made to understand the primary failure frequencies of pressurised natural gas pipeline to be supplied to the site to serve as a fuel source. Based on the European Gas Pipeline Incident Data Group (EGIG) database the evolution of the primary failure frequencies over the entire period (1970-2013) has been provided in ***Table 8.3*** below.

Table 8.3 Primary Gas Pipeline Failure Frequency

Period	No. of Incidents	Total System Exposure (km.yr)	Primary failure frequency (1000 km.yr)
1970-2007	1173	$3.15.10^6$	0.372
1970-2010	1249	$3.55.10^6$	0.351
1970-2013	1309	$3.98.10^6$	0.329
1974-2013	1179	$3.84.10^6$	0.307
1984-2013	805	$3.24.10^6$	0.249
1994-2013	426	$2.40.10^6$	0.177
2004-2013	209	$1.33.10^6$	0.157
2009-2013	110	$0.70.10^6$	0.158

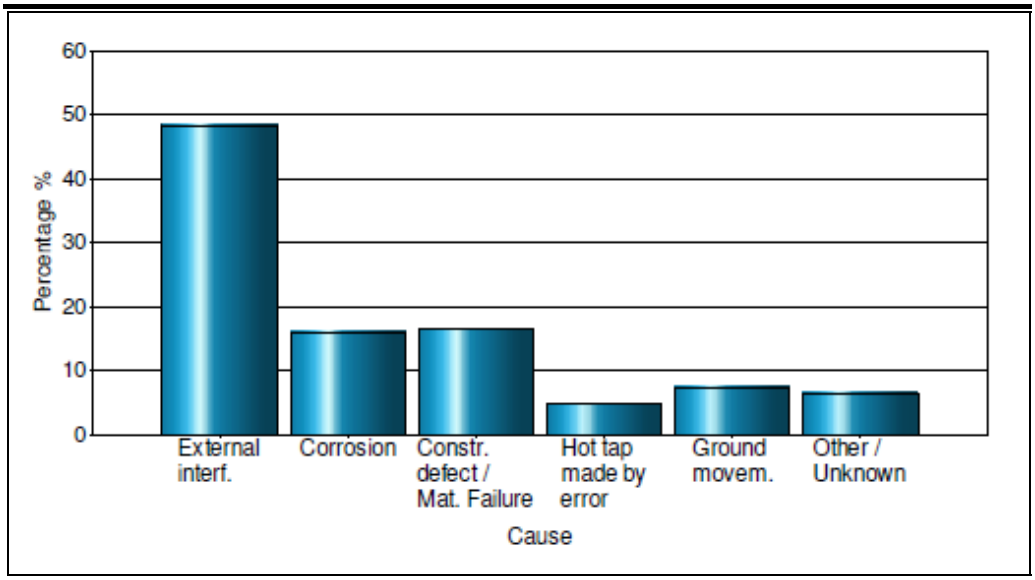
Source: 9th EGIG Report

As referred in the above table the overall failure frequency (0.33) of the entire period (1970-2013) is slightly lower than the failure frequency of 0.35 reported in the 8th EGIG report (1970-2010). The failure frequency of the last 5 years was found to be 0.16 per 1000km.year, depicting an improved performance over the recent years.

Incident Causes

Gas pipeline failure incidents can be attributed to the following major causes viz. external interference, construction defects, corrosion (internal & external), ground movement and hot tap. The distribution of incidents with cause has been presented in the ***Figure 8.2*** below.

Figure 8.2 Gas Pipeline Failure – Distribution of Incident & Causes



Source: 8th EGIG Report

The interpretation of the aforesaid figure indicated external interference as the major cause of pipeline failure contributing to about 48.4% of the total failure incidents followed by construction defects (16.7%) and corrosion related problems (16.1%). Ground movement resulting from seismic disturbance, landslides, flood etc. contributed to only 7.4% of pipeline failure incident causes.

Review of the 9th EGIG report indicates that primary failure frequency varies with pipeline diameter, and the same has been presented in ***Table 8.4*** below.

Table 8.4 Primary Failure Frequency based on Diameter Class (1970-2013)

Nominal Diameter (inch)	Primary failure frequency (per km.yr)		
	Pinhole/Crack	Hole	Rupture
diameter < 5"	4.45×10^{-4}	2.68×10^{-4}	1.33×10^{-4}
5" ≤ diameter < 11"	2.80×10^{-4}	1.97×10^{-4}	6.40×10^{-5}
11" ≤ diameter < 17"	1.27×10^{-4}	0.98×10^{-4}	4.10×10^{-5}
17" ≤ diameter < 23"	1.02×10^{-4}	5.00×10^{-5}	3.40×10^{-5}
23" ≤ diameter < 29"	8.50×10^{-5}	2.70×10^{-5}	1.20×10^{-5}
29" ≤ diameter < 35"	2.30×10^{-5}	5.00×10^{-6}	1.40×10^{-5}
35" ≤ diameter < 41"	2.30×10^{-5}	8.00×10^{-6}	3.00×10^{-6}
41" ≤ diameter < 47"	7.00×10^{-6}	-	-

Nominal Diameter (inch)	Primary failure frequency (per km.yr)		
	Pinhole/Crack	Hole	Rupture
diameter ≥ 47"	6.00 X 10^{-6}	6.00 X 10^{-6}	6.00 X 10^{-6}

Source: 9th EGIG Report

The pipeline failure frequency viz. leaks or rupture for the natural gas pipeline has been computed based on the aforesaid table. For pipeline with diameter varying within 11 to 17 inches, the probability of pinhole is estimated to be **1.27 x 10^{-4} per km year,** while full bore rupture is considered to be **4.10 x 10^{-5} per km year.**

Table 8.5 Natural Gas Pipeline - Failure Frequency

Sl. No	Pipeline Failure Case	EGIG Failure Frequency (per km.year)	Avg. Pipeline Length (km)	Project Pipeline Failure Frequency (per year)	Frequency
1	Natural Gas Pipeline Rupture	4.10 x 10^{-5}	0.5	2.05 x 10^{-5}	Remote
2	Natural Gas Pipeline Leak	1.27 x 10^{-4}	0.5	0.63 x 10^{-4}	Remote

Thus the probability of pipeline leak and rupture with respect to the pipeline transportation of natural gas as fuel to the site is identified to be as "*Remote*" (Refer ***Table 8.2***).

8.4.2 Frequency Analysis – Hydrogen Storage

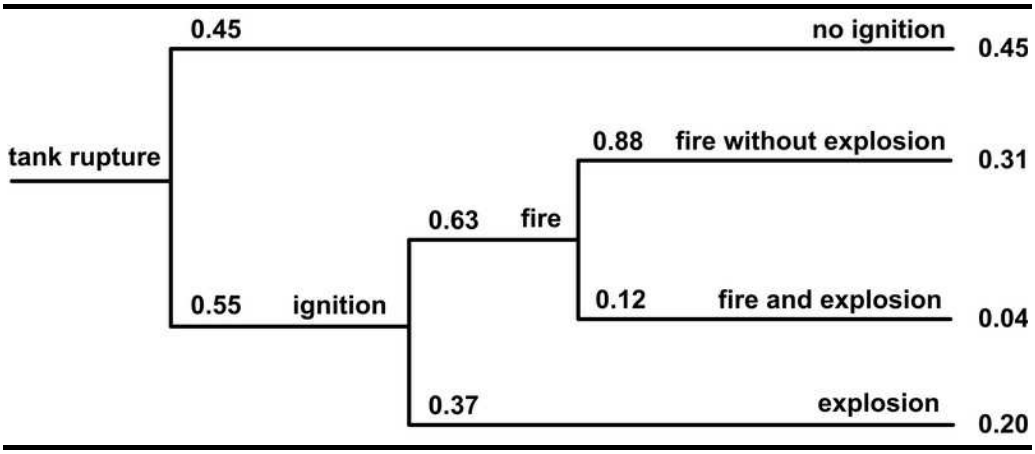
Frequencies of the event outcomes (such as explosion, fireball, etc.) for a given hydrogen release scenario are calculated by multiplying the initial frequency with the associated branch probabilities of the event tree diagram (Refer ***Figure 8.3***). Several references concluded that an unconfined space release explosion is a very unlikely event, because an explosion requires several circumstances, such as the presence of obstacles and a very strong source of ignition (>1000 Joule). According to the evaluation given by several authors[1] based on explosion accidents in the past it can be considered that the probability is 0.2 for explosion, and 0.8 for fire.

[1] Hydrogen sourcebook n.d.

Cadwallader LC, Herring JS. Safety Issues with Hydrogen as a Vehicle Fuel 1999.

Atomic I, Agency E. Hydrogen as an energy carrier and its production by nuclear power 1999

Figure 8.3 Hydrogen Release – Consequence Probabilities



Source: 8th EGIG Report

The ***Table 8.6***provides a summary of the incident outcome probabilities for hydrogen release scenarios which has been used in the present risk assessment study.

Table 8.6 Hydrogen Storage - Failure Frequency Based on Release Type

Sl. No	Type of Release	Conditional Probability on Release	Failure Rate (per year)	Frequency
1	Instantaneous	Early Explosion	4.1×10^{-8}	Improbable
2		Fireball	1.6×10^{-7}	Improbable
3		Late Explosion	8.8×10^{-10}	Improbable
4		Flash Fire	5.2×10^{-9}	Improbable
5	Continuous	Jet Fire	2.4×10^{-6}	Remote
6		Late Explosion	2.2×10^{-7}	Improbable
7		Flash Fire	8.8×10^{-7}	Improbable

Source: Hydrogen Safety Risk Assessment Methodology applied to a Fluidized Bed Membrane Reactor for Autothermal Reforming of Natural Gas N. Psara, M. Van Sint Annaland, F. Gallucci

8.4.3 Frequency Analysis – Sulphuric Acid Piping

Piping may fail as a result of corrosion, erosion, mechanical impact damage, pressure surge (water hammer) or operation outside design limitations of pressure and temperature. Corrosion- and erosion-caused failures usually result in small leaks, which are detected early and corrected. For significant failures, the leak duration may be of the order of ten to thirty minutes before detection of such events.

The generic leak frequency data for process piping is generally expressed in terms of the cumulative total failure rate per year for a 10 m section of pipe for each pipe diameter. Furthermore, the failure frequency normally decreases with increasing pipe diameter. The failure data given in Table 8.7 represent the total failure rate, incorporating all failures of whatever size and due to all probable causes. These frequencies are based on an environment where no excessive vibration, corrosion/ erosion or thermal cyclic stresses are expected.

Table 8.7 Failure Frequencies for Sulphuric Acid Piping

Sl. No	Description	Full Bore Rupture	Leak	Frequency
1	Pipeline <75mm dia	1.0×10^{-6}	5.0×10^{-6}	Remote
2	Pipeline 75mm < dia <150mm	3.0×10^{-7}	2.0×10^{-6}	Remote
3	Pipeline >150mm dia	1.0×10^{-7}	5.0×10^{-7}	Improbable

Source: TNO "Purple Book"

8.5 CONSEQUENCE ANALYSIS

In parallel with the frequency analysis, hazard prediction / consequence analysis exercises were undertaken to assess the likely impact of project related risks on onsite personnel, infrastructure and environment. In relation to the proposed project as well as the existing activities have been considered, the estimation of the consequences for each possible event has been based either on accident frequency, consequence modeling or professional judgment, as appropriate. Overall, the consequence analysis takes into account the following aspects:

- Nature of impact on environment and community;
- Occupational health and safety;
- Asset and property damage;
- Corporate image; and
- Timeline for restoration of property damage.

The following criteria for consequence rankings (Refer ***Table 8.8)*** have been drawn up in context of the possible consequences of the risk events that may occur during the proposed project operations:

Table 8.8 Severity Categories and Criteria

Consequence	Ranking	Criteria Definition
Catastrophic	5	• Multiple fatalities/permanent total disability to more than 50 persons. • Net negative financial impact of >10 crores • International media coverage • Loss of corporate image and reputation
Major	4	• Single fatality/permanent total disability to one or more persons • Net negative financial impact of 5 -10 crores • National stakeholder concern and media coverage.
Moderate	3	• Short term hospitalization & rehabilitation leading to recovery • Net negative financial impact of 1-5 crores • State wide media coverage
Minor	2	• Medical treatment injuries • Net negative financial impact of 0.5 – 1 crore • Local stakeholder concern and public attention

Consequence	Ranking	Criteria Definition
Insignificant	1	• First Aid treatment • Net negative financial impact of <0.5 crores. • No media coverage

Risk Evaluation

Based on ranking of likelihood and frequencies, each identified hazard has been evaluated based on the likelihood of occurrence and the magnitude of consequences. The significance of the risk is expressed as the product of likelihood and the consequence of the risk event, expressed as follows:

Significance = Likelihood X Consequence

The ***Table 8.9*** below illustrates all possible product results for the five likelihood and consequence categories while the ***Table 8.10*** assigns risk significance criteria in three regions that identify the limit of risk acceptability. Depending on the position of the intersection of a column with a row in the risk matrix, hazard prone activities have been classified as low, medium and high thereby qualifying for a set of risk reduction / mitigation strategies.

Table 8.9 Risk Matrix

			Likelihood →				
			Frequent	**Probable**	**Unlikely**	**Remote**	**Improbable**
			5	**4**	**3**	**2**	**1**
Consequence ↑	**Catastrophic**	**5**	25	20	15	10	5
	Major	**4**	20	16	12	8	4
	Moderate	**3**	15	12	9	6	3
	Minor	**2**	10	8	6	4	2
	Insignificant	**1**	5	4	3	2	1

Table 8.10 Risk Criteria and Action Requirements

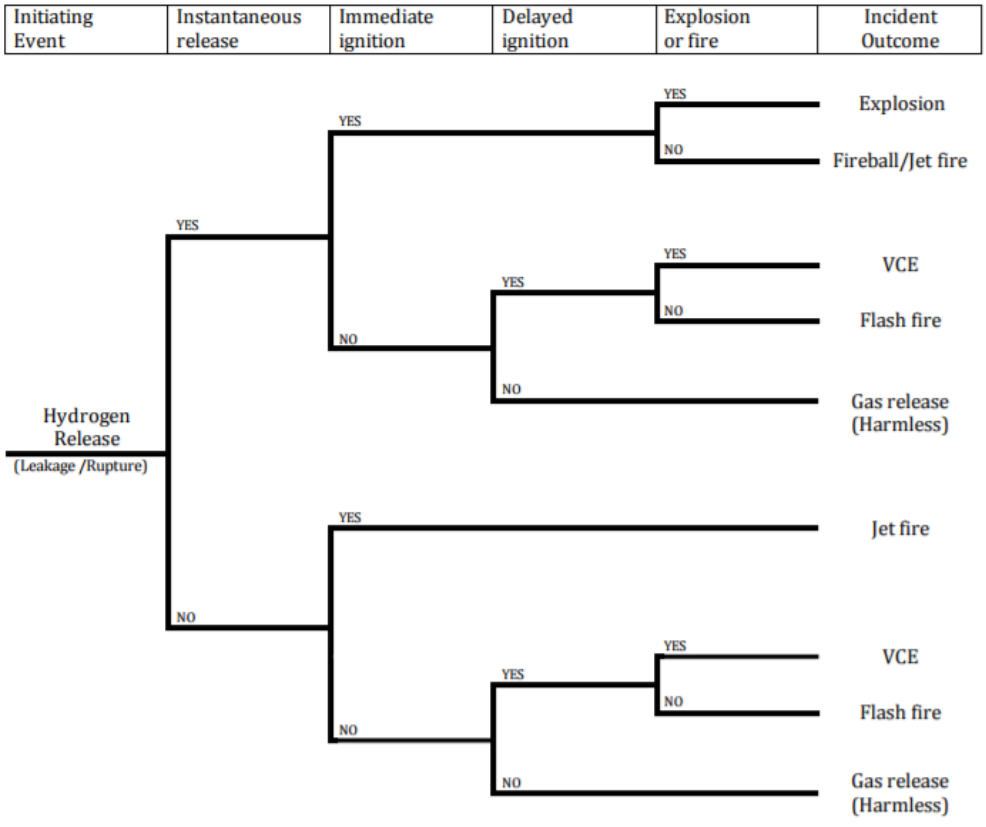
S.N.	Risk Significance	Criteria Definition & Action Requirements
1	**High (16 - 25)**	**"Risk requires attention"** – Project HSE Management need to ensure that necessary mitigation are adopted to ensure that possible risk remains within acceptable limits
2	**Medium (10 – 15)**	**"Risk is tolerable"** – Project HSE Management needs to adopt necessary measures to prevent any change/modification of existing risk controls and ensure implementation of all practicable controls.
3	**Low (5 – 9)**	**"Risk is acceptable"** – Project related risks are managed by well-established controls and routine processes/procedures. Implementation of additional controls can be considered.
4	**Very Low (1 – 4)**	**"Risk is acceptable"** – All risks are managed by well-established controls and routine processes/procedures. Additional risk controls need not to be considered

8.5.1 Consequence Analysis - Hydrogen Storage

For the case of hydrogen, a release may have many event outcomes, depending on the timing and type of ignition. For example, a hydrogen release may be ignited immediately at the point of release or it may be ignited after the cloud has been dispersed for a certain amount at time or it may not ignite at all. For a given release of hydrogen an early explosion, fireball, or jet fire outcomes may occur, if it is followed by immediate ignition. The hazards may be realised following tank overfilling, spontaneous rupture and fire events in the storage tank and ancillary equipment such as transfer pumps, metering equipment, etc. all of which can release significant quantities of flammable material on failure.

Having identified a set of top events and estimated their initial frequencies as discussed in the previous section, it is necessary to consider the range of possible consequences that could occur after the original failure, and to estimate the probabilities of alternative outcomes which can be done by using an "Event tree analysis" (ETA). ***Figure 8.4*** illustrates the event tree diagram to develop incident outcomes from a hydrogen release in the gaseous phase.

Figure 8.4 Hydrogen Release – Potential Consequences



Source: Hydrogen Safety Risk Assessment Methodology applied to a Fluidized Bed Membrane Reactor for Autothermal Reforming of Natural Gas N. Psara, M. Van Sint Annaland, F. Gallucci

Hydrogen Storage Tank - Failure Scenarios

The following representative scenarios have been considered for modelling the consequences of the hydrogen storage tank failures (Refer ***Table 8.11***).

Table 8.11 Hydrogen Storage Tank – Risk Modelling Scenarios

Sl. No	Tank	Tank Diameter (m)	Tank Height (m)	Tank Volume (KL)	Accident Scenario	Threat Modelled
1	Hydrogen Tank	2.0	12.7	40.0	10mm dia leak	Jet Fire
2		2.0	12.7	40.0	25mm dia leak	Jet Fire
3		2.0	12.7	40.0	50mm dia leak	Jet Fire
4		2.0	12.7	40.0	50% instantaneous release of total mass and ignition	VCE

The hydrogen storage tank failure risk scenarios have been modeled using ALOHA and interpreted in terms of Thermal Radiation Level of Concern (LOC) encompassing the following threshold values (measured in kilowatts per square meter) to create the default threat zones:

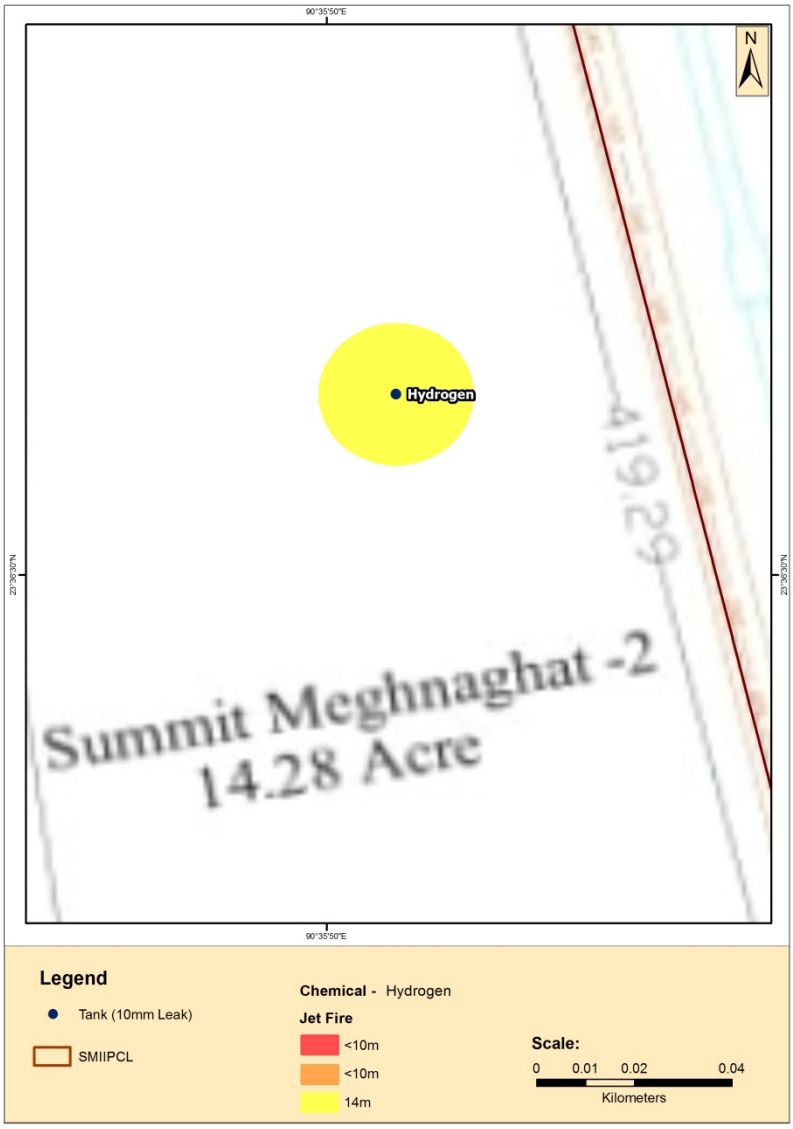
Red: 10 kW/ (sq. m) -- potentially lethal within 60 sec;
Orange: 5 kW/ (sq. m) -- second-degree burns within 60 sec; and
Yellow: 2 kW/ (sq. m) -- pain within 60 sec

For vapour cloud explosion, the following threshold level of concern has been interpreted in terms of blast overpressure as specified below:
Red: 8.0 psi – destruction of buildings;
Orange: 3.5 psi – serious injury likely; and
Yellow: 1.0 psi – shatters glass

Scenario 1: Hydrogen Storage Tank Failure – Leak of 10mm dia

The jet fire threat zone plot for release and ignition of hydrogen gas from storage tank failure (10mm dia) is represented in ***Figure 8.5*** below.

Figure 8.5 Threat Zone Plot –Hydrogen Tank Failure (10mm dia)



Source: ALOHA

THREAT ZONE:

Threat Modeled: Thermal radiation from pool fire

Red : <10 meters --- (10.0 kW/ (sq. m) = potentially lethal within 60 sec)

Orange: <10 meters --- (5.0 kW/ (sq. m) = 2nd degree burns within 60 sec)

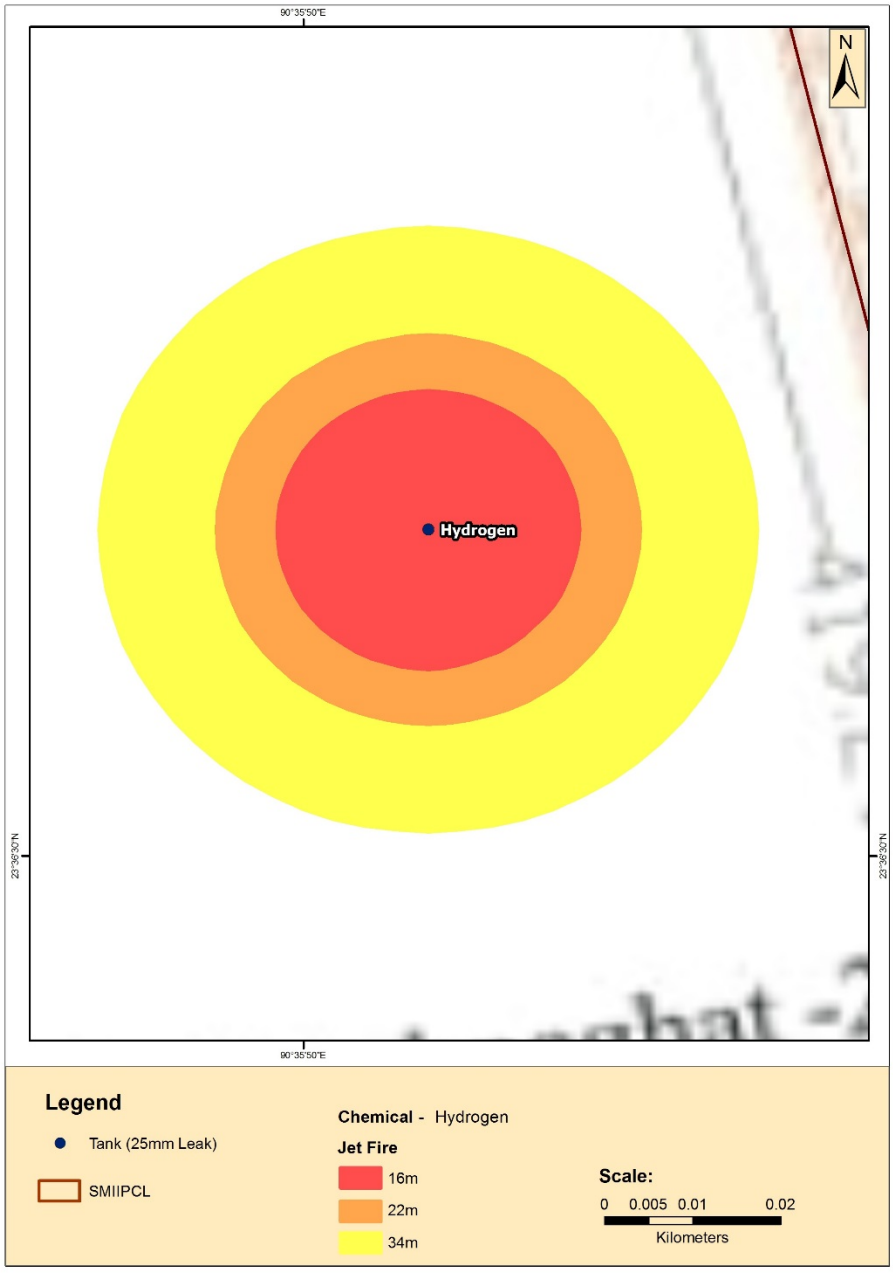
Yellow: 14 meters --- (2.0 kW/ (sq. m) = pain within 60 sec)

The worst hazard for release and ignition of hydrogen gas from storage tank leak (10mm dia) will be experienced to a maximum radial distance of <10m from the source with potential lethal effects within 1 minute.

Scenario 2: Hydrogen Storage Tank Failure – Leak of 25mm dia

The jet fire threat zone plot for release and ignition of hydrogen gas from storage tank failure (25mm dia) is represented in ***Figure 8.6*** below.

Figure 8.6 ***Threat Zone Plot –Hydrogen Tank Failure (25mm dia)***



Source: ALOHA

THREAT ZONE:

Threat Modeled: Thermal radiation from pool fire

Red : 16 meters --- (10.0 kW/ (sq. m) = potentially lethal within 60 sec)

Orange: 22 meters --- (5.0 kW/ (sq. m) = 2nd degree burns within 60 sec)

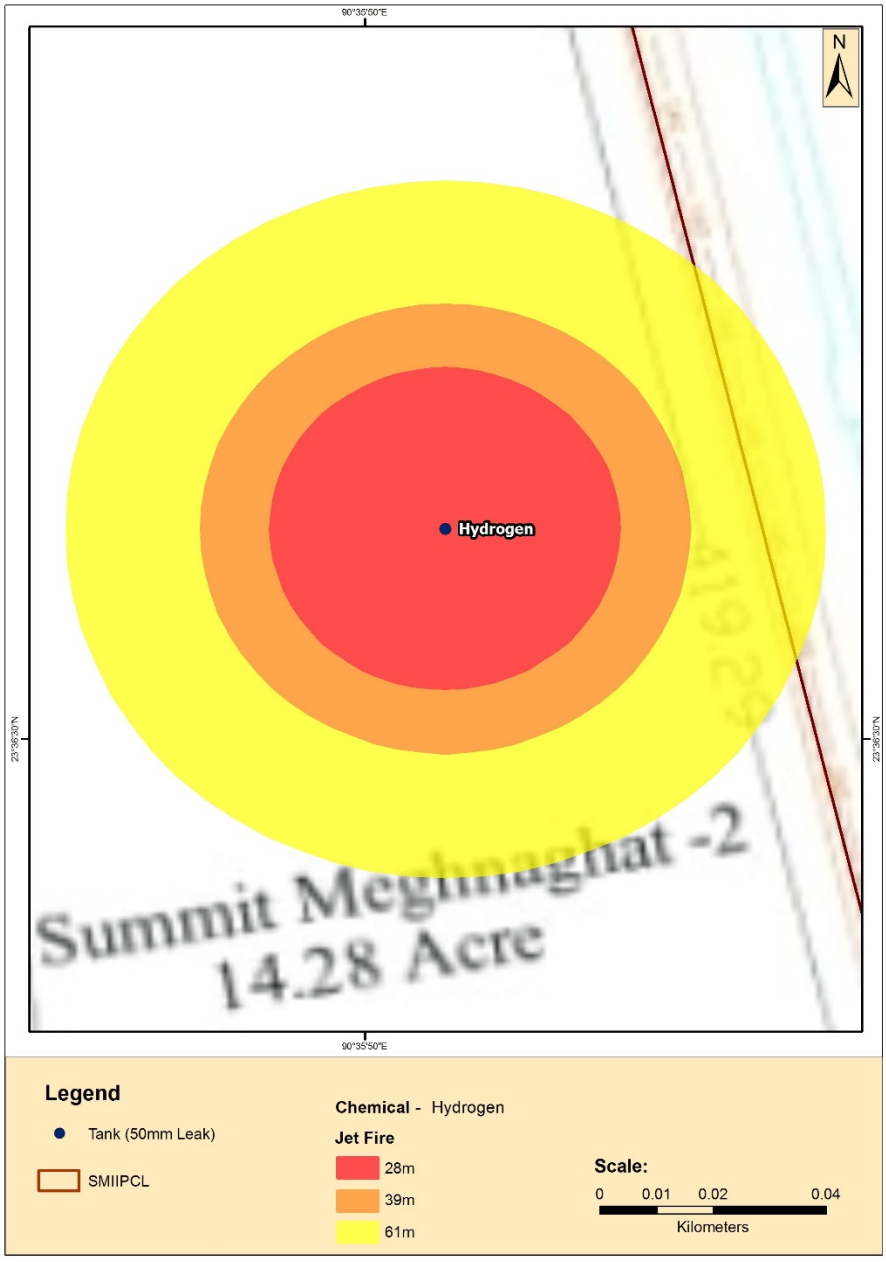
Yellow: 34 meters --- (2.0 kW/ (sq. m) = pain within 60 sec)

The worst hazard for release and ignition of hydrogen gas from storage tank leak (25mm dia) will be experienced to a maximum radial distance of 16m from the source with potential lethal effects within 1 minute.

Scenario 3: Hydrogen Storage Tank Failure – Leak of 50mm dia

The jet fire threat zone plot for release and ignition of hydrogen gas from storage tank failure (50mm dia) is represented in ***Figure 8.7***below.

Figure 8.7 ***Threat Zone Plot –Hydrogen Tank Failure (50mm dia)***



Source: ALOHA

THREAT ZONE:

Threat Modeled: Thermal radiation from pool fire

Red : 28 meters --- (10.0 kW/ (sq. m) = potentially lethal within 60 sec)

Orange: 39 meters --- (5.0 kW/ (sq. m) = 2nd degree burns within 60 sec)

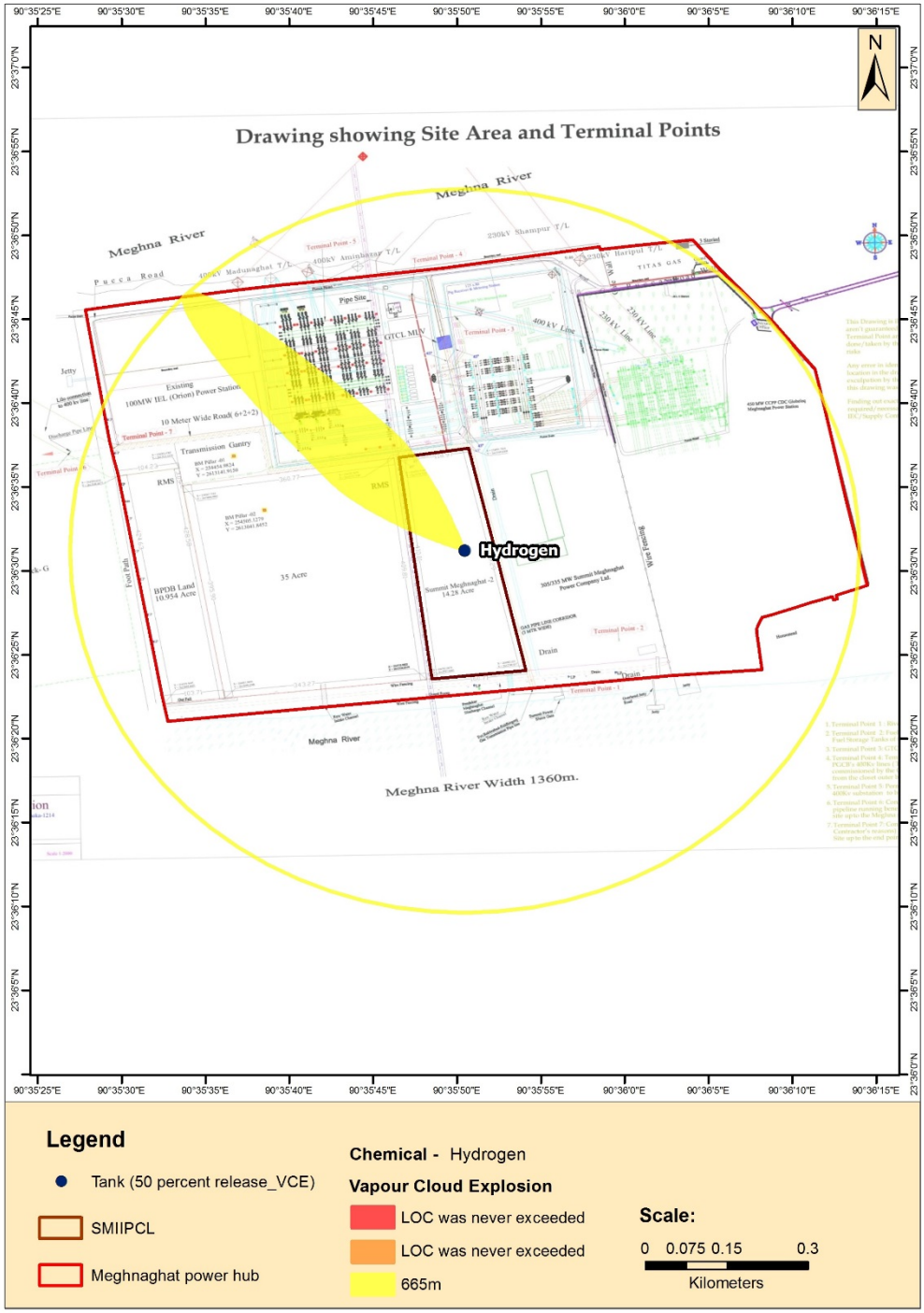
Yellow: 61 meters --- (2.0 kW/ (sq. m) = pain within 60 sec)

The worst hazard for release and ignition of hydrogen gas from storage tank leak (50mm dia) will be experienced to a maximum radial distance of 28m from the source with potential lethal effects within 1 minute.

Scenario 4: Hydrogen Storage Tank Failure – 50% instantaneous release and ignition

The VCE threat zone plot for instantaneous release and ignition of 50% of the total hydrogen storage is represented in ***Figure 8.8*** below.

Figure 8.8 Threat Zone Plot –Hydrogen Tank Failure (50% release and ignition)



Source: ALOHA

THREAT ZONE:

Threat Modeled: Overpressure (blast force) from vapor cloud explosion

Type of Ignition: ignited by spark or flame

Level of Congestion: uncongested

Model Run: Heavy Gas

Red : LOC was never exceeded --- (8.0 psi = destruction of buildings)

Orange: LOC was never exceeded --- (3.5 psi = serious injury likely)

Yellow: 665 meters --- (1.0 psi = shatters glass)

For VCE scenario modelled, the LOC for blast overpressure (8 psi) was never exceeded. The threat zone plot for blast overpressure of 1psi was found to be experienced within a radius of 665 m from source.

For calculating the risk significance of hydrogen storage failure, the likelihood ranking is considered to be "2" as the failure probability for such failure is computed to be ~2.4 x 10^{-6}per year. With respect to consequence ranking, for the aforesaid incident it has been identified to be as "3" given for a worst case scenario lethal effects is likely to be experienced within a maximum radial zone ~20 meters. However, considering that such storages will be equipped appropriate state of the art process and fire safety controls in consistent with regulatory requirements viz. Bangladesh Pressure Vessel Rules 1995, the risk is likely to be less significant.

Risk Ranking – Hydrogen Tank Failure (Worst Case Scenario)

Likelihood ranking	**2**	**Consequence ranking**	**3**
Risk Ranking & Significance =6 i.e. "Low" i.e. Risk is Acceptable and can be managed through use of existing controls with the option for installation of additional controls, if necessary.			

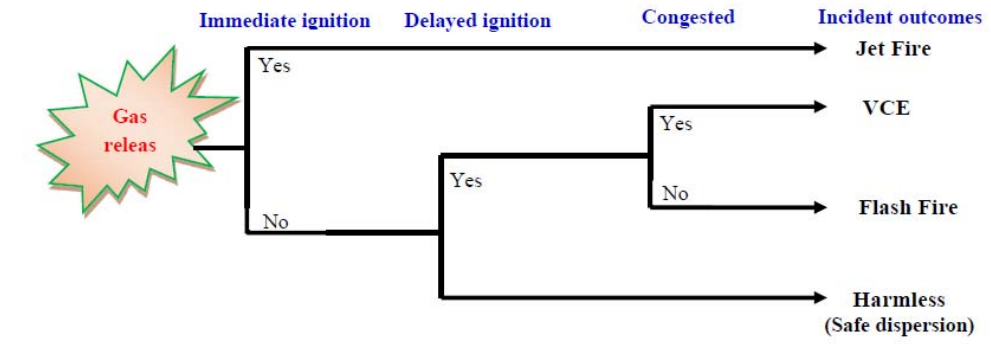
8.5.2 Consequence Analysis – Pipelines

Pipeline generally contains large inventories of oil or gas under high pressure; although accidental releases from them are remote they have the potential of catastrophic or major consequences if related risks are not adequately analysed or controlled. The consequences of possible pipeline failure is generally predicted based on the hypothetical failure scenario considered and defining parameters such as meteorological conditions (stability class), leak hole & rupture size and orientation, pipeline pressure & temperature, physicochemical properties of chemicals released etc.

In case of pipe rupture containing highly flammable natural gas, an immediate ignition will cause a jet fire. Flash fires can result from the release of natural gas through the formation of a vapour cloud with delayed ignition and a fire burning through the cloud. A fire can then flash back to the source of the leak and result in a jet fire. Flash fires have the potential for offsite impact as the vapour clouds can travel considerable distances downwind of the source. Explosions can occur when a flammable gas cloud in a confined area is ignited; however where vapour cloud concentration of released material is lower than Lower Flammability Limit (LFL), consequently the occurrence of a VCE is highly unlikely. VCE, if occurs may result in overpressure effects that become more significant as the degree of confinement increases (Refer ***Figure 8.9***).Therefore, in the present study, only

the risks of jet fires for the below scenarios have been modelled and calculated.

Figure 8.9 Natural Gas Release – Potential Consequences



[*Source: "Safety risk modelling and major accidents analysisof hydrogen and natural gas releases: Acomprehensive risk analysis framework" - Iraj Mohammadfam, Esmaeil Zarei*]

Based on the above discussion and frequency analysis as discussed in the earlier section, the following hypothetical risk scenarios (Refer ***Table 8.12***) have been considered for consequence analysis of the natural gas supply pipeline (12inch dia) of 0.5km length.

Table 8.12 Pipeline Risk Modelling Scenarios

Scenario	Pipeline	Accident Scenario	Design Pressure (bar)	Pipeline Temperature	Potential Risk
1	Natural Gas Supply Pipeline	Leak of 25mm dia	41.36	24°C	Jet Fire
2	Natural Gas Supply Pipeline	Leak of 50mm dia	41.36	24°C	Jet Fire
3	Natural Gas Supply Pipeline	Complete rupture	41.36	24°C	Jet Fire VCE

The pipeline failure risk scenarios have been modeled using ALOHA and interpreted in terms of Thermal Radiation Level of Concern (LOC) encompassing the following threshold values (measured in kilowatts per square meter) for natural gas (comprising of ~95% methane[1]) to create the default threat zones:

Red: 10 kW/ (sq. m) -- potentially lethal within 60 sec;

Orange: 5 kW/ (sq. m) -- second-degree burns within 60 sec; and

Yellow: 2 kW/ (sq. m) -- pain within 60 sec.

[1] https://www.naesb.org//pdf2/wgq_bps100605w2.pdf

http://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=18&ved=0ahUKEwjF7MiDttPRAhVCMI8KHd7aD6cQFghrMBE&url=http%3A%2F%2Fwww.springer.com%2Fcda%2Fcontent%2Fdocument%2Fcda_downloaddocument%2F9781848828711-c1.pdf%3FSGWID%3D0-0-45-862344-p173918930&usg=AFQjCNEaJklfYKl3fRUdi6xiRYeW-FJb2A

For vapour cloud explosion, the following threshold level of concern has been interpreted in terms of blast overpressure as specified below:

Red: 8.0 psi – destruction of buildings;

Orange: 3.5 psi – serious injury likely; and

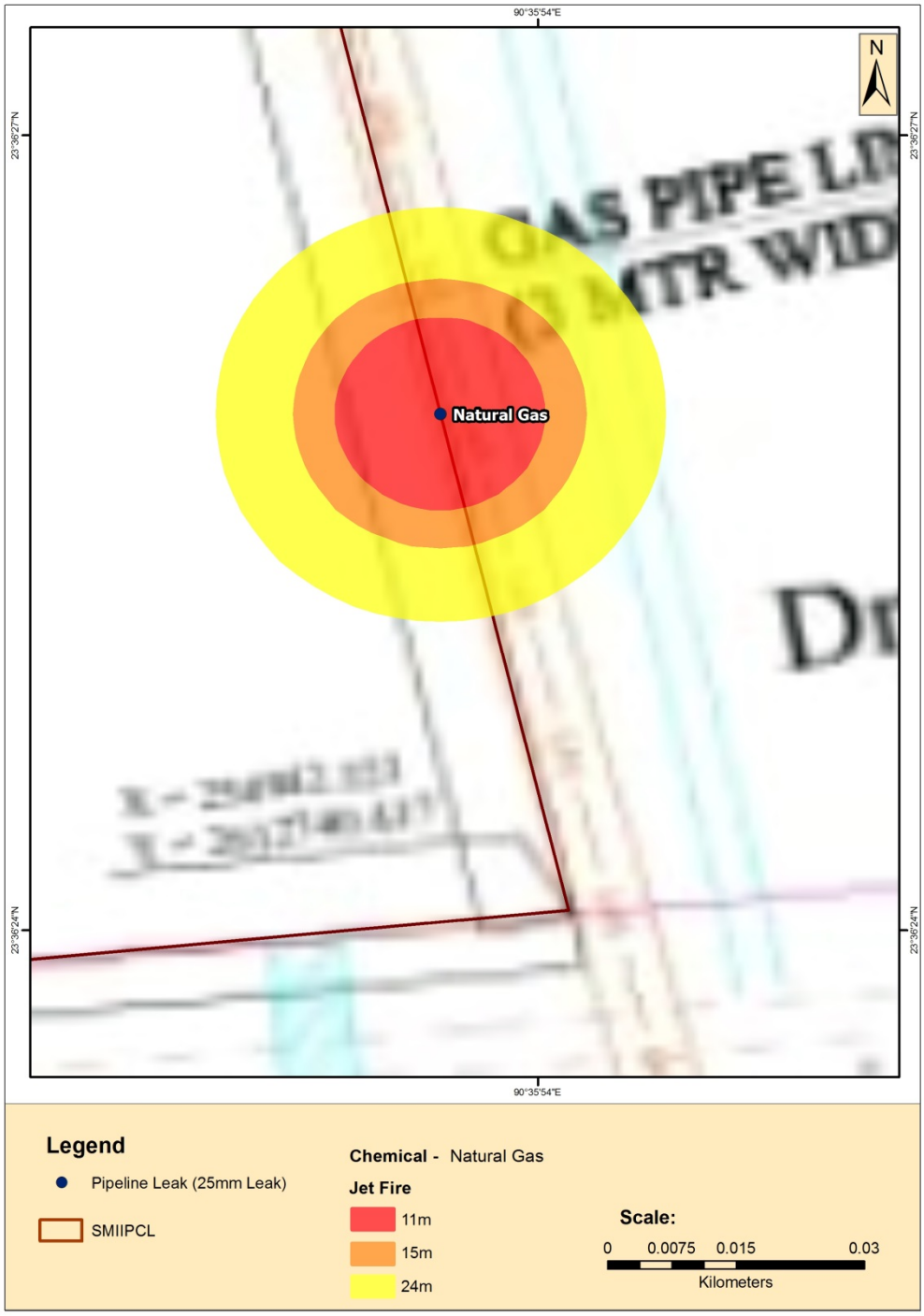
Yellow: 1.0 psi – shatters glass

The risk scenarios modelled for natural gas pipeline has been presented below:

Scenario 1: Natural Gas Pipeline Leak (25mm dia)

The jet fire threat zone plot for release and ignition of natural gas from pipeline leak of 25mm dia is represented in ***Figure 8.10*** below.

Figure 8.10 Threat Zone Plot – Natural Gas Pipeline Leak (25mm dia)



Source: ALOHA

THREAT ZONE:

Threat Modeled: Thermal radiation from jet fire

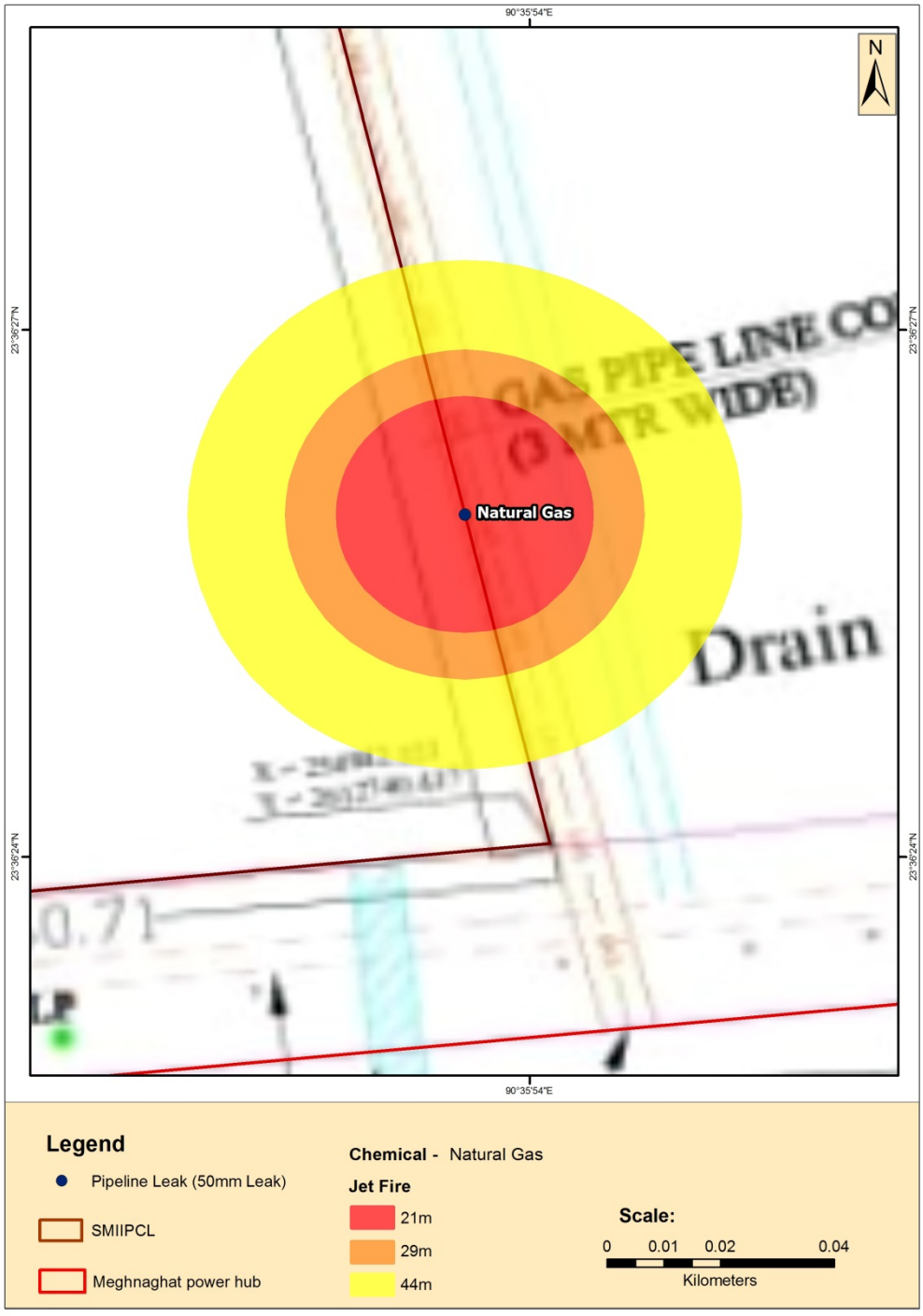
Red : 11 meters --- (10.0 kW/ (sq. m) = potentially lethal within 60 sec)
Orange: 15 meters --- (5.0 kW/ (sq. m) = 2nd degree burns within 60 sec)
Yellow: 24 meters --- (2.0 kW/ (sq. m) = pain within 60 sec)

The worst hazard for release and ignition of natural gas from the pipeline leak of 25mm dia will be experienced to a maximum radial distance of 11m from the source with potential lethal effects within 1 minute.

Scenario 2: Natural Gas Pipeline Leak (50mm dia)

The jet fire threat zone plot for release and ignition of natural gas from pipeline leak of 50mm dia is represented in ***Figure 8.11*** below.

Figure 8.11 Threat Zone Plot – Natural Gas Pipeline Leak (50mm dia)



Source: ALOHA

THREAT ZONE:

Threat Modeled: Thermal radiation from jet fire

Red : 21 meters --- (10.0 kW/ (sq. m) = potentially lethal within 60 sec)

Orange: 29 meters --- (5.0 kW/ (sq. m) = 2nd degree burns within 60 sec)

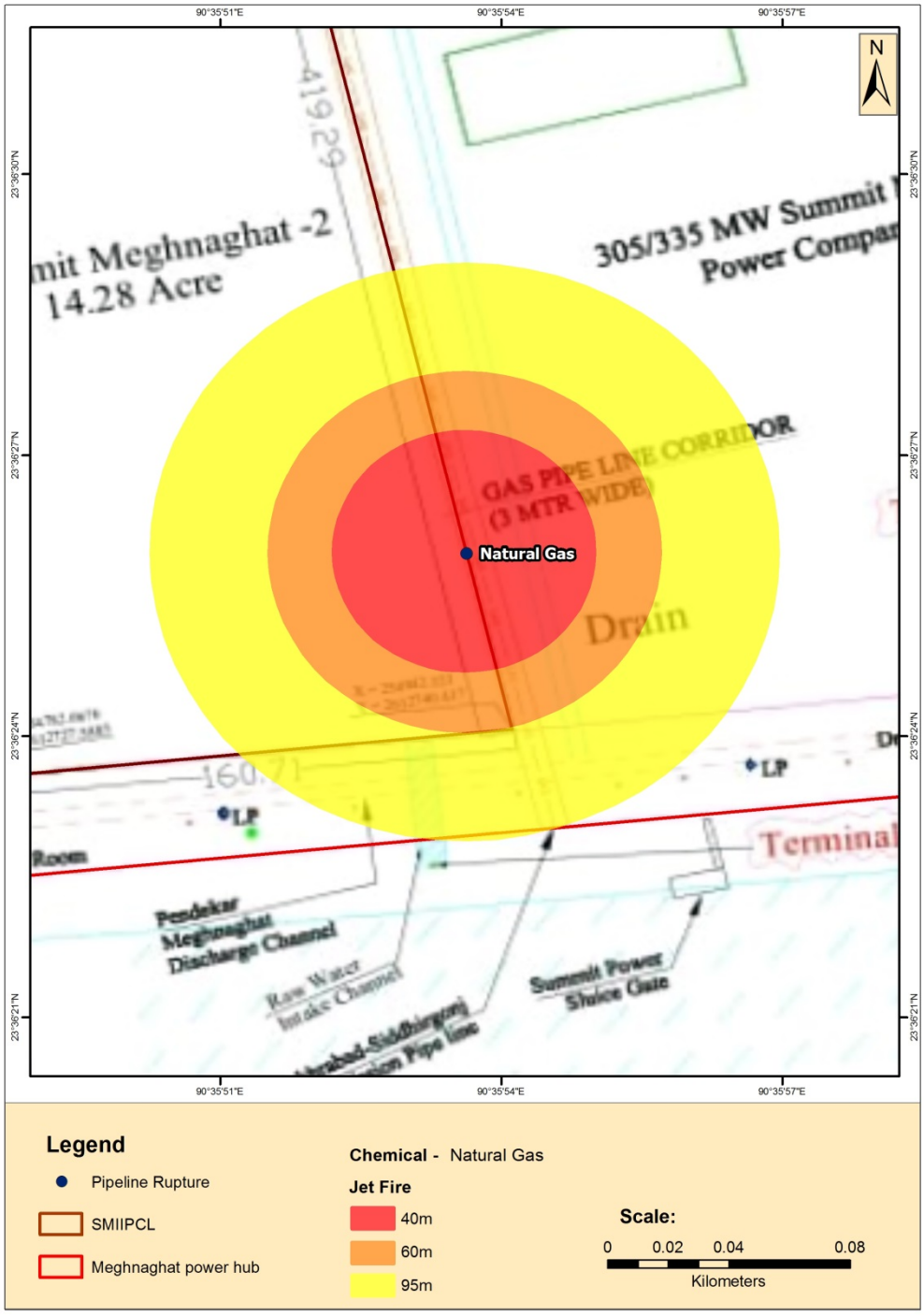
Yellow: 44 meters --- (2.0 kW/ (sq. m) = pain within 60 sec)

The worst hazard for release and ignition of natural gas from the pipeline leak of 50mm dia will be experienced to a maximum radial distance of 21m from the source with potential lethal effects within 1 minute.

Scenario 3: Natural Gas Pipeline Rupture

The jet fire threat zone plot for release and ignition of natural gas from pipeline rupture (worst case) is represented in ***Figure 8.12***below.

Figure 8.12 Threat Zone Plot – Natural Gas Pipeline Rupture



Source: ALOHA

THREAT ZONE:

Threat Modeled: Thermal radiation from jet fire

Red : 40 meters --- (10.0 kW/ (sq. m) = potentially lethal within 60 sec)

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

Yellow: 95 meters --- (2.0 kW/ (sq. m) = pain within 60 sec)

The worst hazard for release and ignition of natural gas from the pipeline rupture will be experienced to a maximum radial distance of 40m from the source with potential lethal effects within 1 minute.

For VCE modelled for catastrophic failure of natural gas pipeline onsite, the LOC level was never exceeded

THREAT ZONE:

Threat Modeled: Overpressure (blast force) from vapor cloud explosion

Type of Ignition: ignited by spark or flame

Level of Congestion: uncongested

Model Run: Heavy Gas

Red : LOC was never exceeded --- (8.0 psi = destruction of buildings)

Orange: LOC was never exceeded --- (3.5 psi = serious injury likely)

Yellow: LOC was never exceeded --- (1.0 psi = shatters glass)

For calculating the risk significance of natural gas pipeline, the likelihood ranking is considered to be "2" as the probability of pipeline rupture is computed to be ~4.1×10^{-5} per year; whereas the consequence ranking has been identified to be as "4" as given for a worst case scenario (rupture) lethal effects is likely to be limited within a radial zone of ~40m. Also no social sensitivities in the form of village settlements, educational institutions etc. were found to be located within this zone. Further considering adequate number of gas leak and fire detection system of appropriate design will be provided for the pipeline supply of natural gas to prevent for any major risk at an early stage of the incident.

Risk Ranking – Natural Gas Pipeline Rupture (Worst Case Scenario)

Likelihood ranking	**2**	**Consequence ranking**	**3**
Risk Ranking & Significance = 6 i.e. "Low" i.e. Risk is Acceptable and can be managed through use of existing controls and evaluation of additional controls.			

8.5.3 Consequence Analysis – Sulphuric Acid Storage Tanks/Piping

The main hazards associated with the storage and handling of sulfuric acid is release and exposure to toxic/corrosive fumes resulting release of the hazardous material. The hazards may be realised following tank overfilling and leaks/failures in the storage tank and ancillary equipment such as transfer pumps, metering equipment, etc. all of which can release significant quantities of corrosive material on failure.

Sulphuric Acid Storage – Hypothetical Failure Scenarios

The following representative scenarios for the tanks were considered (Refer ***Table 8.13***).

Table 8.13 Sulphuric Acid Storage Tank – Risk Modelling Scenarios

Sl. No	Tank	Tank Volume (KL)	Accident Scenario	Threat Modelled
1	Sulphuric Acid Tank	30	5% release of the total acid storage	Exposure to toxic/corrosive vapour
2		30	15% release of the total acid storage	Exposure to toxic/corrosive vapour
3		30	50% release of the total acid storage	Exposure to toxic/corrosive vapour

The sulphuric acid storage tank failure risk scenarios have been modeled using ALOHA and interpreted in terms of Toxic Level of Concern (LOC) encompassing the following threshold values (measured in mg/m^3) to create the default threat zones:

Red: 120 mg/m^3 – EPRG-3: concentration beyond which life-threatening health effects are developed or experience when exposed for a period of one hour;

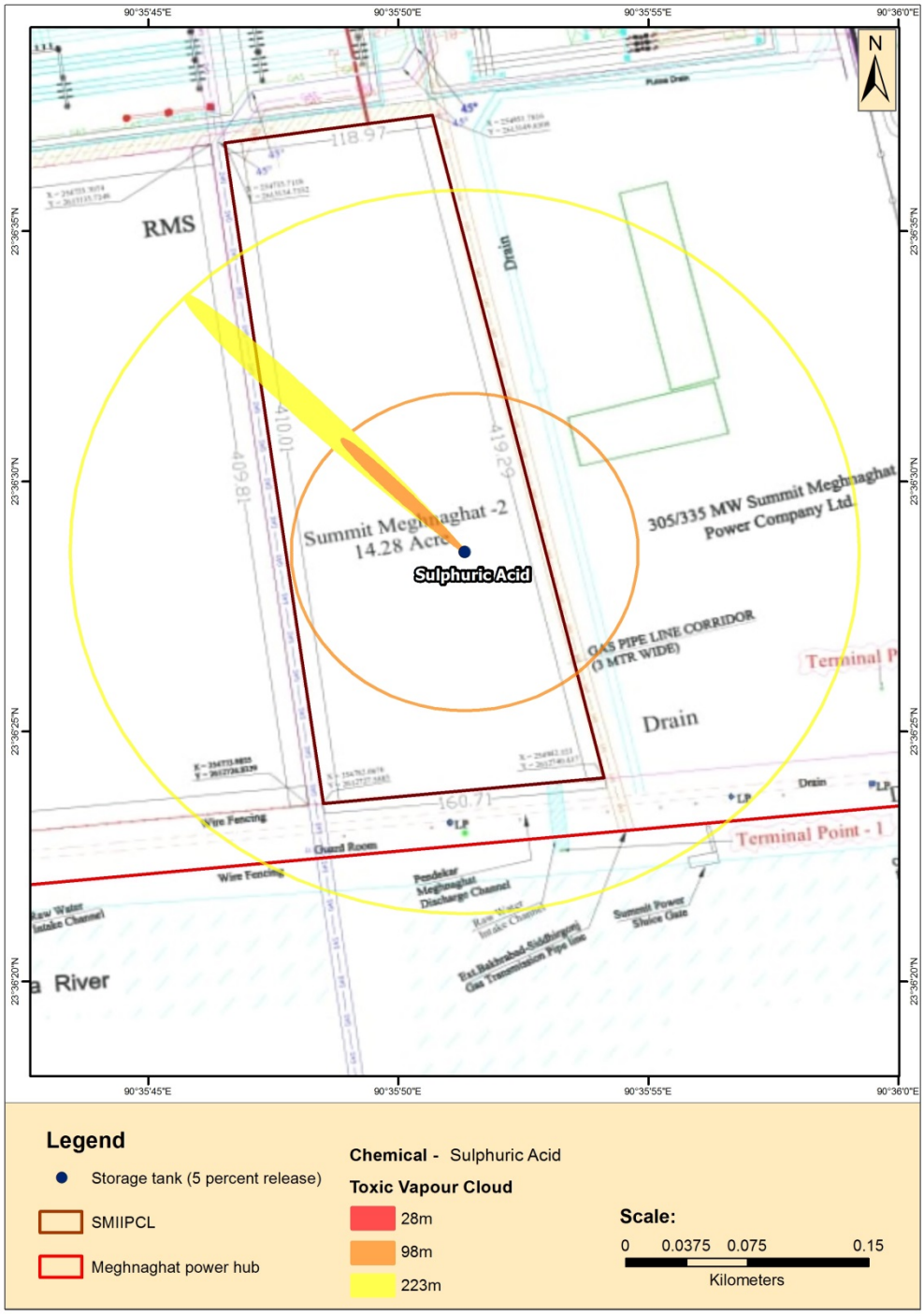
Orange: 10 mg/m^3 -- EPRG-2: concentration beyond which irreversible or other serious health effects or symptoms are experienced or developed when exposed for a period of one hour; and

Yellow: 2 mg/m^3 -- EPRG-1: concentration beyond which mild, transient adverse health effects are likely to be experience if exposed over a period of one hour; and

Scenario 1: Sulphuric Acid Storage Tank– 5% release of total storage

The toxic LOC threat zone plot for release of sulphuric acid vapour from sulphuric acid storage tank is represented in ***Figure 8.13*** below.

Figure 8.13 Threat Zone Plot– 5% release of total sulfuric acid storage



Source: ALOHA

THREAT ZONE:

Threat Modeled: Toxic Level of Concern

Red : 28 meters --- 120 mg/m^3 = EPRG-3))

Orange: 98 meters --- 10 mg/m^3 = EPRG-2)

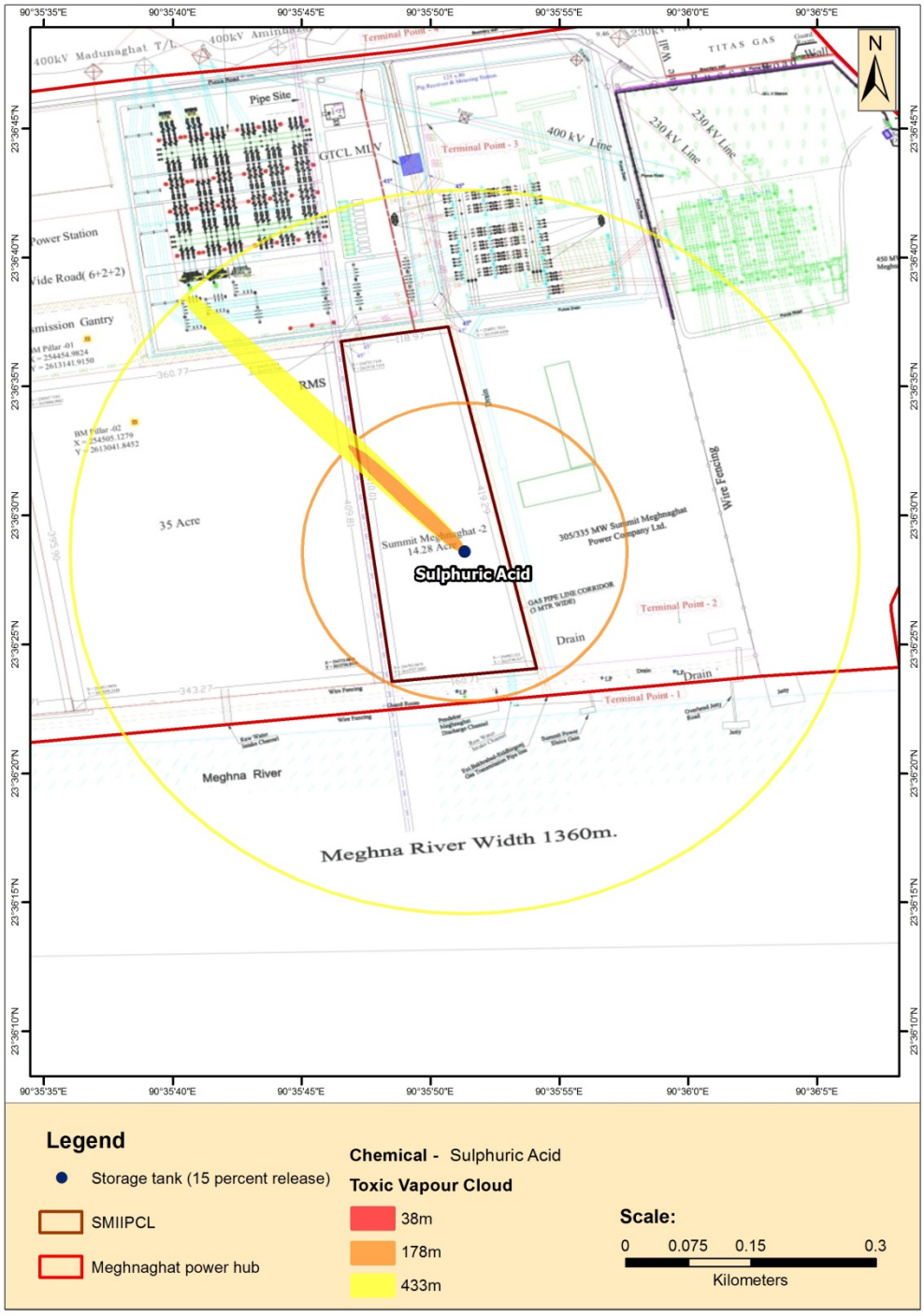
Yellow: 223 meters --- 2 mg/m^3 = EPRG-1)

The worst hazard for release of 5% of total storage of sulphuric acid will be experienced within a radial distance of 28m from source. The total of mass of sulphuric acid released for the scenario is computed to be 414g over a 60 minute duration.

Scenario 2: Sulphuric Acid Storage Tank– 15% release of total storage

The toxic LOC threat zone plot for release of sulphuric acid vapour from sulphuric acid storage tank is represented in ***Figure 8.14*** below.

Figure 8.14 Threat Zone Plot– 15% release of total sulfuric acid storage



Source: ALOHA

THREAT ZONE:

Threat Modeled: Toxic Level of Concern

Red : 38 meters --- 120 mg/m^3 = EPRG-3))

Orange: 178 meters --- 10 mg/m^3 = EPRG-2)

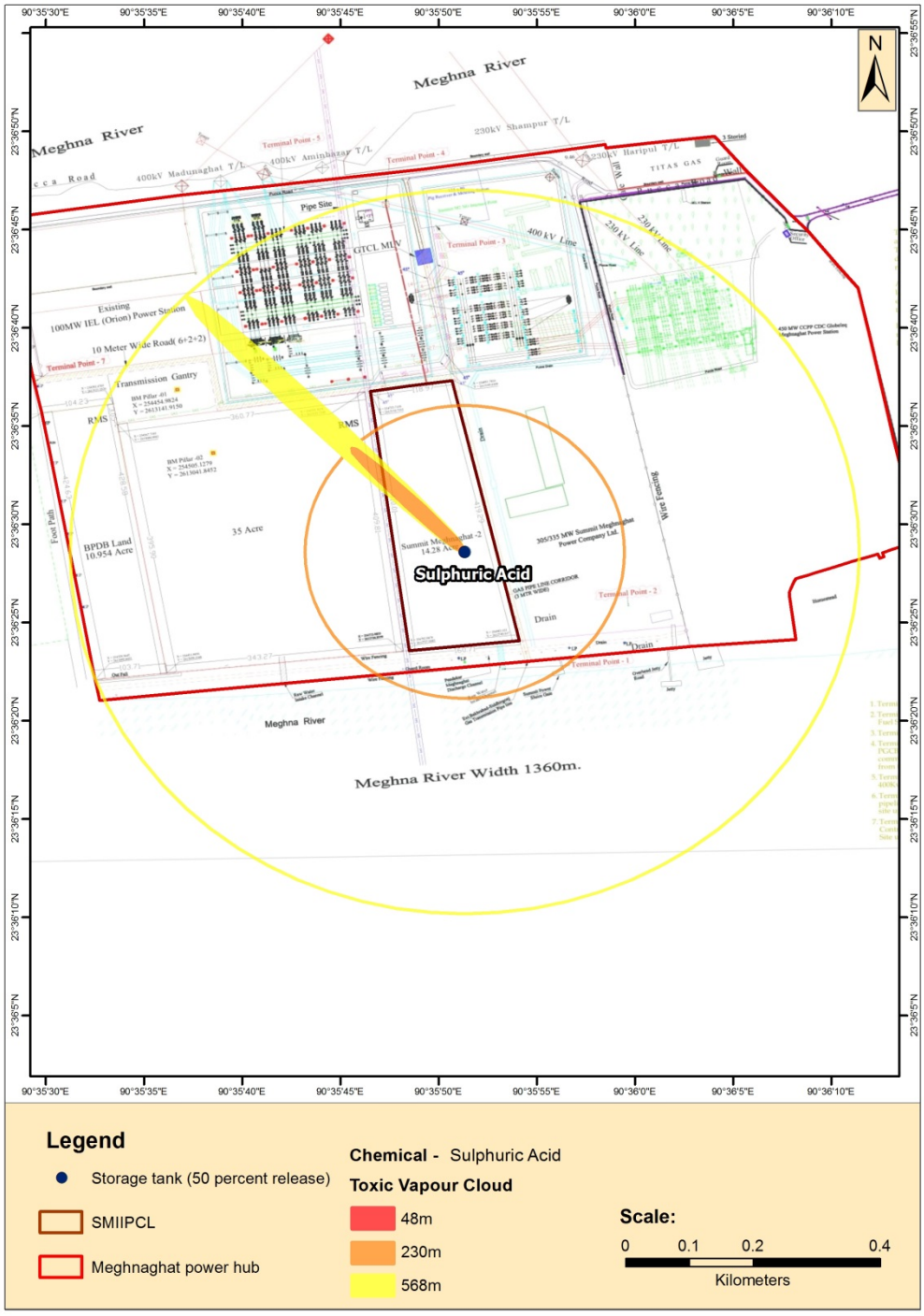
Yellow: 433 meters --- 2 mg/m^3 = EPRG-1)

The worst hazard for release of 15% of total storage of sulphuric acid will be experienced within a radial distance of 38m from source. The total of mass of sulphuric acid released for the scenario is computed to be 3.16kg for 60 minute duration.

Scenario 3: Sulphuric Acid Storage Tank– 50% release of total storage

The toxic LOC threat zone plot for release of sulphuric acid vapour from sulphuric acid storage tank is represented in ***Figure 8.15*** below.

Figure 8.15 Threat Zone Plot– 50% release of total sulfuric acid storage



Source: ALOHA

THREAT ZONE:

Threat Modeled: Toxic Level of Concern

Red : 48 meters --- 120 mg/m^3 = EPRG-3))

Orange: 230 meters --- 10 mg/m^3 = EPRG-2)

Yellow: 568 meters --- 2 mg/m^3 = EPRG-1)

The worst hazard for release of 50% of total storage of sulphuric acid will be experienced within a radial distance of 48m from source. The total of mass of sulphuric acid released for the scenario is computed to be 5.41kg for 60 minute duration.

For calculating the risk significance of sulphuric acid storage tank failure, the likelihood ranking is considered to be "2" as the failure probability for such failure is computed to be ~2.0 x 10^{-6}per year. With respect to consequence ranking, for the aforesaid incident it has been identified to be as "3" given for a worst case scenario life threatening health effects are likely to be manifested within a radius of 48m from source. However considering appropriate mitigation measures and controls will be adopted by the site to both prevent and control any major risk associated with sulphuric acid at source, the risk assessed to be of less significance.

Risk Ranking – Sulphuric Acid Tank Failure (Worst Case Scenario)

Likelihood ranking	**2**	**Consequence ranking**	**3**
Risk Ranking & Significance = 6 i.e. "Low" i.e. Risk is Acceptable and can be managed through use of existing controls and evaluation of additional controls.			

8.5.4 Consequence Analysis – HSD Storage

As discussed earlier since diesel will be supplied from the storage of Summit M-1 we have considered the risk analysis carried out by SGS for the said project for the consequence analysis. The risk assessment undertaken for the said project show that the fatality risk levels of the facilities to be acceptable, in accordance to the UK-Health and Safety Executive requirement. It is however appropriate to consider that the facility is handling hazardous substances, and likely to impose significant consequence impacts to the personnel nearby if an unwanted event occurs.

The following best practices should be adhered to demonstrate the ALARP (As Low as reasonably Practicable) performance:

- Safety measures are to be maintained at their expected level of performance and their good condition to be regularly ensured
- Strict ignition control shall be ensured
- Regular maintenance and inspection should be performed
- Ensure availability and effectiveness of Fire & Gas detecting system and the emergency alarm system and means of communication, which would enable early warning to all personnel in the event of accidental release and subsequently enable all personnel to take appropriate action.

For details please refer to the risk assessment study undertaken by SGS for Summit M-1 project presented in ***Annex I***.

8.6 RISK REDUCTION MEASURES

The storage and handling of flammable and corrosive fuel/chemicals at the site to be planned and designed so that they do not constitute any significant fire or explosion risks to people and properties within and surrounding the facility.

8.6.1 Design Considerations

In consistent with the aforesaid philosophy, Summit will design the project in accordance to ASME, BIS and other relevant international standards. The plant operation and control will be achieved through a modern state of-the-art control and instrumentation system employing DCS. With respect to the sulphuric acid and hydrogen storage tanks, the firefighting facilities will be designed as per regulatory requirements and international best practices. All acid and alkali storage tanks on site will be equipped with secondary containment in order to contain leaks and spills. Adequate number of gas leak detection and fire detection system as per stipulated norms will be provided for the pipeline supply of natural gas. For hydrogen storage tanks, applicable regulatory provisions (as specified in the *Bangladesh Pressure Vessel Rules, 1995*) related to hydrogen design, its storage and handling will be complied with.

8.6.2 Hazard Zone Classification

Hazard zonation/classification of the site will be undertaken by Summit which will be consistent with the requirements of the National Electrical code (NEC) and US NFPA 497. As per NEC, there are three categories of the hazardous areas namely Class I, Class II and Class III. With respect to the respect to the proposed project, natural gas pipeline/metering station and hydrogen storage onsite to be classified as Class I hazardous area as flammable gas/vapour is involved. All electrical equipment installed in classified hazardous location is required to conform to the requirements of the international standard IEC 60079.

8.6.3 Emergency Planning & Response

For operations, the proponent will develop and implement a comprehensive Emergency Response Plan (ERP) in order to deal with both onsite and offsite emergencies. The overall objectives of ERP are summarized as follows:

- To establish and define roles of coordinators, plant key personnel & other emergency response personnel;
- To establish guidelines for effective response to any emergency;
- To contain and control emergency incidents;
- To prevent loss of life and minimize the risk of injuries to people working within the complex and neighbouring population;
- To minimize damage to company installations and public property & environment;

- To inform employees, public and authorities on the hazards/risks assessed, safeguards provided and the role to be played by Summit; and
- Ensure a smooth interface between District Disaster Management Authority and Site Emergency Response Plan (ERP).

An Emergency Response Team (ERT) comprising of trained and qualified personnel will be constituted and will be in charge of the execution of the plan under the direct supervision of a Site Incident Commander. ERT will be responsible in periodically evaluating the performance of firefighting resources through reviews/inspections. Further, ERT will be conducting periodic mock drills to assess the overall preparedness of the facility in effectively responding to emergency scenarios. Consider the emergency scenarios are identical to the Summit M1 project please refer to the ***Annex K*** for the detailed emergency response procedure as developed for the aforesaid project.

8.6.4 Safety Management Measures for Operations

Hydrogen Storage – Design & Operational Safety Considerations

Tanks/vessel utilized for the storage of hydrogen to be stored outside at a safe distance from ventilation intakes and vehicle routes. Additional safety considerations for storage shall include the following (but not limited to):

- Materials of construction including materials used in piping, valves and seals must be carefully selected to account for their deterioration when exposed to hydrogen at the intended operating conditions;
- Hydrogen piping system should be designed accordance with applicable codes and standards (ASME B31.3, ASME B31.12 etc.);
- Buildings/sheds used for storage of hydrogen should be constructed of non-combustible material;
- Detached storage facilities should have normal and emergency ventilation system with inlets low to the ground. The inlets and exhausts should be oriented in the same direction (for wind tolerance);
- Hydrogen sensors should be installed at the storage installation to detect any leaks;
- The storage installation should have automatic shut off system that activates if a leak is detected or a problem occurs in the facility that is being supplied with hydrogen;
- Ignition sources (e.g. open flames, electrical equipment etc). should not be allowed within the storage facility;
- The gaseous hydrogen system should be electrically bonded and grounded;
- Flow restrictors such as orifice meters shall be installed in the hydrogen supply lines to limit the supply flow rate and controlling leakage rate; and
- All piping system should be labelled to indicate content, flow direction including design and test pressures.

Sulphuric Acid Storage – Design & Operational Safety Considerations

Sulphuric acid stored in any type of metallic container would evolve hydrogen which is highly flammable and explosive. Pressure inside the container may build up on this account. Such pressure should be relieved frequently by opening plugs of the metallic containers or alternatively such containers should be provided with safety vents. Additionally the following safety design considerations/measures shall be adopted for sulphuric acid storage and handling:

- Small quantities of sulphuric acid should be stored away from other chemicals, especially organic materials, nitrates, cyanides and sulphides, chlorates, carbides, metal powders, oxidizing chemicals, peroxides and explosives;
- Containers of sulphuric acid should be inspected regularly for leaks. Damaged containers should be handled with special care.
- Electrical wiring should be made of acid-resistant insulation and encased in rigid metal or PVC conduits. Smoking shall be strictly prohibited where sulphuric acid is stored;
- Each storage tank should be provided with a vent of sufficient size. The vent should be of a type which will maintain the tank at atmospheric pressure and which is capable of being cleaned easily. The vent should be fitted with a column made of acid resistant transparent material packed with granules of self-indicating silica-gel with adequate moisture holding capacity. The spent silica gel should be replaced by regenerated one as soon as colour change is noted. Alternatively, a device to scrub the entering air by concentrated sulphuric acid may be provided;
- All tanks should be placed squarely on good foundation and raised off the ground by at least two layers of acid-proof bricks. The tanks should be mounted with a slight slope towards the sludge hole or outlet valve. A plug operated from the top of the tank should be provided over the outlet valve. Gauge glasses in acid tanks should be avoided;
- The tank should be surrounded by a bund wall having adequate capacity to hold the complete content of the tank. The bund wall and the floor of the bunded area should be made of acid resistant material. The slope of the floor should end up in a slump having drain pipe with valve approachable from outside. The drain should discharge into an acid resistant neutralization sump of adequate size; and
- The flanges on the acid pipelines should be so covered that any leakage may not cause spray of acid. If the flanges are above working and walking surfaces, catch pots with adequate drain pipes may be provided to avoid dripping of acid on the body.

Preventive Measures for Handling of Natural Gas

- Leak detection sensors to be located at areas prone to fire risk/ leakages;
- All safety and firefighting requirements as per the international safety norms to be put in place;

- High temperature and high pressure alarm with auto-activation of water sprinklers as well as safety relief valve to be provided;
- Flame proof electrical fittings to be provided for the installation;
- Periodical training/awareness to be given to work force at the project site to handle any emergency situation;
- Periodic mock drills to be conducted so as to check the alertness and efficiency and corresponding records to be maintained;
- Signboards including emergency phone numbers and 'no smoking' signs should be installed at all appropriate locations;
- Plant shall have adequate communication system;
- Pipeline route/equipment should be provided with smoke / fire detection and alarm system. Fire alarm and firefighting facility commensurate with the storage should be provided at the unloading point;
- 'No smoking zone' to be declared at all fire prone areas. Non sparking tools should be used for any maintenance; and
- Wind socks to be installed to check the wind direction at the time of accident and accordingly persons may be diverted towards opposite direction of wind.

Preventing Fire and Explosion Hazards

- Proper marking to be made for identification of locations of flammable storages;
- Provision of secondary containment system for all fuel and lubricating oil storages;
- Provision of fire and smoke detectors at potential sources of fire and smoke;
- Storing flammables away from ignition sources and oxidizing materials;
- Providing specific worker training in handling of flammable materials, and in fire prevention or suppression;
- Equipping facilities with fire detectors, alarm systems, and fire-fighting equipment;
- Fire and emergency alarm systems that are both audible and visible;
- For safety of people the building, regulations concerning fire safety to be followed. Some of the requirements include:
- Installation of fire extinguishers all over the building;
- Provision of water hydrants in operative condition;
- Emergency exit;
- Proper labelling of exit and place of fire protective system installation;
- Conducting mock drills;
- Trained personnel to use fire control systems.

General Health and Safety

- The facility will adopt a total safety control system, which aims to prevent the probable accidents such as fire accidents or chemical spills.
- Firefighting system, such as sprinklers system, portable extinguishers (such as CO_2) and automated fire extinguishers shall be provided at strategic locations with a clear labelling of the extinguisher so the type of

the extinguisher is easily identifiable. Also a main hydrant around the buildings will be available. On all floors an automated fire detection system will be in place.

- The site operations manager will take steps to train all emergency team members and shall draw up an action plan and identify members. The appointed emergency controller shall act as the in-charge at the site of the incident to control the entire operation.
- The staff shall be trained for first-aid and firefighting procedures. The rescue team shall support the first-aid and firefighting team.
- A first-aid medical centre will be onsite to stabilise the accident victim. The emergency team will make contact with a nearby hospital for further care, if required.
- A training and rehearsal of the emergency response by emergency team members and personnel on site will be done regularly.
- A safe assembly area will be identified and evacuation of the premises will be practised regularly through mock drills.
- In case an emergency is being declared, the situation shall be reported to the authorities such as local police, the chief inspector of factories and the state pollution control board as per rules and regulation of law of the land.
- Safety manual for storage and handling of hazardous chemicals shall be prepared.
- All the personnel at the site shall be made aware about the hazardous substance stored and risk associated with them.
- Personnel engaged in handling of hazardous chemicals shall be trained to respond in an unlikely event of emergencies.
- A written process safety information document shall be compiled for general use and summary of it shall be circulated to concerned personnel.
- MSDS shall be made available and displayed at prominent places in the facility. The document compilation shall include an assessment of the hazards presented including (i) toxicity information (ii) permissible exposure limits. (iii) Physical data (iv) thermal and chemical stability data (v) reactivity data (vi) corrosivity data (vii) safe procedures in process.
- Safe work practices shall be developed to provide for the control of hazards during operation and maintenance
- In the material storage area, hazardous materials shall be stored based on their compatibility characteristics.
- Near miss and accident reporting system shall be followed and corrective measures shall be taken to avoid / minimize near miss incidents.
- Safety measures in the form of DO and Don't Do shall be displayed at strategic locations.
- Safety audits shall be conducted regularly.
- Firefighting system shall be tested periodically for proper functioning.
- All hydrants, monitors and valves shall be visually inspected every month.
- Disaster Management Plan shall be prepared and available with concerned personnel department.

Personal Protective Equipment

In certain circumstances, personal protection of the individual maybe required as a supplement to other preventive action. It should not be regarded as a substitute for other control measures and must only be used in conjunction with substitution and elimination measures. PPEs must be appropriately selected individually fitted and workers trained in their correct use and maintenance. PPEs must be regularly checked and maintained to ensure that the worker is being protected.

First Aid

First aid procedures and facilities relevant to the needs of the particular workforce should be laid down and provided in consultation with an occupational physician or other health professional.

Health assessment should form a part of a comprehensive occupational health and safety strategy. Where employees have to undergo health assessment, there should be adequate consultation prior to the introduction of such program. Medical records should be kept confidential. Site should be able to relate employee health and illness data to exposure levels in the workplace.

9 STAKEHOLDER ENGAGEMENT

A stakeholder is defined as "an individual, group, or organization, who may affect, be affected by, or perceive itself to be affected by a decision, activity, or outcome of a project". "Stakeholder Analysis" is the process of sorting identified stakeholder groups according to their impact on the project and the impact the project will have on them. This information is then used to assess the manner in which the interests of the stakeholders or projects impact on them should be addressed in the project development plan or its operation.

The importance of stakeholder analysis lies in the assessment and understanding of the socio-political environment surrounding the project. It allows for:

- Identification of the interests, concerns and societal risks surrounding the stakeholders, as well as conflicts of interests (if any);
- Identification of relations between stakeholders that may enable "coalitions" of project sponsorship, ownership and co-operation as well as the mechanisms which may influence other stakeholders;
- Key groups/ individuals to be identified who need to be informed about the project during the execution phase;
- Identifying stakeholders (those who might have an adverse impact on the project) and taking appropriate measures to mitigate their influence; and;
- Development of a framework for participatory planning and implementation of various project activities including interventions for community development.

This Section of the report describes the stakeholder engagement process undertaken during the ESIA scoping phase to gather baseline information and assess the potential impacts and risks due to the project. The process initiated with the Kick-off Meeting held on 4th October 2017 between Summit Meghnaghat II Power Company Limited, a wholly owned subsidiary of Summit Corporation Limited and ERM to understand the environmental and social scope.

9.1 PURPOSE & OBJECTIVE OF STAKEHOLDER ENGAGEMENT

9.1.1 Purpose

This stakeholder engagement and consultation covers stakeholder engagement requirements as part of the Environmental and Social Impact Assessment (ESIA) study for the Project in next phase.

9.1.2 *Scope and Specific Objectives*

The broad objective of the stakeholder engagement and involvement process is to provide authorities, as well as interested and affected stakeholders with the opportunity to identify issues, concerns, and opportunities regarding the proposed Project and to address key stakeholder concerns during the preparation of the various safeguard policy documents (ESMF) for the Project. Specific objectives for stakeholder consultations are as follows:

- To address relevant issues including those perceived as being important by other sectoral agencies, public bodies, local communities, affected groups and others,
- To improve information flows between proponents and different stakeholders, improving understanding of a project,
- To identify important environmental characteristics or mitigation opportunities,
- To ensure that the magnitude and significance of impacts has been assessed properly,
- Improves the acceptability and quality of mitigation and monitoring process

9.2 *IDENTIFICATION OF STAKEHOLDERS*

The stakeholder identification was carried out by ERM in discussion with Summit Corporation Limited. The key stakeholders who were consulted to collect relevant information for the scoping purpose are provided in ***Table 9.1.***

Table 9.1 List of Stakeholders Identified

Stakeholder Category/Group	Key Stakeholders
Local Community	• Residents of Pirajpur Union Parishad • Fishermen in Pirajpur and its neighbouring Union Parishads • Fishermen in Char Balki Island • Persons doing Recreational Fishing • Residents and Commercial entities along the access road.
Institutional Stakeholder	• BPDB • Department of Fisheries • Department of Inland Waterways • Office of Land Acquisition, District Commissioner • Department of Land Revenue • Department of Agriculture • District Administration • Department of Public Health and Engineering • Bangladesh Inland Waterways Authority • Bangladesh Water Development Board • Public Works Department • Local Government Engineering Department • Public Health Department including hospitals and primary health centres

Stakeholder Category/Group	Key Stakeholders
Others	• School teachers • Local workforce in Meghnaghat power hub • NGOs working in the study area

9.3 *STAKEHOLDER CONSULTATION*

As part of the ESIA study, ERM held preliminary consultations with a few stakeholders available during the site reconnaissance visit. A brief overview of these stakeholder consultations is provided below.

Table 9.2 Summary of Stakeholder Consultations during Site Reconnaissance

Stakeholder Name	Key Points from Discussion
Community Members in Char Balki	• Char Balki is the largest fishing hamlet in the neighbourhood of the project site. • There are 50-60 active fishing households in this island. • Some of them own agriculture land cultivate paddy along with practicing fishing in Meghna River. • The land acquisition for thermal power plan in their island has reduced availability of agriculture land. • Therefore, their reliance on fishing and other industrial employment opportunities has increased. • Most of the fishing households own boats. They mostly use the traditional boats which are fixed by 2 to 4hp diesel motors. A few of them still use non-motorised boats. • The fishing is done through drag-nets of varying sizes depending on the fish species targeted. • A few of them also use lines for fishing occasionally. • In post monsoon period, some of the wealthy fishermen go for 'cage or captive fishing' which is locally known as 'kata fishing'. An enclosure is created in Meghna River using nets and bamboo poles where fish fingerlings are released. They depend on hyacinth and fish feeds and grow within this enclosure. • The fishing grounds are mostly located downstream, though areas close to the existing water intake and jetty are also used. • Practicing fishermen reported reduction of fish catch in recent years due to rapid industrialisation. • They also complained about the pollution of the water in Meghna River which sometimes causes itching and skin irritations. • Some of the community members reported that prior to development of the power hub, some of them used the vacant char land to cultivate seasonal vegetables. This practice has been abandoned for several years now. • A number of young people now migrate to work as wage labourers due to lack of suitable employment opportunities locally. • The community expressed their concern over the impacts of industries on the Meghna River water and its eco-system which they perceive to be the cause for reduction in their fish catch volume over the decade.
Fisherman Practicing Kata Fishing	• The kata fishing requires a sizable financial investment. Hence, only wealthy households are able to practice it.

Stakeholder Name	Key Points from Discussion
	• In general, they invest around 15-20 Lakhs taka per season. • They hire local fishermen on wages to prepare the bamboo framework and net lines. It also requires regular maintenance and supervision. • The Kata fishing is mostly done around the Char Balki island and the tributaries of the Meghna river. • They reported instances of damages to their kata fishing area by movement of large barges which causes immense loss to them. • They perceive any increase in the movement of barges and large ships will pose threat to their fishing practice and would increase instances of conflict with local industries.
People pursuing recreational fishing at Meghna River	• People as far as Dhaka come to this area with their fishing rods to fish; • There are multiple locations along the banks of Meghna where recreational fishing is done; • In general they spend 2 to 6 hours at these sites and their daily catch varies. • They spread across the area as crowding at one location does not help them catching fish. In a rough estimate, around 20-30 persons in the day come to this area for fishing. • The economic profile of these recreational fishermen varies, though none of them depend on this for livelihood or for food supply.
Surveyor from Land and Revenue Office-Pirajpur	• The entire area demarcated for the power hub is in possession of BPDB and no char land is allotted to anyone for cultivation. • Prior to the development of the Power hub, most part of the land was government land though a small portion was privately owned. • The land acquisition process to their knowledge has been completed and there are no pending cases. However, the detail of the land acquisition is not available with them. • The land acquisition division in District Commissioner's office was reported to have the details about the land acquisition process.

In addition to that ERM had also conducted stakeholder consultations as part of the CEIA study in the Year 2016 and a summary of key consultations is provided below:

Pirajpur Union Parishad

Profile: The Union Parishads (UPs) are responsible for planning and administration of local areas and also provide a range of services to the residents of these regions. The regions have undergone rapid urbanisation due to industrial growth. Consultations were carried out with representatives of Pirajpur Union Parishad. The consultations helped in understanding the stake of the UPs in industrial growth and their capacity to handle the burden of the growth.

Emerging Issues:

- Local administrative units do not have any control over the industry operations. The industrial units obtain their approvals from central agencies and they generally do not require any approvals from UPs.

- Most industries do not participate in any development activity in their surrounding areas; however they are constantly using natural resources and common infrastructure (road, drainage, etc.)
- Industrial growth has resulted in influx of population within the administrative areas, especially in the adjacent Unions to the Meghnaghat Industrial Area causing a high pressure on civic amenities – especially drainage, solid waste disposal and on roads. Union Parishad roads have been majorly impacted due to constant use by industrial heavy vehicles.
- A gradual decline of ground water level over the years has occurred due to extensive use in these industrial regions.

Health Institutions

Profile: The government health institutions are responsible for implementation of health policies and are the pillars of health care delivery system. Consultations with the health institutions were conducted to get an insight into growing health hazards due to rapid industrialisation and associated urbanisation in the region and also to develop an understanding of policies, plans, directives and their status of implementation by various implementing agencies and health care delivery systems.

Emerging Issues:
- Unplanned industrial development poses health threats to the local residents
- Industrial pollution has its impact on the health condition of the local people; respiratory problems, skin diseases, diarrhoea, etc. are quite commonly reported from the industrial areas
- Water borne diseases like typhoid, jaundice, diarrhoea are also very common within the industrial areas.
- Reported cases of air and water borne diseases among the local residents shows an increasing trend
- Poor living condition of the local and migrants generally observed because of high population stress, inadequate civic infrastructure and weak economic conditions.
- Health infrastructure is inadequate to sustain the pressure of huge migrant and floating population.
- Health and hygiene related awareness among the local people is low

Local Communities

Profile: Consultations were carried out with community people at Pirajpur, especially the area, that house the industrial zone and also the adjacent location that has faced population influx due to industrial growth in the region.

Emerging Issues:
- Agriculture is no more a primary activity, more people are now into business and small commercial activities that has evolved over the years due to industrialisation and has also helped in increasing family incomes.

- Work opportunities for local people in nearby industries are less as the industries prefer to hire people from outside the area to minimise and avoid any conflict situation.
- Most members of the fisherman community had to give up their occupation as the fish catch decreased in the river. The principal reason was attributed to the pollution of the river systems from waste water discharges from industries such as chemical factories, paper mills and dyeing units.
- The Kata fishing is mostly done around the Char Balki island and the tributaries of the Meghna river. They reported instances of damages to their kata fishing area by movement of large barges which causes immense loss to them.
- Water borne diseases and respiratory diseases are commonly reported from these industrial regions however awareness on health hazards due to industrial pollution among general community is quite low.
- Migrant workers have rented out make shift residences, that are mostly unplanned and lacks proper civic infrastructure e.g. sanitation and drainage facilities.

Department of Environment (DOE)

Profile: Department of Environment helps in securing clean and healthy environment for the benefit of present and future generation. Consultation with the DOE helped in gathering necessary information on the various industries in Meghnaghat industrial areas that helped in assessing the industrial stressors that impact the environmental and social conditions.

Emerging Issues: In Meghnaghat due to the growing number of industries the water of the Meghna River is getting polluted, as like Siddhirganj. DOE conducts periodic environmental monitoring (six monthly), and accordingly penalises industries who are found to exceed the stipulated standards. However there are existing limitations and it is always not possible to monitor each and every industry on a more frequent basis. At times units are also found to be repeat offenders even after penalising them.

Land Revenue Office

Profile: The Office is responsible for land revenue and registration of land parcels in that Upazila and primarily maintaining land records of the Upazila.

Emerging Issues:
- The entire area demarcated for the power hub is in possession of BPDB and no char land is allotted to anyone for cultivation.
- Prior to the development of the Power hub, most part of the land was government land though a small portion was privately owned.
- The land acquisition process to their knowledge has been completed and there are no pending cases. However, the detail of the land acquisition is not available with them.

- The land acquisition division in District Commissioner's office was reported to have the details about the land acquisition process.

Figure 9.1 Consultations with Community



Additional consultation carried out as part of fisheries study will be incorporated along with public disclosure meetings of the findings of draft ESIA study report.

This environmental and social impact assessment of the Summit M2 project of SMIIPCL dual fuel (Natural Gas and High Speed Diesel Oil) based combined cycle power plant of capacity around 600 MW (the Project) has been prepared based on an understanding of the technical specifications available as of January 2018, existing studies and reports undertaken, a scoping exercise in October – November 2017 and subsequent site visits, stakeholder consultations, baseline environmental monitoring and socio-economic surveys which were started from December 2017 and ongoing. The Project site is located within the area earmarked and developed for power generation by the Government of Bangladesh in Meghnaghat Power Hub as well as to fulfil the objectives of PSMP.

Through this process an assessment has been done of the potential environmental and social impacts attributable to the construction and operation phases of the Project in line with the applicable environmental regulations in Bangladesh and international standards of ADB and the IFC. Environmental and social impacts during decommissioning of the Plant have not been considered in the impact assessment, as these will depend on the options available at the time of expiry of the power purchase agreement between SMIIPCL and BPDB.

Qualitative and quantitative (where possible) assessments of impacts have been presented with an impact rating against each potential impact and mitigation measures to minimize and reduce the impacts. Cumulative environmental impacts particularly on air quality, and noise have also been assessed taking into consideration overall development of the Meghnaghat Power Hub.

The environmental and social assessment of the Project ascertains that the Project is unlikely to cause any significant adverse environmental and social impacts. Many of the impacts are localised and short-term or temporary in nature and can be readily addressed by some embedded control measures in the engineering design of the Project as well as additional mitigation measures as suggested in the Environmental and Social Management Plan. The Project received favourable support from local people and other stakeholders during consultations undertaken for the study. Stakeholders appreciated that in addition to providing a reliable power supply to the region, the Project will have several other benefits such as supporting economic growth in the region by opening avenues for further development, employment (direct and indirect) and improving local infrastructure.

The stakeholder feedback and perceptions towards the project has also been influenced by the recent developments such as proposed coal based power plant at Char Balaki, other industrial operations in the Meghnaghat Industrial Area.

10.1 PROJECT IMPACTS

10.1.1 Pre-construction Impacts

The project is to be developed within the industrial area and does not require any land procurement/ acquisition for project site as well as laydown areas, construction camps etc. Additional land outside the project site is available for these purposes. The Project study area is not having any ecologically protected areas. No archaeological or protected monuments are located in the Project vicinity. The nearest physical cultural resources (mosques and temples – excluding mosque within the power complex) of local importance are located over 600 m from the Project.

10.1.2 Construction Phase Impacts

During the construction phase of the Project, the key environmental issues are noise and dust generation. There is also a risk of contamination of soil, groundwater and on the Meghna River from accidental spills and leaks of hazardous materials (e.g. oil) during handling, transportation, and storage at the site.

Various mitigation measures have already been considered as embedded control measures by the Project Developer. The adverse impacts identified are generally manageable through good housekeeping and a diligent implementation of the ESMP by the EPC Contractor and its supervision by the Project Developer and their team of consultants. The nearest air quality and noise sensitive receptors will be a focus for monitoring of any impact arising due to the construction activities.

The social assessment of the Project ascertains that the Project is unlikely to cause any major social impacts during the construction phase. The adverse impacts are likely to be with respect to influx and in-migration into the project area and community health & safety. During the construction phase there will be impact from migration of labour into the Project area, construction activities and increased movement of traffic. The range of impacts identified include: conflicts with the local community, health and safety issues inconvenience due to vehicle movements, risk of spread of communicable and sexually transmitted diseases, waste disposal and unhygienic conditions. The magnitude and significance of most of these impacts would be limited to the construction period, with limited spill over to the operation phase.

As the project intends to have a construction camp outside the premises of the allotted land, but within the Meghnaghat Power Hub, the interaction between the community and migrant workers would be controlled. Furthermore, by implementing the recommended mitigation measures the Project will minimise the identified risks whereas on-going consultation and engagement will support the maintenance of a harmonious relation with the local community.

10.1.3 Operations Phase Impacts

During the operation phase of the Project, the two key impacts will be from the increase in ambient noise and air quality levels due to operation of plant equipment and auxiliary machinery. It has been demonstrated through air quality dispersion modelling with natural gas as primary fuel as well as HSD as secondary fuel, the incremental ground level concentrations due to the operation of the Plant will be well within the applicable ambient air quality standards. Continuous emission monitoring system from the stacks and continuous as well as periodic ambient air quality monitoring throughout operations will confirm compliance to the applicable standards/ guidelines and enable identification of further measures to reduce impacts to ALARP. Incremental noise levels due to the operation of Plant will meet the applicable GOB standards/IFC guidelines for industrial areas. However, the nearest noise sensitive receptors will have slightly higher noise levels than the applicable standards/ guidelines due to the higher background noise levels which are resulted primarily due to other industrial operations including cement plants, power plants, traffic and anthropogenic activities.

Induced draft cooling towers have been proposed in the project to reduce the water intake and outfall. About 250m^3/hr of cooling tower blowdown and treated wastewater will be discharged into Meghna River, however, same will not be continuous and will limit for about 3 to 4 hrs per day. The cooling tower blowdown will maintain increase in temperature difference between intake and outfall water temperature < 3°C and due to that the warming of surface water will be limited to a smaller area at outfall location, which will mix within a short distance (< 50 m) from the outfall location. A surface water quality monitoring program, along with quarterly monitoring of aquatic ecology and fisheries has been formulated to further understand the extent of impact, if any, and to alert SMIIPCL to take additional mitigation measures.

Local Community Benefits

The project development of SMIIPCL's power plant in addition to existing power plants and other large and medium scale industries will enable local economic benefits linked to employment generation, local procurement, encouragement of local enterprise development and skill development within the communities.

10.2 OVERALL PROJECT CATEGORISATION

To conclude, a majority of the environmental and social impacts are localised, short-term or temporary although some of them are permanent in nature like health associated risks due to air emissions and effluent release, but can be mitigated with appropriate mitigation measures built in as part of the Project planning process.

It is therefore established that the Project activities will trigger the ADB SPS Safeguard Requirement 1 and IFC Performance Standard 1 to 4 and 6 due to environmental and ecological impacts arising from the Project, involvement of about 800 workers during construction phase (peak demand) and about 90 workers during operation phase and occupational health and safety (*PS2 – Labour and Working Conditions*); emissions, effluents and waste generation during the entire project life cycle (*SR1 – Environment and PS3 - Resource Efficiency and Pollution Prevention*) and community health and safety (*PS4 - Community Health, Safety and Security*) and livelihood linked to fisheries limited extent (*SR1 – Environment and PS6 – Biodiversity Conservation and Sustainable Management of Living Natural* Resources) based on the assessment of the Project AOI.

However, PS5, PS 7 and 8 as well as SR-2 and SR – 3 will not be triggered, as the interactions between the baseline and the project development does not entail impacts to any land acquisition, involuntary resettlement and indigenous community, their ancestral domain or rights and protected archaeological/ physical cultural site in the vicinity of the Project and its associated facilities.

10.3 ENVIRONMENTAL AND SOCIAL MANAGEMENT

The effective implementation of the ESMP and adherence with the GOB, ADB and IFC guidelines and the ESMS of SCL will assist in minimising the environmental impacts to acceptable levels. No additional studies for the ESIA are envisaged at this stage; however, the report is required to be updated based on complete primary baseline monitoring data and disclosure of the findings of this ESIA to the stakeholders.

Post environmental assessment, surveillance and monitoring are essential to track and sustain the effectiveness of the mitigation measures suggested. A detailed monitoring plan has been prepared as part of the EMP. The focus areas of monitoring cover air, surface water quality, groundwater quality, noise, soil erosion, soil and groundwater contamination, occupational health and safety as well as community health and safety. The reporting requirements along with the follow up actions in case of deviation from the norms have been detailed in the ESMP. The frequency has also been set in consideration of the likely impacts.

10.4 RESIDUAL IMPACTS

Table 10.1 present the outcomes of the comprehensive assessment of identified impacts as a result of various phase of the project and present significance of residual impacts before mitigation (with embedded controls) and with suggested mitigation measures.

Table 10.1 Summary of Impact Assessment and Residual Impacts

Project Activities/ Impacts	Nature of Impact	Significance of Residual Impacts	
		Before Mitigation	With Mitigation
Construction Phase (Summit M2 Project)			
Soil compaction	Negative	Negligible	Negligible
Soil erosion	Negative	Negligible	Negligible
Soil and sediment contamination	Negative	Minor	Negligible
Soil contamination from waste handling	Negative	Negligible	Negligible
Waste water discharge	Negative	Minor	Negligible
Ground water contamination	Negative	Minor	Negligible
Air quality degradation due to dust generation	Negative	Moderate	Minor
Air quality degradation due to exhaust emissions	Negative	Minor	Minor
Noise from Construction Activities and transportation of man/ material (Day and Night time)	Negative	Negligible to Minor	Negligible to Minor
Terrestrial ecology (vegetation clearance, terrestrial habitat)	Negative	Minor	Negligible
Aquatic habitat disturbance (Temporary jetty, vessel movement)	Negative	Minor	Minor
Influx and in-migration	Negative	Moderate	Minor
Community health from changes in environmental conditions	Negative	Moderate	Minor
Local economy and skills development	Positive		
Operation Phase (Summit M2 Project)			
Contamination of soil and sediment from wastes	Negative	Negligible	Negligible
Surface water abstraction	Negative	Negligible	Negligible
Water pollution from wastewater discharge	Negative	Negligible	Negligible
Ground water contamination	Negative	Minor	Negligible
Ambient Air Quality (by use of natural gas and HSD as fuel for power generation)	Negative	Minor to Negligible	Minor to Negligible
GHG Emission due to Summit M2 project	Negative	Moderate	Moderate
Noise from Operation of Plant and vehicular movement in Access Road (Day and night time)	Negative	Negligible to Minor	Negligible to Minor
Electric and magnetic field	Negative	Minor	Negligible
Impact on Terrestrial habitat	Negative	Minor	Negligible to Minor
Risks due to hazardous materials handling and storage	Negative	Minor	Negligible to Minor
Community health and safety due to project induced traffic	Negative	Minor	Negligible
Risks of industrial accidents and fatalities to workers	Negative	Minor	Negligible
Impact on fishing communities	Negative	Minor	Negligible
Employment generation and in-migration of skilled workforce	Positive		
Cumulative Impacts due to Operation of Proposed Power Projects			
Ambient Air Quality (Operation of Summit M2, Reliance and Orion Coal Project)	Negative	Minor	Negligible to Minor
Noise from Operation Summit M2 and Reliance Power Projects	Negative	Negligible to Minor	Negligible to Minor

10.5 CONCLUSION

Based on the analysis conducted in this environmental and social assessment, it is concluded that overall the Project will result in positive socio-economic benefits and the negative environmental impacts that have been identified are mostly short-term and localised in nature, and can be minimized adequately through good design, appropriate application of mitigation measures and regular supervision of implementation.

Annex A

Letter of Intent from Bangladesh Power Development Board

"শেখ হাসিনার উদ্যোগ,
ঘরে ঘরে বিদ্যুৎ"

Central Secretariat
Bangladesh Power Development Board
WAPDA Building (1st Floor)
Motijheel C/A, Dhaka-1000.

বাংলাদেশ বিদ্যুৎ উন্নয়ন বোর্ড

Bangladesh Power Development Board

Memo No-27.11.0000.101.14. 076-17-3722 Date: 27-11-2017

Consortium of Summit Corporation Limited and GE, USA
Summit Centre,
18, Karwan Bazar C/A, Dhaka-1215,
Bangladesh,
E-mail: summitcorporationlimited@summitcentre.com

Subject: Letter of Intent (LOI) for the development of a Dual Fuel (NG/RLNG and HSD) fired Combined Cycle Power Generation Facility of 583MW (Gas/RLNG)/534 MW(HSD) (Net) Capacity at Meghnaghat, Narayangonj, Bangladesh on Build-Own-Operate (BOO) basis under Private Sector Power Generation Policy of Bangladesh by Consortium of Summit Corporation Limited and GE, USA.

Ref: 27.00.0000.071.14.053.2017.644 Dated: 13/11/2017.

Dear Sir,

A. REFERENCE

This Letter of Intent, hereinafter referred to as the "LOI" is being issued to the addressee, pursuant to approval received from the Power Division, Ministry of Power, Energy and Mineral Resources (MPEMR), Bangladesh Secretariat, Dhaka vide memo referred above for the development of the project identified below (the "Project") under the special act, 2010 (Revised 2015) for enhancement of power & energy (বিদ্যুৎ ও জ্বালানীর দ্রুত সরবরাহ বৃদ্ধি (বিশেষ বিধান) আইন, ২০১০ (সংশোধিত ২০১৫)) on the terms described in this LOI.

B. AUTHORIZATION

The People's Republic of Bangladesh represented by the Power Division, Ministry of Power, Energy and Mineral Resources, hereinafter referred to as the "GOB" accords its approval on the following Levelized Tariff of Consortium of Summit Corporation Limited and GE (the "Sponsor") to design, finance, insure, construct, own, Commission, operate and maintain (the "Project") a 583MW (NG/RLNG)/534 MW(HSD) (Net) (at Reference Site Conditions) Dual Fuel (NG/RLNG and HSD) based Combined Cycle Power Generating Facility at Meghnaghat, Narayanganj, hereinafter referred to as the "Facility", as more fully described in the Proposal:

- Levelized Tariff Charge: for Gas Operation= US Cents 3.6932/kWh
  for HSD Operation= US Cents 15.7563/kwh
  for R-LNG operation= US Cents 6.8109/kWh

(at 84.6% plant factor, 12% discount factor, Gas Price = USD 2.4/GJ, R-LNG price US dollar 7.2625/mmbtu, HSD Price = USD 20.36/GJ and exchange rate 1 USD = 80 Taka)

The Facility will have a net electric power generating capacity of 583 MW (NG/RLNG)/534 MW (HSD) (Net). Net Dependable Capacity and Net Energy Output from the Facility will be sold under the Power Purchase Agreement, hereinafter referred to as the "PPA". The Company formed by the Sponsor shall be solely responsible for the financing, development and completion of the Project and development of the necessary related facilities in accordance with the requirements contained in the Proposal and the timetable and milestones contained in the Proposal, under the terms & conditions mentioned in this LOI.

C. PROJECT IN BRIEF:

1.	Contracted Capacity	:	583MW (NG/R-LNG) and 534 MW(HSD)
2.	Shareholding of the Company formed by the Sponsor	:	Summit Corporation Limited - 80% and General Electric Company - 20%
3.	Location of the Project Site	:	Meghnaghat, Narayanganj.
4.	Land of the Project	:	BPDB will provide 14.28 (Fourteen point Two Eight) acres of land available in Meghnaghat, Narayanganj Power Hub area to the Sponsor in "as is" condition. Additional land apart from the BPDB's land shall be arranged by the Sponsor at its own cost and responsibility. The Sponsor shall develop the land at its own cost and responsibility. BPDB shall not incur any liability for delay in developing the land by the Sponsor what so ever the reason.
5.	Fuel Type	:	Dual Fuel (NG/R-LNG and HSD). For Gas/R-LNG (main fuel) operation, the fuel issue will be settled by the competent authority of GOB. The Sponsor shall ensure necessary gas to its power plant under the GSA to be signed with Petrobangla or its Subsidiary. The Commercial Operation Date (COD) will be in Gas/R-LNG operation. For HSD operation (interim arrangement), HSD will be supplied under the Fuel Supply Agreement to be signed with BPC & the Company.
6.	Plant Type	:	Combined Cycle Power Project. (1+1+1 configuration)
7.	Project Agreements to be signed for Implementation of the Project		Power Purchase Agreement (PPA), Land Lease Agreement (LLA), Implementation Agreement (IA) and Gas Supply Agreement (GSA) and Fuel Supply Agreement (FSA)
8.	Power Evacuation Facility	:	The evacuation voltage will be at 400kV level. The Company (sponsor) shall construct and own 400kV switchyard for evacuation of power. The Company (sponsor) shall install all equipments and construct one Interconnection link (overhead line or underground cable, as applicable and approved by PGCB) including bay/diameter extension at its own cost and responsibility as per requirement and approval of PGCB to connect company's switchyard to PGCB's 400kV switchyard/Line. The 400kV switchgear, breaker, current transformer, potential transformer, associated relays, controls, protection, communication and instrumentation system including all relevant equipment at PGCB's 400kV switchyard will be built and commissioned by the Company (sponsor) at its own cost and responsibility maintaining standard procedure/approval of PGCB then transferred to PGCB at no cost for operation and maintenance. The power line communication facilities (if required) at the remote end (PGCB substation) shall be constructed by Company (sponsor), owned and operated by PGCB as a back-up communication link of optical communication system, responsible for transmitting SCADA data, voice & Tele-protection. The Company (sponsor) shall provide communication links to the SCADA control system for the Grid System including adequate Remote Terminal Unit (RTU) points to accommodate PGCB and the National Load Dispatch Centre (NLDC) requirements.

9.	System Operational Requirement		The plant shall be capable of contributing primary frequency response (i.e. Free Governor Mode of Operation (FGMO)) to participate in stabilizing system frequency. The governor system shall be fitted with adjustable droop and shall have capability to operate with droop of 4% to 5%. The response to a change of system frequency shall be fully available within 10 seconds of the frequency change and be sustainable for a further 30 seconds. The plant shall be capable of running on Automation Generation Control (AGC/LFC) Mode. Therefore, the plant shall participate in secondary & tertiary frequency control. The plant shall provide all required SCADA, Communication interfaces (Voice, Data & Tele-protection) & equipments to operate the plant on AGC & Tertiary mode from NLDC. Secondary response shall fully available by 30 seconds from the time of frequency change to take over from primary response, and shall be sustainable for a period of at least 30 minutes. All SCADA & Communication equipments within plant & communication media (i.e. OPGW) from plant to NLDC (PGCB substation in case of existing communication capacity/facilities from NLDC to substation is available) for running AGC & Tertiary control shall be ensured by the plant. All data of the plant required for SCADA & EMS software shall be provided to NLDC. The plant should also have facilities for automatic voltage regulation from plant side as a future provision.
10.	Project Effective Date	:	Means the date on which the last of Project Agreements is executed.
11.	Required Commercial Operations Date (RCOD)	:	36 months from the Project Effective Date in Combined Cycle Operation only.
12.	Contract Period	:	22 years
13.	Financial Closing Date	:	9 (nine) months from the Project Effective Date
14.	Reference Date in relation to the inflation/indexation for invoice payment under PPA	:	Means the Letter of Intent (LOI) issue date.

D. FORMATION OF COMPANY

The Sponsor shall form a "Company" for the purpose of this Project, which will be a special purpose vehicle i.e. a public/private limited company incorporated in the Joint Stock Companies, Bangladesh promoted and sponsored by the Sponsor (in case of Joint Venture Consortium by all the Joint Venture Partners). The Project Agreements shall be executed by that "Company" which will be responsible for design, finance, insure, build, own, operate and maintain etc. of the Project. After the incorporation of the "Company", the rights and obligations of the Sponsor hereunder will be assigned to the "Company".

E. NO LIABILITY FOR REVIEW

No review, examination, evaluation or approval by BPDB of any document, instrument, drawing, specifications or design proposed or delivered by the Sponsor or the Company in connection with the delivering of its Proposal or BPDB's evaluation thereof or the issuance of this LOI shall relieve the Sponsor or the Company from any obligation or liability that it would otherwise have had for its negligence in the preparation of such document, instrument, drawing, specification or design or failure to comply with applicable laws of Bangladesh or to satisfy the Company's obligations under this LOI, the Project Agreements, or the other documents comprising the Security Package (as defined in the IA) with respect thereto, nor shall BPDB be liable to the Sponsor or the Company or any other person by reason of its review, examination, evaluation or approval of any document, instrument, drawing, specification, or design.

F. PROPOSAL AND PROPOSAL SECURITY

The Proposal submitted by the Sponsor will be initially valid for at least 6 (six) months from the date of issuance of this LOI. The Sponsor Shall be required to submit the Bank Guarantee as Proposal Security of the amount of USD 5.83 (Five point Eight Three) million only at the rate of USD 10,000.00 per MW for 583MW (NG/RLNG)/534 MW(HSD) along with the acceptance of this LOI. The Proposal Security shall have to be initially valid for at least 6 (six) months from the date of issuance of this LOI.

G. VALIDITY OF THE PROPOSAL AND THE PROPOSAL SECURITY

The validity of the Proposal and Proposal Security shall have to be extended upon request from BPDB for an additional period of three (3) Months or more until such time as the Project Agreements are executed.

H. GOVERNING LAW

This Letter of Intent (**LOI**) shall be governed by and construed in accordance with the Laws of Bangladesh.

I. ACCEPTANCE OF LETTER OF INTENT (LOI)

You are requested to communicate your unconditional acceptance (not acknowledgement) of this LOI within 7(seven) days from the issuance of this LOI. If the Sponsor fails to submit the required amount of Proposal Security upon acceptance of LOI, BPDB shall have the right to terminate the LOI.

J. TERMINATION OF LOI

1. The Sponsor will provide its unconditional acceptance of LOI within seven (7) days and the initialed Project Agreements within 30 (thirty) days from the issuance of this LOI.

   If the Sponsor fails to furnish (i) the acceptance of LOI along with Proposal Security and (ii) initialed Project Agreements within stipulated time as mentioned above, BPDB shall reserve the right to terminate this LOI.

2. The Company formed by the Sponsor will sign (i) the Implementation Agreement ("IA") with the GOB, (ii) the Power Purchase Agreement ("PPA") & the Land Lease Agreement ("LLA") with BPDB, (iii) the Gas Supply Agreement ("GSA") with the concerned Gas Supplier and (iv) Fuel Supply Agreement (FSA) with Bangladesh Petroleum Corporation (BPC) (collectively, the "Project Agreements"), failure to which, BPDB shall reserve the right to terminate this LOI by written notification to the Sponsor & forfeit the Proposal Security.

3. The Sponsor shall be required to submit the Bank Guarantee as Proposal Security for the amount of USD 5.83 million (Five point Eight Three million) at the rate of USD 10,000.00 per MW for 583MW (NG/RLNG)/534 MW(HSD) upon acceptance of LOI. This Proposal Security shall continue till the Project Effective Date of the Project. If the Company fails to sign the Project Agreements within 7 (seven) Days following the notification of BPDB; BPDB shall have the right to terminate the LOI as well as to forfeit the Proposal Security.

4. The Sponsor will provide the Performance Security Deposit for the amount of USD 20.988 million (Twenty point Nine Eight Eight million) only at the rate of USD 36,000.00 per MW for 583MW (NG/RLNG)/534 MW(HSD) (Contracted Capacity), Certificate of Incorporation (along with Memorandum and Articles of Association) for newly formed "Company" in Bangladesh no later than two (2) days prior to the date of signing of the Project Agreements, failure to which, BPDB shall reserve the right to terminate this LOI by written notification to the Sponsor as well as to forfeit the Proposal Security.

5. The Sponsor shall extend the Proposal validity & the Proposal Security validity at least 7 (seven) days prior to the expiration of the Proposal validity and Proposal Security validity until such time as the project Agreements are executed, failure to which, BPDB shall have the right to forfeit the Proposal Security.

6. Upon termination of LOI, neither the Sponsor nor the Company shall have any claim for compensation or damages against BPDB or any other governmental agency on any grounds whatsoever.

Please note that, if the Company fails to execute the Gas Supply Agreement (GSA) with the concerned Gas Supplier, BPDB shall have no obligation to execute this LOI.

BPDB looks forward to working with you to make the Project a great success.

27.11.17

(Md. Emrul Hossain)
Secretary (Addl. Charge)
Bangladesh Power Development Board

Md. Fazlul Hoque
Director
IPP CELL-1, BPDB, Dhaka.

Memo No-27.11.0000.101.14.076, 3722

Date: 27-11-2017

Copy to:

1. Chairman, Petrobangla, Petro Centre, Kawran Bazar, Dhaka.
1. Member, Finance/Company Affairs/Generation/Administration/R&D/Distribution, BPDB, Dhaka.
2. Managing Director, PGCB, IEB Bhaban, Ramna, Dhaka. Fax: 7171833.
3. Managing Director, Titas Gas Transmission & Distribution Company Ltd, Kawran Bazar, Dhaka
4. Managing Director, Gas Transmission Company Ltd (GTCL), Sher-e-bangla Nagar, Dhaka
5. Chief Engineer, Private Generation/Generation/P&D, BPDB, Dhaka.
6. Controller of Accounts & Finance, BPDB, Dhaka.
7. Director, IPP Cell-1/System planning/Finance/Contract and Consultant Administration, BPDB, Dhaka.
8. C S O to Chairman, BPDB, Dhaka.
9. P S to Secretary, Power Division/Energy Division, Ministry of Power, Energy & Mineral Resources, Bangladesh Secretariat, Dhaka.
10. P S to State Minister, Ministry of Power, Energy & Mineral Resources, Bangladesh Secretariat, Dhaka.

(Pranob Kumar Ghosh)
Senior Assistant Secretary (Dev.)
Central Secretariat, BPDB, Dhaka.

Annex B

Rapid Environment Assessment Checklist

Country /Project Title: Bangladesh/ Summit Meghnaghat-2 Power Project

589.750 (Net) MW on Gas/ 541.220 (Net) MW on Liquid Fuel of Combined Cycle Power Station, Meghnaghat Power Hub, Bangladesh

Sector: Thermal Power Plant

SCREENING QUESTIONS	Yes	No	REMARKS
A. Project Siting Is the project area adjacent to or within any of the following environmentally sensitive areas?			
▪ Cultural Heritage Site		☑	As per the information available from Department of Archaeology, Bangladesh (www.archaeology.gov.bd), there are reportedly no cultural heritage sites and archeological monuments close to the project site. The nearest archaeologically important sites are Tomb of Sultan Ghiasuddin, the shrines of Panjpirs and Shah Abdul Alla and a beautiful mosque at Goaldi village, which are about 5 km north of the project site. Other important site is Idrakpur Fort, which is about 9.5 km south-west in Munshiganj. There are religious structures such as local mosques in the unions as well as in nearby areas including in the Meghnaghat industrial area. The key ones are Meghnaghat Jama Mosque, BPML-1 Jama Mosque, Protap Nagar Jama Mosque within Meghnaghat Industrial Area; and Dudghata Mosque, Mongalargoan Maszid, Chowdhurygoan Mosque in the Pirijpur Union. These are located between 1 and 2 km from the project site.
▪ Protected Area		☑	There is reportedly no protected area, such as National Park, Wildlife Sanctuary, Game Reserve, Safari Parks, Eco-Parks, Reserve and Protected Forests within the 10 km study area. The nearest Ecological Critical Area is Sitalakhya River, which is approximately 9.2 km west from project site. The ecosystem of Sitalakhya River is considered to be threatened to reach a critical state. Sitalakhya River and its foreshore areas were declared as "ecologically critical area" (ECA), according to provisions of the Environmental Conservation Act 1995 and the Environmental Conservation Rules 1997.
▪ Wetland	☑		In Bangladesh wetlands area classified into river, streams, Baors, Haors and Beels. All of these are considered as wetlands and regarded as valuable fish and wildlife

SCREENING QUESTIONS	Yes	No	REMARKS
			habitat. The Meghnaghat Industrial area has been developed on the riverine island of Meghna River. The Meghna River is located on the east and minor channel of Meghna River is on west. In the 10 km study area, there are other channels and numbers of beels and canals. However none of the important wetlands are located in the 10 km study radius.
▪ Mangrove		☑	No mangrove vegetation was observed in and around the study area during the reconnaissance and baseline survey visit. Also no reference was available about mangrove vegetation in the Narayanganj District.
▪ Estuarine		☑	The Project site and district is not part of any estuary.
▪ Buffer Zone of Protected Area		☑	There is no Protected areas on land in 10 km radius study area around the proposed project site The Sitalakhya River has been declared as an Ecologically Critical Area and is located 9.2 Km west of the Project Site.
▪ Special Area for Protecting Biodiversity		☑	None
B. Potential Environmental Impacts Will the Project Cause…			
▪ Impairment of historical/cultural monuments and other areas, and loss/damage to these sites?		☑	No impairment of historical/ cultural monuments and loss/ damage to these sites envisaged due to the proposed project.
▪ Encroachment into precious ecosystem (e.g. sensitive habitats like protected forest areas or terrestrial wildlife habitats?		☑	No encroachment into precious ecosystem is envisaged due to the proposed Project, as there is reportedly no protected area, such as National Park, Wildlife Sanctuary, Game Reserve, Safari Parks, Reserve, and Protected Forests protected by law, within the study area.
▪ Dislocation or involuntary resettlement of people?		☑	None
▪ Disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		☑	None
▪ Aesthetic degradation and property value loss due to establishment of plant and ancillary facilities?		☑	The Project is being developed next to an existing Power plant so aesthetically it has precedents. The area was identified and developed for power plants so property value loss due to establishment of plant is not expected.
▪ Risks and vulnerabilities related to occupational health and safety due to physical, chemical,	☑		The occupational health and safety impacts during the construction and operation

SCREENING QUESTIONS	Yes	No	REMARKS
biological, and radiological hazards during project construction and operation?			phase of the Project would be (i) heat, (ii) noise, (iii) confined spaces, (iv) electrical hazards, (v) fire and explosion hazards, (vi) chemical hazards and (vii) dust
▪ Noise and dust from construction activities?	☑		Noise and dust will be temporally generated due to civil works, movement of heavy machinery, transportation of man & material, excavation of earth and other construction activities.
▪ Short-term soil erosion and silt runoff due to construction?	☑		As per the Bangladesh Meteorological Department (BMD), district Narayanganj receives heavy rainfall. Based on the rainfall record of 24 years (1991 – 2015), annual average rainfall varied from 1787 - 2900 mm. The proposed project site is already developed and raised above HFL. During construction of plant, some earth work is expected due to piling and foundations. During monsoon season, erosion of exposed soil (due to earth work) some erosion may occurred. This eroded matter may discharged into the nearest Meghna River is surface water drainage system with sedimentation tank not properly planned and maintained.
▪ Fugitive dust during transportation, unloading, storage, and processing of coal, and polluted runoff from coal storage?	☑		The proposed power plant is based on natural gas as primary fuel and HSD will be used only in case of non-availability of natural gas supply as secondary fuel. No use of coal is envisaged in the project.
▪ Risk of oil spills, which could pollute surface and groundwater and soil?	☑		Such risks exist during the construction as well as operation phase of the Project. HSD will be transported and stored at near to site in existing tank farm of Summit M1 project. No new tank farm for the project to store HSD is planned.
▪ Hazards in gas pipeline operation and gas storage at power plant sites?	☑		The gas pipeline operation would have fire and explosion hazard, as the natural gas will be present in pipeline at high pressure (about 600 psig). However, no gas storage is required at site. The gas pipeline will be constructed in accordance with GSA specification and will be transferred to gas supplier after testing & commissioning. It will be gas supplier's property as part of the gas supply network during the plant operation. The pipeline will have a minimum cover of 1.0 m on top of it. Cathodic protection will be in place for the buried section of the pipeline and the design will be based on soil resistivity.
▪ Changes in flow regimes downstream of the water intake due to abstraction for cooling purposes?		☑	The cooling system using induced draft cooling towers is basically a closed system which reduces the fresh water requirement for cooling purpose significantly in

SCREENING QUESTIONS	Yes	No	REMARKS
			comparison of once through cooling system. The fresh water requirement for cooling water make-up and other plant water requirements will therefore be limited to 1000 m^3/day, which will be abstracted for the Meghna River. The Meghna River is wide river near Meghnaghat Industrial area. The surface water is available through-out the year. The withdrawal of 1000 m^3/day, from Meghna River may not cause any significant impact to other down-stream users.
▪ Pollution of water bodies and aquatic ecosystem from wastewater treatment plant for boiler feed, bleed-off from cooling towers, boiler blowdown and wash-water, and effluent from ash pond?		☑	Project will be having induced draft cooling towers for cooling purpose, which will reduce the water requirement as well as discharges. About ¼ of the total intake water (including cooling tower blowdown, treated domestic and industrial effluent) will be discharged into the Meghna river through a channel of about 700 m length.
▪ Air pollution from fuel gas discharged into the atmosphere?	☑		NOx and CO will be primarily emitted from gas based power generation, whereas SO2, NOx, CO, and PM will be emitted from HSD based power generation during non-availability of gas.
▪ Public health and safety hazards due to solid waste disposal in sanitary landfills (see Matrix of Impacts and Measures for Solid Waste Disposal)?	☑		Solid waste generation from the project would be limited and only from the canteen and office complex. In addition to that construction waste (inert) will be generated during the construction stage. The solid and non-hazardous wastes generated from the various areas during operations will be collected and segregated at the point of generation and stored in proper designated areas and disposed of through waste disposal contractors or authorized recyclers. It is planned that hazardous wastes (such as Chemical Cleaning waste from the CT compressor, Waste/used oil from the power house and workshop, Oil/dust contaminated cloths and rags from the lube oil system and spill kit waste) generated from the proposed Project will be collected and stored in designated roofed-areas and/or barrels with concrete flooring and secondary containment and disposed of/ sold through contractors or treated prior to discharge.
▪ Large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		☑	During the peak construction phase, the project will require about 800 personnel. A site camp will be provided for EPC contractor/ subcontractor personnel. It is reported that majority of unskilled and semi-skilled workforce will be engaged

SCREENING QUESTIONS	Yes	No	REMARKS
			from neighboring areas and this will reduce the requirement of housing arrangement for these workers. Also as the project area is already been developed as an industrial hub with existing worker population, hence, no large population influx is anticipated. During the operation phase, manpower requirement will be between 60 to 75 personnel. A dormitory will be provided for O&M team within the project site.
▪ Social conflicts if workers from other regions or countries are hired?		☑	There will be no social conflicts as the place has local workers available in the region.
▪ Risks community safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?	☑		Natural gas will be supplied to the project through underground pipeline, whereas a new natural gas pipeline will be constructed for that of about < 0.5 km length. Fuel oil (HSD) required for gas turbines will be delivered by Bangladesh Petroleum Corporation. The oil will be delivered by barges to the existing jetty on the Meghna River of Summit M1 project and will be stored in existing tank farm of Summit M1 project. No new jetty/ tank farm is proposed for Summit M2 project.
▪ Community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project (e.g. ash pond) are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?	☑		The plant operation will require chemicals for water treatment and process requirements. A list of the hazardous chemicals which will be used in the Plant, such as hydrochloric acid, caustic lye, sulphuric acid, chlorine etc.

A Checklist for Preliminary Climate Risk Screening

Country /Project Title: Bangladesh/ Summit Meghnaghat-2 Power Project

589.750 (Net) MW on Gas/ 541.220 (Net) MW on Liquid Fuel of Combined Cycle Power Station, Meghnaghat Power Hub, Bangladesh

Sector: Thermal Power Plant

Screening Questions		Score	Remarks[1]
Location and Design of project	Is siting and/or routing of the project (or its components) likely to be affected by climate conditions including extreme weather related events such as floods, droughts, storms, landslides?	0	The proposed project site not located in active flood risk zone, cyclone/ storm surge prone area. The proposed project site is already raised above HFL
	Would the project design (e.g. the clearance for bridges) need to consider any hydro-meteorological parameters (e.g., sea-level, peak river flow, reliable water level, peak wind speed etc.)?	0	Dependency of the project on river water is limited for meeting the raw water requirement, which is limited due to the use of cooling towers in the project. As, the Meghna River is large and surface water resource is available throughout the year. The proposed withdrawal will not cause any measurable change of river hydrology.
Materials and Maintenance	Would weather, current and likely future climate conditions (e.g. prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydro-meteorological parameters likely affect the selection of project inputs over the life of project outputs (e.g. construction material)?	0	Weather and current and future climate conditions are unlikely to impact the selection of project inputs (primarily natural gas).
	Would weather, current and likely future climate conditions, and related extreme events likely affect the maintenance (scheduling and cost) of project output(s)?	1	It is possible that changes in weather and likely future climate conditions could affect the maintenance of project outputs.

(1) [1] If possible, provide details on the sensitivity of project components to climate conditions, such as how climate parameters are considered in design standards for infrastructure components, how changes in key climate parameters and sea level might affect the siting/routing of project, the selection of construction material and/or scheduling, performances and/or the maintenance cost/scheduling of project outputs.

Screening Questions		Score	Remarks[1]
Performance of project outputs	Would weather/climate conditions and related extreme events likely affect the performance (e.g. annual power production) of project output(s) (e.g. hydro-power generation facilities) throughout their design life time?		

Options for answers and corresponding score are provided below:

Response	Score
Not Likely	0
Likely	1
Very Likely	2

Responses when added that provide a score of 0 will be considered low risk project. If adding all responses will result to a score of 1-4 and that no score of 2 was given to any single response, the project will be assigned a medium risk category. A total score of 5 or more (which include providing a score of 1 in all responses) or a 2 in any single response will be categorized as high risk project.

Result of Initial Screening (Low, Medium, High): Medium

Annex C

Involuntary Resettlement Impact Categorization Checklist

Probable Involuntary Resettlement Effects	Yes	No	Not Known	Remarks
Involuntary Acquisition of Land				
1. Will there be land acquisition?		☑		Land acquisition for Meghnaghat Power Hub (which includes the proposed project) was done in 1997-98 and handed over to BPDB. No new land acquisition for the project is anticipated. 14.28 acres of land for the Project will be obtained through process of land lease agreement from BPDB. In addition to that about 9.4 acres of land will be required for Laydown Area and Worker's Accommodation during construction period. Area identified for the same are also available within the Meghnaghat power hub and will be obtained through land lease agreement from BPDB.
2. Is the site for land acquisition known?		☑		No land acquisition will be undertaken for the project.
3. Is the ownership status and current usage of land to be acquired known?	☑			Land required for the project including laydown area and workers' accommodation area are located within the Meghnaghat power hub and land ownership is presently with BPDB.
4. Will easement be utilized within an existing Right of Way (ROW)?	☑			BPDB will grant SMIIPCL the right to the non-exclusive, free and unfettered use of the Access road throughout the term of the LLA. In addition to that RoW for the gas pipeline up to the valve station of Petrobangla appointed agency will be provided by the BPDB.
5. Will there be loss of shelter and residential land due to land acquisition?		☑		Not applicable

Probable Involuntary Resettlement Effects	Yes	No	Not Known	Remarks
6. Will there be loss of agricultural and other productive assets due to land acquisition?		☑		Not applicable
7. Will there be losses of crops, trees, and fixed assets due to land acquisition?		☑		Not Applicable
8. Will there be loss of businesses or enterprises due to land acquisition?		☑		Nat Applicable
9. Will there be loss of income sources and means of livelihoods due to land acquisition?		☑		No loss of income sources is anticipated and no loss of livelihood due to land acquisition for the project, as no land acquisition will be undertaken.
Involuntary restrictions on land use or on access to legally designated parks and protected areas				
10. Will people lose access to natural resources, communal facilities and services?		☑		Typically, local people can lose access to natural resources, but the exact nature and scale is not known.
11. If land use is changed, will it have an adverse impact on social and economic activities?		☑		The area where the Project is located has already been demarcated as industrial zone (especially power hub). However, any adverse impact on social and economic activities is not known at this stage.
12. Will access to land and resources owned communally or by the state be restricted?		☑		
Information on Displaced Persons:				
e likely number of persons that will be displaced by the Project? [☑] *No* [ ] *Yes* If yes, approximately how many? _____				
oor, female-heads of households, or vulnerable to poverty risks? [☑] *Unknown* [ ] *No* [ ] *Yes*				
persons from indigenous or ethnic minority groups? [ ] *Unknown* [☑] *No* [ ] *Yes*				

Annex D

Indigenous Peoples Impact Screening Checklist

KEY CONCERNS (Please provide elaborations on the Remarks column)	YES	NO	NOT KNOWN	Remarks
A. Indigenous Peoples Identification				
1. Are there socio-cultural groups present in or use the project area who may be considered as "tribes" (hill tribes, schedules tribes, tribal peoples), "minorities" (ethnic or national minorities), or "indigenous communities" in the project area?		☑		The census data (2011) of Bangladesh shows that the total population of ethnic minority in Sonargaon Upazila is 162 and in Pirijpur Union Parishad is 6. There are 42 ethnic households in Sonargaon Upazilla and 1 household in Pirijpur Union. There will be no impact on the ethnic minority household.
2. Are there national or local laws or policies as well as anthropological researches/studies that consider these groups present in or using the project area as belonging to "ethnic minorities", scheduled tribes, tribal peoples, national minorities, or cultural communities?		☑		Not applicable
3. Do such groups self-identify as being part of a distinct social and cultural group?		☑		Not applicable
4. Do such groups maintain collective attachments to distinct habitats or ancestral territories and/or to the natural resources in these habitats and territories?		☑		Not applicable
5. Do such groups maintain cultural, economic, social, and political institutions distinct from the dominant society and culture?		☑		Not applicable
6. Do such groups speak a distinct language or dialect?		☑		Not applicable

KEY CONCERNS (Please provide elaborations on the Remarks column)	YES	NO	NOT KNOWN	Remarks
7. Has such groups been historically, socially and economically marginalized, disempowered, excluded, and/or discriminated against?		☑		Not applicable
8. Are such groups represented as "Indigenous Peoples" or as "ethnic minorities" or "scheduled tribes" or "tribal populations" in any formal decision-making bodies at the national or local levels?		☑		Not applicable
B. Identification of Potential Impacts				
9. Will the project directly or indirectly benefit or target Indigenous Peoples?		☑		Not applicable
10. Will the project directly or indirectly affect Indigenous Peoples' traditional socio-cultural and belief practices? (e.g. child-rearing, health, education, arts, and governance)		☑		Not applicable
11. Will the project affect the livelihood systems of Indigenous Peoples? (e.g., food production system, natural resource management, crafts and trade, employment status)		☑		Not applicable
12. Will the project be in an area (land or territory) occupied, owned, or used by Indigenous Peoples, and/or claimed as ancestral domain?		☑		Not applicable
C. Identification of Special Requirements *Will the project activities include:*				
13. Commercial development of the cultural resources and knowledge of Indigenous Peoples?		☑		Not applicable

KEY CONCERNS (Please provide elaborations on the Remarks column)	YES	NO	NOT KNOWN	Remarks
14. Physical displacement from traditional or customary lands?		☑		Not applicable
15. Commercial development of natural resources (such as minerals, hydrocarbons, forests, water, hunting or fishing grounds) within customary lands under use that would impact the livelihoods or the cultural, ceremonial, spiritual uses that define the identity and community of Indigenous Peoples?		☑		Not applicable
16. Establishing legal recognition of rights to lands and territories that are traditionally owned or customarily used, occupied or claimed by indigenous peoples?		☑		Not applicable
17. Acquisition of lands that are traditionally owned or customarily used, occupied or claimed by indigenous peoples?		☑		Not applicable

D. Anticipated project impacts on Indigenous Peoples - Not Applicable

Project Component / Activity / Output	Anticipated Positive Effect	Anticipated Negative Effect
1.		
2.		
3.		
4.		
5.		

Note: The project team may attach additional information on the project, as necessary.

Annex E

Screening Checklist for Greenfield Projects – Summit Corporation Limited

SITE SELECTION/SCREENING FOR GREENFIELD PROJECT

Project Title	589.750 (net) MW on Gas/ 541.220 (net) MW on Liquid Fuel of Combined Cycle Power Station (Summit Meghnaghat 2)
Type of Project	Dual fuel fired combined cycle power project (CCPP)
Project Components (as e.g. power plant, fuel pipeline, water arrangements, transmission line, access road, arrangement for transportation of materials through jetty, worker accommodation etc)	• Power plant (1 dual fuel GT + 1 ST + 1 HRSG); • LNG and HSD pipelines of less than 500 m; • Water intake from Meghna River; • Induced draft cooling towers; • Temporary jetty in close vicinity for transportation of heavy lifts and major construction materials; • Use of existing pontoon of Summit Meghnaghat 1 project for HSD unloading; • Use of existing tank farm of Summit Meghnaghat 1 project for HSD storage; • Existing access road connection; • Workers accommodation and laydown areas within 500 m from the site.
Status of Land (Made available by GoB/to be transferred/to be acquired/to be purchased/existing)	Site located within Meghnaghat Power Hub of the Bangladesh Power Development Board (BPDB), Government of Bangladesh. Same will be leased to the project company (Summit Meghnaghat II Power Company Limited) after signing of the land lease agreement (LLA).
Total Land involved	• Available land to be leased for the power plant : 14.28 acres • Land requirement for laydown area/s (construction phase) : 6.20 acres • Land requirement for workers' accommodation (construction) : 3.20 acres
Location details	Meghnaghat Power Hub Mouza: Char Ramjan Sonaullah Union: Pirijpur Upazilla: Sonargaon District: Narayanganj (Bangladesh)
Coordinates	The Project site co-ordinates are as follows: • NW corner: 23°36'36.73"N, 90°35'46.53"E • NE corner: 23°36'37.31"N, 90°35'50.69"E • SE corner: 23°36'24.10"N, 90°35'54.10"E • SW corner: 23°36'23.56"N, 90°35'48.50"E

GO/ NO-GO CRITERIA FOR GREENFIELD PROJECT

S. No.	Criteria / Things to Check for	(Please tick appropriate one)		Evidence Details		Remarks
		Go	No Go			
1.	Work in or near an ecological or cultural area of international or national importance (e.g., RAMSAR wetland, National Park, protected ecological preserve, world heritage site, etc.)	☒	☐	Protected areas as per Wildlife (Conservation and Security) Act, 2012 Reserved and protected forests Ecologically critical area	None, within 10 km radial zone (No forest land within Narayanganj and Mushiganj districts) None within 10 km radial zone Shitalakshya River: 9.2 km* west	
2.	Land involving, impacting, or simply near Indigenous Peoples, Traditional Cultures or equivalent communities.	☒	☐	The census data (2011) of Bangladesh shows that the total population of ethnic minority in Sonargaon Upazila is 162 and in Pirijpur Union Parishad is 6. There are 42 ethnic households in Sonargaon Upazilla and 1 household in Pirijpur Union.		
3.	• Coastal Areas - Site falling within High Tide line (HTL) • Distance from flood plains or riverine systems (In context to Bangladesh, there could be many such sites which are in the HTL. Such information should trigger the mitigation requirement and the associated cost it may induce.	☒	☐	Project site is not close to coastal areas, however, the site abuts Meghna River. The Meghnaghat Power Hub is not prone to flooding. The Project site is also not affected by flood waters in the past, since BPDB has raised the land above . In order to avoid any flooding event, BPDB has raised the land above HFL and embankment has been constructed around the power hub.		
4.	Are there any sites of cultural or archaeological importance at the site within 500 m?	☒	☐	The nearest cultural and archaeological sites of importance are located in Sonargaon, which include Tomb of Sultan Ghiasuddin, the shrines of Panjpirs and Shah Abdul Alla and a mosque at Goaldi village.		
5.	Seismic Zone Note: This is to identify extra measures which may be required during construction stages.	☒	☐	The project site and study area is located in Seismic Zone II resulting in a basic seismic coefficient z = 0.20.		Refer to Section 4.3.11 of the E&S Scoping Report for

					details
6.	• Large scale resettlement (Example involving more than 350 HHs) • Is the land being used for economic/livelihood purposes for sizeable population and has the potential to increase livelihood and associated vulnerability	☒	☐	The proposed project area was acquired by BPDB in 1997-98. Prior to acquisition this char area was only used for cultivation in dry season. Presently there is no cultivation done. The project area is fenced and grazing is not observed. There is no settlement, trees or and crop cultivation in the project area. Therefore, R&R issue is not applicable for this project.	
7.	Is the land categorised as tribal land/ indigenous people land or any such category followed in Bangladesh	☒	☐	The project site is part of Meghnaghat Power Hub, which is an industrial area for setting up of power infrastructure.	
8.	Work on a project (or in a region) that is the subject of any actions or campaigns being waged by any NGO etc.	☒	☐	No such information was found during the external factors review of the project.	

Note: Only after majority of Primary Siting Criteria is met for a particular Site, it will be subjected to more rigorous Social and Environmental Screening Checklist for the selected Site at a later stage of the project either internally or through a third party ESDD to trigger the need for specialized studies.

SITE SELECTION/SCREENING FOR GREENFIELD PROJECT

No.	Screening questions	Details			Remarks if any
1.	**Resource related Sourcing details:**				
	Total Land (Area, type of land government/private)	14.28 acres for Project and additional 9.3 acres for laydown area and construction camp during construction stage of the project.			Entire land is owned by BPDB. No private land is required for the project.
	Water availability and connectivity	About 1000 m^3/day, which will be sourced from Meghna River			
	Fuel availability and connectivity	Natural gas will be provided by Petro Bangla or any of its company at the Meghnaghat Power Hub.			Project will take tapping from the valve station to be located within Meghnaghat Power Hub.
	Connectivity to the site	Site is already having an access road from the Dhaka-Chittagong Highway.			
	Effluent and waste disposal arrangements	An effluent treatment plant and sewage treatment plant will be provided at site and treated water along with cooling tower blow down will be discharged through about 0.5 km long channel to the Meghna River.			
	Manpower	During the peak construction phase, the project will require about 800 personnel. During the operation phase, manpower requirement will be between 60 to 75 personnel.			A construction camp will be provided within Meghnaghat Power Hub for the migrant workers as well as expats, whereas local workers will make their own arrangements. During operation phase, a dormitory will be provided for O&M team within project site.
2.	**Project Siting** **Is the project located within or near to any of the following environmentally sensitive areas?**	**Yes**	**No**	**NA**	
	Protected Area-National park, wildlife sanctuary, Ramsar site, world heritage site etc (Km, Direction)	☐	☒	☐	
	Buffer Zone of Protected Area (Km, Direction)	☐	☒	☐	
	Area for protecting biodiversity- ecopark, migration corridor of CR/EN species etc (Km, Direction)	☐	☒	☐	
	Wetland (Km, Direction)	☐	☒	☐	

No.	Screening questions	Details			Remarks if any
	Estuarine (Km, Direction)	☐	☒	☐	
	Mangrove (Km, Direction)	☐	☒	☐	
	Cultural Heritage site (Km, Direction)	☒	☐	☐	More than 5 km away from site
	Indigenous people (Km, Direction)	☐	☒	☐	As per Census 2011, only 1 HH in Pirijpur Union.
	Natural hazards prone (especially floods and cyclones)	☐	☒	☐	Site is already a developed land with flood embankment and elevation above the HFL.
3.	**Mapping (Distance and direction) of the Project and associated components with respect to sensitive receptors**	**Yes**	**No**	**NA**	
	Distance from nearest settlement and Houses (Nos:) in that settlement	☐	☒	☐	Settlement near approach road: 0.65 km* north-east Dudghata village: 0.95 km* north-west
	School	☐	☒	☐	None within 500 m from site
	Other Major settlements (Km, Direction)	☐	☒	☐	Pirijpur, Char Balaki, Islampur (within 2 km radial zone)
	Religious or culturally important property or site	☐	☒	☐	Meghnaghat Jama Maszid (1.5 km)
	Place or property of local/national importance	☐	☒	☐	None specific
	Other common property resources as roads, water bodies, agricultural roads etc	☐	☒	☐	Meghna River (forms boundary of Meghnaghat Power Hub from three directions)
4.	**Will the project result in the following?**	**Yes**	**No**	**NA**	
	Displacement or involuntary resettlement of people	☐	☒	☐	
	Disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups	☐	☒	☐	
	Impairment of historical/cultural property or sites and loss/damage to these sites	☐	☒	☐	
	Large influx of population resulting in increased burden on infrastructure and services	☐	☒	☐	
	Community safety risks/biodiversity risks due to accidental or natural hazards or structural failures (ash pond, storage/transportation of flammable chemicals, fuel, hazardous chemicals etc.)	☐	☒	☐	
5.	**Will project or any of its component impact the following in the project area?**	**Yes**	**No**	**NA**	
	Land use	☐	☒	☐	

No.	Screening questions	Details			Remarks if any
	Aesthetics	☐	☒	☐	
	Habitats like protected forest areas or terrestrial wildlife habitat	☐	☒	☐	
	Water body/Aquatic ecosystem or habitat	☒	☐	☐	Treated water and cooling tower blow down will be discharged into Meghna River.
	Flow regime of the river (due to water intake)	☐	☒	☐	Water demand for the project is limited to 1000 m3/hr, which is about 0.005% of the available water in Meghna River during the lean season
	Ground water scenario	☐	☒	☐	No ground water abstraction for the project is planned
	Ambient air quality	☒	☐	☐	Use of Natural Gas and HSD for power generation will result into emission of criteria pollutants (e.g. NOx, PM, CO, SO2). Project will meet the emission guidelines of the DoE as well as World Bank guidelines.
	Ambient noise levels	☒	☐	☐	From operation of turbines, cooling towers, pumps, compressors and other equipment and machinery
	Cultural heritages	☐	☒	☐	None within 5 km from the site
	Community health and safety	☒	☐	☐	Use of HSD and Chlorine can result into community risks
	Common property resources	☐	☒	☐	
6.	**Information/Issues in the Public domain about the Project Area**				
	Any aspect of Significance (such as particular ecological species, agricultural crop or pattern, livelihood, skills etc)	☒	☐	☐	Discharge of treated water and cooling tower blow down can impact surface water quality near discharge point.
	Any controversies (related to land etc)	☐	☒	☐	
7.	**Any others**				
	Litigations pending	☐	☒	☐	

SITE COMPARISON SUMMARY:

Not applicable for the Project as the project site is already identified and developed by the BPDB for Power Project.

Parameters for Selection	**Site 1**	**Site 2**	**Site 3**
Land Availability Status			
Water Availability			
Fuel Availability			
Connectivity			
Resettlement required			
Distance from environmentally sensitive area as Protected areas, wildlife sanctuaries, national park, Ramsar site, UNESCO heritage site etc			
Distance from nearest Settlement and no of Houses			
Indigenous People impact			
Cultural heritage site			

Summary of Key Remarks (if any) and **Project Categorization**

Refer to Scoping Report (Section 5)

Note: The summary will provide enough information to be able to clearly highlight the E&S sensitivity and the associated risk which the company will be possibly exposed to because of the Project. Preliminary project categorisation will also be undertaken at this stage and will be further confirmed based on subsequent assessments.

Details of further studies required

Refer to Scoping Report – Section 8 (ToR for ESIA Study)

Note: This will not necessarily be a complete list of all studies to be conducted; however will inform theToR preparation for conducting ESDD (if required) and subsequent ESIA and specific studies.

Opinion on selection of particular site:	
Date:	

Note: This will ensure that the ESMS committee and the board are in a position to take an informed decision after critically evaluating the findings on site level E&S screening.

Annex F

Flora recorded at Project Site and Study Area

Sl. No.	Species	Project Site	Study Area
A.	**Trees**		
1	*Alstonia scholaris*		X
2	*Acacia auriculiformis*		X
3	*Acacia mangium*		X
4	*Acacia nilotica*		X
5	*Albizia lebbeck*		X
6	*Alstonia scholaris*		X
7	*Areca catechu*		X
8	*Artocarpus heterophyllus*		X
9	*Bambusa vulgaris*		X
10	*Bombax ceiba*		X
11	*Borassus flabellifer*		X
12	*Calophyllum inophyllum*		X
13	*Cassia siamea*		X
14	*Casuarina equisetifolia*		X
15	*Citrus aurantifolia*		X
16	*Cocos nucifera*		X
17	*Dalbergia sissoo*		X
18	*Delonix regia*		X
19	*Dillenia indica*		X
20	*Eucalyptus camaldulensis*		X
21	*Ficus benghalensis*		X
22	*Ficus religiosa*		X
23	*Gmelina arborea*		X
24	*Leucaena leucocephala*		X
25	*Mangifera indica*		X
26	*Melia azedarach*		X
27	*Mimusops elengi*		X
28	*Phoenix sylvestris*		X
29	*Pongamia pinnata*		X
30	*Samanea saman*		X
31	*Saraca asoca*		X
32	*Sterculia foetida*		X
33	*Swietenia mahagoni*		X
34	*Syzygium cumini*		X
35	*Tamarindus indica*		X
36	*Terminalia arjuna*		X
37	*Terminalia catappa*		X
38	*Thespesia populnea*		X
39	*Ziziphus mauritiana*		X
B.	**Shrubs**		X
41	*Bougainvillea spectabilis*		X
42	*Calotropis gigantean*	X	X
43	*Calotropis procera*	X	X

44	*Carica papaya*		X
45	*Carissa carandas*		X
46	*Clerodendrum inerme*		X
47	*Gardenia jesminoides*		X
48	*Hibiscus rosa-sinensis*		X
49	*Lantana camara*	X	X
50	*Lawsonia inermis*		X
51	*Pandanus foetidus*		X
52	*Ricinus communis*	X	X
53	*Rosa centifolia,*		X
54	*Suaeda maritima*		X
55	*Vitex negundo*		X
56	*Woodfordia fruticosa*		X
C.	**Herbs**		
58	*Alternanthera philoxeroides*		X
59	*Alternanthera sessilis*		X
60	*Amaranthus spinosus*	X	X
61	*Bacopa monnieri*		X
62	*Boerhavia repens*		X
63	*Celosia argentea*		X
64	*Centella asiatica*		X
65	*Colocasia esculenta*		X
66	*Cucurbita maxima*		X
67	*Cynodon dactylon*	X	X
68	*Cyperus compressus*		X
69	*Cyperus rotandus*		X
70	*Eclipta prostrata*		X
71	*Enhydra fluctuans*		X
72	*Mimosa pudica*	X	X
73	*Musa paradisiaca*		X
74	*Ocimum basilicum*		X
75	*Ocimum tenuiflorum*		X
76	*Phragmites karka*		X
77	*Phyllanthus niruri*		X
78	*Porteresia coarctata*		X
79	*Saccharum spontaneum*		X
80	*Sesuvium portulacastrum*		X

Annex G

Environment, Social and Health & Safety Policies of Summit Corporation Limited

SUMMIT

SUMMIT CORPORATION LIMITED

Environmental Policy

Summit Corporation Limited including its subsidiaries will manage its power plants operations in a manner that ensures compliance with local laws, International Finance Corporation's (IFC) Performance Standards and good international industry practices. Summit will strive to safeguard the environment and natural resources and promote resource efficiency in its operations. Following will be the core objectives in achieving the above.

At the corporate level, the Company endeavors to:

- Fully implement the requirements of Environment Conservation Rules 1997 and its subsequent amendments, any rules, regulations imposed/ issued by Department of Environment, Bangladesh and any concerned authority of Bangladesh.
- Fully implement the requirements of World Bank Group EHS guidelines and in particular the IFC Performance Standards.
- Assess and manage the adverse environmental and social impacts in accordance with IFC Performance Standards.
- Ensure that its operations consider the impact on biodiversity and implement appropriate mitigation measures;
- Provide support and assistance to plant operations through Summit Group Turbine Division and Summit Power Limited.
- Report regularly on the environmental systems and performance of the power plants to the Board.

Our Commitment is to:

- Conduct business in compliance with all applicable environmental laws, regulations and commitments and seek to apply international standards where relevant;
- Make environmental considerations a priority in business planning and in the operation of our power plants;
- Review emissions, effluents and wastes and continually strive to reduce their impact wherever feasible;

- Encourage employees and contractors to take individual responsibility for their actions with respect to the environment through appropriate communications and training;
- Ensure preparedness to respond in a timely and appropriate manner to environmental incidents resulting from plant operations;
- Designate one employee of each facility as coordinator to prepare a plant specific environmental management program with applicable procedures based on the Company's guidelines and conforming to the ISO 14001:2004 standard and implement appropriate training and record keeping;
- Set annual environmental objectives and targets and commit to continuous improvement;
- Demonstrate visible leadership, commitment and involvement towards achieving the Company's E&S objectives;
- Carry out an audit and management review of environmental management systems at least once every two years.

Authorized Signature

REVISION	DATE OF ISSUE
1ST	06.06.2011
2ND	01.08.2016

SUMMIT

SUMMIT CORPORATION LIMITED

SOCIAL POLICY

Summit Corporation Limited (Summit) is committed to address and recognize its (including its subsidiaries) social responsibility within its sphere of influence. Company will contribute and respond immediately where there are scopes of social progress within its sphere of influence.

Reference frame

In appraising such power plants, the Company will be guided by the standards resulting from the following laws, statute, conventions, principles and standards:

i. Environment Conservation Rules 1997 and its subsequent amendments, any rules, regulations imposed/ issued by Department of Environment, Bangladesh and any concerned authority of Bangladesh

ii. Corporate Social Responsibility (CSR) of Summit Group

iii. The standards of World Bank Group and in particular, the International Finance Corporation (IFC) Performance Standards

The policy should be implemented to:

1. Ensure that full compensations and benefits are given to project displaced and affected persons which they are entitled to.
2. Identify and engage community and different level of stakeholders.
3. Address and proper management of any sort of grievances resulting from the construction and operation works of the Company.
4. Restore the livelihood of the Project Affected People (PAP), vulnerable groups within the area of influence of the Company.
5. Enhance the economic status of the community by providing means of income and support.
6. Participate within the process of women empowerment by introducing new programs dedicated to community women.
7. Maintain an effective practice of Community Consultation and Participation so that the communication and channel with the community is adequately maintained. The practice of Informed Consultation and Participation (ICP) can be a key to this process.

8. Prioritize the community people in the case of any decision making process.

9. Introduce and perform regular monitoring and review system to address the effectiveness of the policy.

Exceptions

By the time of emergency, or any event which poses greater threat to the society, the Company should respond immediately irrespective of its Social Policy.

Authorized Signature

Revision	Date of Issue
1st	01.08.2016
2nd	

SUMMIT

SUMMIT CORPORATION LIMITED

Health and Safety Policy

Summit Corporation Limited including its subsidiaries will manage its power plants operations in a manner that protects the health and safety of its employees, customers, contractors and the public, while fully complying with applicable laws, regulations and other standards to which the asset facilities subscribes. Summit will strive to continuously improve Health & Safety performance with a goal of zero incidents by following good international industry practices (other local laws, IFC Performance Standards and relevant EHS guidelines), maintaining industrial hygiene & best process/practices of occupational health/safety. Following will be the core principles in achieving the above.

Guiding Principles:

- Full implementation the requirements of the Environment Conservation Rules 1997 and its subsequent amendments, any rules, regulations imposed/ issued by Department of Environment, Bangladesh and any concerned authority of Bangladesh.
- Full implementation the requirements of the World Bank Group EHS guidelines and in particular the International Finance Corporation (IFC) Performance Standards .
- Health & Safety excellence is mandatory for our long-term success.
- Health & Safety excellence requires the commitment and personal involvement of all levels of management and all employees.
- Employees have the obligation and the ability to prevent accidents.
- Incidents and non-compliance are unacceptable.
- All employees and contractors are responsible and accountable for understanding and complying with all regulations, company requirements and procedures relating to their job performance.

The Company is committed to:

- Improve Health and Safety compliance and performance through the implementation of Health & Safety Management Systems which will be conformant to OHSAS 18001 standards.
- Integrate Health & Safety concerns into all business and operational planning and decision making.
- Provide a safe work environment and training for all employees.
- Achieve upper quartile performance in all key Health & Safety metrics for the industry in which we operate.

- Involve the same level of commitment and performance for contractors that work in our facilities as we do from our employees.
- Utilize materials, natural resources and energy efficiently to produce our product and service.
- Respond in a timely and appropriate manner if an incident resulting from operations does occur.
- Work proactively with legislators, regulators, concerned groups, and industry peers to develop and advance effective approaches to human health and safety protection.
- Communicate regularly on Health and Safety issues, expectations and performance with employees, contractors, customers and regulators and to management and all concerned of any unlawful or unsafe works conditions, other lapses including those of security.
- Demonstrate visible leadership, commitment and involvement towards achieving the Company's H&S objectives.
- Ensure availability of effective crisis management and emergency response capabilities to respond to incidents and/or situation akin to emergency across our power plants facilities.
- Audit assets and operating practices regularly, and take appropriate corrective actions.
- Revise this policy on a regular basis to ensure its continued relevance, effectiveness and suitability to the business.

Authorized Signature

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2ND	01.08.2016

Annex H

Framework Environmental and Social Management Plans for Construction Phase

Contents

1	*POLLUTION PREVENTION MANAGEMENT PLAN (PPMP)*	*1*
1.1	*INTRODUCTION*	*1*
1.2	*SCOPE*	*1*
1.3	*OBJECTIVES*	*1*
1.4	*APPLICABLE LEGISLATIONS AND REGULATORY STANDARDS*	*2*
1.5	*IMPACT AVOIDANCE AND IMPACT MITIGATION*	*2*
1.5.1	*Pollution Prevention - Policies and Principles*	*2*
1.5.2	*Approach*	*3*
1.6	*POLLUTION PREVENTION & MANAGEMENT*	*3*
1.6.1	*Inventory of Pollution & Emission Sources*	*4*
1.6.2	*Conduct Pre-Project Survey*	*5*
1.6.3	*Assess Discharge & Emissions Impact Using Modelling Approaches & Other Assessment Tools*	*5*
1.7	*MONITORING, REPORTING AND REVIEW*	*6*
1.8	*ACCOUNTABILITIES*	*6*
1.9	*REPORTING AND REVIEW*	*6*
2	*WASTE MANAGEMENT PLAN (WMP)*	*8*
2.1	*INTRODUCTION*	*8*
2.2	*SCOPE*	*8*
2.3	*OBJECTIVES*	*8*
2.4	*APPLICABLE LEGISLATIONS AND REGULATORY STANDARDS*	*9*
2.5	*IMPACT AVOIDANCE AND IMPACT MITIGATION*	*10*
2.5.1	*Approach*	*10*
2.5.2	*Waste Management*	*11*
2.5.3	*Final Disposal*	*15*
2.6	*MONITORING, REPORTING AND REVIEW*	*16*
2.7	*ACCOUNTABILITIES*	*17*
2.8	*REPORTING AND REVIEW*	*17*
3	*TRAFFIC MANGEMENT PLAN (TMP)*	*18*
3.1	*INTRODUCTION*	*18*
3.2	*SCOPE*	*18*
3.3	*OBJECTIVES*	*18*
3.4	*APPLICABLE LEGISLATIONS AND REGULATORY STANDARDS*	*19*
3.5	*IMPACT AVOIDANCE AND IMPACT MITIGATION*	*19*
3.5.1	*Traffic Management Planning*	*19*
3.5.2	*Route Selection and Management*	*20*
3.5.3	*Pre-condition Survey*	*20*
3.5.4	*Traffic Management Implementation*	*20*
3.5.5	*Parking*	*21*
3.5.6	*Driver Training*	*21*
3.5.7	*Road Maintenance*	*22*
3.5.8	*Vehicle Management and Maintenance*	*22*

3.5.9	*Community Liaison and Community Safety*	*23*
3.6	*MONITORING, REPORTING AND REVIEW*	*23*
3.7	*ACCOUNTABILITIES*	*24*
3.8	*REPORTING AND REVIEW*	*24*
4	*EMERGENCY RESPONSE PLAN (ERP)*	*25*
4.1	*INTRODUCTION*	*25*
4.2	*SCOPE*	*25*
4.3	*OBJECTIVES:*	*25*
4.4	*EMERGENCY RESPONSE*	*26*
4.4.1	*Approach*	*26*
4.4.2	*Roles and Responsibilities*	*26*
4.4.3	*Pre-Start Up*	*27*
4.4.4	*Alert Procedures*	*28*
4.4.5	*Emergency Response Situations*	*29*
4.5	*MONITORING, REPORTING AND REVIEW*	*31*
4.6	*ACCOUNTABILITIES*	*31*
4.7	*REPORTING AND REVIEW*	*31*
5	*CONSTRUCTION LABOUR MANAGEMENT PLAN*	*32*
5.1	*Purpose, Scope and Objectives*	*32*
5.2	*Applicable Standards*	*33*
5.3	*Labour Accommodation during Construction and Operation Phase*	*33*
5.4	*Components of the CLMP*	*34*
5.4.1	*Summary of Key Impacts*	*34*
5.4.2	*Key Interventions under the CLMP*	*34*
5.5	*Institutional Set Up*	*40*
5.6	*Monitoring*	*40*
5.7	*Reporting and Documentation*	*40*
APPENDIX A: LABOUR ACCOMMODATION CHECKLIST		*43*
6	*STAKEHOLDER ENGAGEMENT PLAN*	*46*
6.1	*Preamble and Purpose*	*46*
6.2	*Objectives of the SEP*	*46*
6.3	*Principles of Stakeholder Engagement*	*47*
6.4	*Stakeholder Mapping*	*48*
6.5	*Engagement Mechanisms*	*50*
6.6	*Monitoring, Reporting and Review*	*54*
6.7	*Accountabilities*	*54*
6.8	*Reporting and Review*	*54*
7	*GRIEVANCE REDRESSAL PLAN*	*55*
7.1	*Objective of Grievance Redressal Plan*	*55*
7.2	*Structure of Grievance Redress Mechanism*	*55*
7.3	*Principles of Grievance Management*	*56*
7.4	*Grievance Reporting*	*57*

7.5 REDRESSAL PROCESS 57
7.6 MONITORING, REPORTING AND REVIEW 59

1 POLLUTION PREVENTION MANAGEMENT PLAN (PPMP)

1.1 INTRODUCTION

A Framework Pollution Prevention Management Plan (PPMP) has been prepared for the proposed project in order to guide the development of detailed management plan. The PPMP is developed to assist the operation to meet the objectives of prevention of pollution which would result due to the construction related activities of the project and its associated facilities. The PPMP is based on the assessment of impacts on air quality, ambient noise levels, and water quality, which would occur during the site preparation and construction phase of the Project.

This PPMP builds on the conceptual information presented in the Project documents and applies to all of the activities conducted during the site preparation and construction. The PPMP is to be read in conjunction with the other environmental management plans.

1.2 SCOPE

***Site preparation and Construction Phase*:** The responsibility to frame the detailed PPMP and its implementation will be with the EPC Contractor selected by SMIIPCL for the phase.
***Areas*:** Project site and associated facility areas where any preparation/ construction activity will be carried out related to the Project.
***Define*:** Project site, Jetty area, Labour accommodation, roads, lay down areas, batching plant, etc.

Note: This is a guidance framework for pollution prevention and it is expected that this framework will be developed into specific plans by the EPC Contractor for maintaining ambient air quality, water quality, noise levels within the project footprint and surrounding areas during the construction phase. Each plan developed under the pollution prevention management plan framework is expected to follow the framework content and requirements.

1.3 OBJECTIVES

The PPMP aims to ensure that discharges and emissions from the project during the construction phase do not result in unacceptable impacts on the environment and surrounding community. It focuses on the strategies to be used to monitor the air quality (particulate levels, in particular), ambient noise levels, water quality, mitigation of emissions and discharges at sources, monitoring and reporting and reviewing of monitoring results in terms of ESIA requirements.

The objectives of pollution prevention management plan for the Project are as follows:

- To develop inventory of emission and discharge sources;
- To maximise pollution control at source;
- To analyse alternate emission and disposal control strategies and technologies;
- To identify critical issues after implementation of mitigation measures; and
- To address pollution issues by adopting additional mitigation measures and regular monitoring.

1.4 APPLICABLE LEGISLATIONS AND REGULATORY STANDARDS

The following acts, regulations and guidelines have been reviewed and are applicable to PPMP fully or partly in the Project:

Table 1.1 Applicable Legislations

S. No.	Applicable Legislation	Agency Responsible	Applicability
1.	Environmental Conservation Rules, 1997 and subsequent amendments thereof	Department of Environment (DoE)	Applicable as the project falls under Red Category and require environmental clearance and to follow standards prescribed in ECR
2.	Water Pollution Control Ordinance, 1970	DoE	Applicable and has to take measures for the prevention, control and abatement of existing or potential pollution of any waters, including construction, modification, extension or alteration of disposal systems
3.	The Ground Water Management Ordinance, 1985	Upazilla Parishad/ Union Parishad	Proposed Project will use surface water source however, should groundwater also be required then licenses will need to be obtained prior to installation of any tube-wells, and ground seepage
4.	Ozone Depleting Substances (Control) Rules, 2004	Ministry of Environment and Forests (MoEF)	Applicable
5.	Noise Pollution (Control) Rules 2006	MoEF	Applicable, follow standards for noise levels.

1.5 IMPACT AVOIDANCE AND IMPACT MITIGATION

1.5.1 Pollution Prevention - Policies and Principles

Pollution prevention within the context of this Management Plan (MP) and the Project refers to:

- Air emissions due to various Project activities including excavation of soil to create building and equipment foundations; pile driving for the equipment foundation; exhaust emission from movement of heavy equipment by barge, heavy loaders, trucks; loading and unloading of materials, concreting works, including operation of concrete batching plant,

which will be located away from sensitive receptors and; operation of diesel generators and other diesel based construction machineries, dust generated from stockpiles of materials, waste, loose earth, handling and moving excavated material and transporting wastes on vehicles,

- Water pollution both on surface and ground water media due to release or discharge of effluents and wastewater, polluted storm water runoff, inappropriate storage of waste leading to water quality impacts from runoff entering the adjoining river to the Project site or seepage to ground water
- Noise and vibration generation due to various Project activities such as usage of heavy equipment during the construction activities, piling and concrete foundations works for major plant and buildings transport, people movement, etc.; and
- Soil pollution due to civil work activities; transportation of construction material, equipment and personnel; storage of construction materials including hazardous material; storage, handling and disposal of wastes generated from site clearance, site excavation and formation, civil works and activities of construction workers (general waste and sewage),erection of Power Plant Building

The pollution issues relating to waste management, traffic and transport have been dealt in detail in the corresponding MPs which should be referred. This MP is supplementing to the above referred issue-specific MPs and should not be construed as contradictory.

1.5.2 Approach

The overall approach for avoiding and mitigating impacts comprises the following elements:

- EPC Contractor will adopt a Good Practicable Environmental Option (GPEO) approach to each discharge/emissions issue.
- Pollution prevention measures will adopt life-cycle assessment principles wherein residual impacts, if any will be avoided to the extent possible;
- The approach of impact avoidance, minimisation and mitigation will be adopted in pollution prevention and management; and
- The Duty of Care principle will be followed - whereby the polluter will ensure that each of the pollution issue is properly managed.

1.6 POLLUTION PREVENTION & MANAGEMENT

The pollution prevention will have following management elements, out of which the notable ones are explained in the subsequent sub-sections:

- Inventory of discharge and emission sources
- Conduct pre-Project surveys

- Analysis of alternate disposal and emission control strategies and technologies.

1.6.1 Inventory of Pollution & Emission Sources

Preparing an inventory of all pollution and emission sources from the Project activities is essentially the first step towards managing the impacts. The Management Plan will involve preparation of an up to date inventory of all emission and discharge sources based on the latest Project activity related information. A preliminary list of emission and discharge sources at Project footprint area is presented below.

- Air emission sources
    - Site preparation and levelling including protection for lay down areas, plant areas, site roads and drainage within plant boundary;
    - Excavation of soil to create building and equipment foundations;
    - Pile driving for the equipment foundation;
    - Exhaust emission from movement of heavy equipment by barge, heavy loaders, trucks;
    - Loading and unloading of materials,
    - Installation of gas pipeline;
    - Concreting works, including operation of concrete batching plant, which will be located away from sensitive receptors and additional net fencing on section of boundary wall facing the residential receptors to reduce dust transport;
    - Operation of diesel generators and other diesel based construction machineries;
    - Dust generated from stockpiles of materials, waste, loose earth, handling and moving excavated material and transporting wastes on vehicles.
- Discharge sources
    - Workshop and washing effluent (due to washing of equipment and machinery);
    - Sewage and sanitary waste;
    - Storm water runoff;
    - Soil contamination at waste dumps, chemical storage, vehicle parking, oil and fuel spills and leaks
- Noise and Vibration sources
    - Usage of heavy equipment during the construction activities
    - Piling and concrete foundations works for major plant and buildings
    - Transport,
    - People movement,

An inventory of pollution and emission sources at all Project footprint area shall be prepared as part of this management element. Inventory of pollution and emission sources helps in formulating the following management approaches:

- Avoidance of discharge or emission, if feasible
- Source reduction
- Resource recovery options
- Recycle options
- Optimal treatment strategies and technologies
- Post-treatment, resource recovery and recycle options
- Ultimate disposal considering the local environmental sensitivities

The inventory database of discharge and emission sources along with standard requirements shall be kept as a living document and updated as and when any new sources are cited at any point in time of the Project period. Any intermittent discharge and emission sources shall also be identified and included in the inventory.

1.6.2 Conduct Pre-Project Survey

The EPC Contractor will conduct the pre-Project survey at various environmental receptors identified in earlier stage specifically and in overall ambient environment generally.

The pre-Project survey will serve as the benchmark levels throughout the Project construction phase and during reinstatement of the footprint areas.

1.6.3 Assess Discharge & Emissions Impact Using Modelling Approaches & Other Assessment Tools

Based on the complete details that will be available at the time of management plan preparation, modelling or other appropriate objective assessment tools to assess the impacts due to discharge and emission from the well sites and other Project footprint areas will be undertaken for following scenarios:

- No mitigation measure
- Alternative mitigation options (for example Gest Practicable Environment Options (GPEO).
- Cumulative scenario, if prevailing at the Project site
- Worst-case scenario

The outcome of this exercise will be to select appropriate methods of treatment for specific discharge and emissions. The Project will adopt a level of treatment/control to achieve regulatory prescribed standards.

1.7 MONITORING, REPORTING AND REVIEW

Mitigation measures have been developed to minimise the likelihood, extent or duration of occurrence, and any associated adverse effects of the construction related activities as part of the ESIA, which needs to be implemented to mitigate the adverse impacts identified due to the Project in the construction phase.

1.8 ACCOUNTABILITIES

The EPC Contractor will be responsible for day to day implementation of management plan and SMIIPCL- HSE and project management team will be monitoring of the implementation of this management plan.

All employees and sub-contractors of the EPC Contractor will be provided with environmental awareness training through a site induction process. All employees and contractors of EPC Contractor will have a responsibility to manage operations in an environmentally responsible manner and report any visible emission/ discharge/ accidental spillage. All pollution related environmental incidents will be reported to the Environmental Coordinator / HSE Manager/ Project Manager.

The EPC Contractor will define detailed responsibilities for activities required as per the PPMP.

1.9 REPORTING AND REVIEW

The EPC Contractor team will present to the SMIIPCL management on a monthly basis the following:

- What is the overall environmental performance of the Project against the national standards and set targets
- How is the pollution prevention at source is being managed and what is the progress against the set targets
- Any environmental issues that have come up in pollution prevention that has triggered a fine or a complaint by the government authorities, the root cause and actions taken;

- Any complaints or grievance from the local community of pollution issues and action taken. Time line for closing of the action.
- Any major issue emerging that will need SMIIPCL management inputs as well as budget for pollution prevention -e.g. need for additional water treatment/ capacity augmentation, etc.

2 WASTE MANAGEMENT PLAN (WMP)

2.1 INTRODUCTION

SMIIPCL recognises that unplanned storage and disposal of waste have the potential to directly impact land and water environment. These impacts have been recognised during the ESIA study and thus a framework Waste Management Plan (WMP) has been prepared in recognition of the impact.

This WMP builds on the conceptual information presented in the Project documents and applied to all of the activities conducted during the site preparation and construction till the handover to SMIIPCL.

2.2 SCOPE

Site preparation and Construction Phase: The responsibility to frame the detailed WMP and its implement will be with the EPC Contractor selected by SMIIPCL for the phase.

Areas: Project site and associated utilities areas where any preparation/ construction activity is going on related to the Project.

Define: Project site, Jetty area, Labour accommodation, roads, lay down areas, batching plant, etc.

Note: This is a guidance framework for waste management and it is expected that this framework will be developed into specific plan/s by the EPC Contractor for managing waste generated due to various site preparation and construction activities within the project and surrounding areas during the construction phase. The WMP is to be read in conjunction with the other environmental management plans.

2.3 OBJECTIVES

The objectives of waste management in the Project are as follows:

- To identify waste types and quantities on site and inventorize them;
- To ensure the disposal of wastes conform applicable guidelines or standards;
- To ensure areas where fuels, oils or other potential contaminants are stored are appropriately bunded;

- To prevent any reactions between waste due to incompatibility in nature;
- To ensure sewage disposal does not degrade the environment;
- To investigate methods to minimise waste generated and implement reasonable and feasible measures to minimise waste
- To identify potential re-use or recycling opportunities and ensure appropriate handling and collection procedures are in place; and
- To have procedures in place for appropriately handling of relevant wastes.

2.4 APPLICABLE LEGISLATIONS AND REGULATORY STANDARDS

The following acts, regulations and guidelines have been reviewed and are applicable to WMP fully or partly in the Project:

Table 2.1 Applicable Legislations[1]

S.N.	Issues	Applicable Legislation	Agency Responsible	Applicability
1.	Industrial Solid Waste	Bangladesh National Environmental Policy	DoE	• To phase-in corrective measures in polluting industries; • To conduct EIAs for all new public and private industrial developments; • To ban, or find environmentally sound alternatives for, the production of goods that cause environmental pollution; and • To minimize waste and ensure sustainable use of resources by industry
2.	Hazardous Wastes Management	The National Conservation Strategy, 1992 provides recommendations for sustainable development of the industrial sector.	GoB	• Hazardous or toxic materials/ wastes shall not be imported as raw materials for industry; • Import of appropriate and environmentally-sound technology shall be ensured; and • Dependence on imported technology and machinery should gradually be reduced in favour of sustainable local skills and resources
3.	Protection of water quality, including strengthening regulations concerning agrochemicals and industrial	The National Water Policy, 1999	DoE	• Applicable, as water for cooling is to be drawn from the Meghna river with discharge of treated water on river and the river course will also be used for transport of heavy equipment.

(1) [1] Bangladesh does not have any legislation related to Solid and Hazardous Waste Management. However, reference wherever found has been included. SMIIPCL/the EPC Contractor is encouraged always to seek the guidance and advice of Department of Environment, Bangladesh in this case – on any clarifications, new legislations.

S.N.	Issues	Applicable Legislation	Agency Responsible	Applicability
	effluent			
4.	Hazardous waste	Convention on Transboundary Movement of Hazardous Waste, 1989	GoB	• Preventing any transboundary movement of hazardous waste from the project and d environmentally sound management of such waste as close as possible to the source of generation.
5	Sludge characterisation and disposal	Bangladesh Standards and Guidelines for Sludge Management (February 2015)	Ministry of Environment and Forests	• Analysis of sludge for proper disposal
6	Bio-medical waste	Medical Waste Management & Processing Rules, 2008	Ministry of Environment and Forests	• Disposal of medical waste and processing

2.5 IMPACT AVOIDANCE AND IMPACT MITIGATION

2.5.1 Approach

The overall approach for avoiding and mitigating impacts comprises the following elements:

- The EPC Contractor will adopt a Good Practicable Environmental Option (GPEO) approach to each waste stream;
- All wastes should be moved to an acceptable permanent grave as soon as practicable. Storage is viewed as a temporary requirement and should be used for as short a time as possible; and
- The Duty of Care principle will be followed - whereby the waste producer will ensure that a waste is properly managed even after that waste has been transferred to a third party.

Treatment of waste simply transfers the pollutant to a different medium; therefore, treatment is less preferable than reuse or recycling as a waste management option. Following the waste management principles outlined above, where the generation of waste is unavoidable, waste minimisation techniques will be followed which may include:

a) a focus on reducing waste at the source, wherever possible, and
b) waste reuse and recycling.

A pre-requisite to the adoption of this approach is the development of a detailed inventory of waste generated by during different project activities. Details on the inventory and the sequence of activities that follow from this information are outlined below and described in the following sub-sections on waste management and final disposal.

2.5.2 *Waste Management*

Waste Inventory

A summary of main waste streams that will be generated during the construction phase activities as identified in ESIA. The waste inventory database will be updated once more accurate information about the activities to be carried out by the EPC contractor within site and construction activity areas.

Waste Classification

All wastes will be classified at the point of production to determine appropriate segregation procedures, storage and ultimate treatment/disposal. Initial classification will result in the waste being assigned as liquid or solid waste. Then the classification will further categorise the waste within one of the following categories:

- Inert;
- Non-hazardous; and
- Hazardous.

The classification process will initially involve reference to the waste inventory and, in particular, the details relating to segregation, labelling, storing and treatment of each waste item. In the event that the waste is not included in the inventory or unrecognisable, samples will be taken and analysed to allow classification according to the above waste classes. The inventory will then be updated. If a waste is unrecognisable and sampling is not deemed appropriate or practical, the waste will be deemed hazardous and disposed of in a manner consistent with hazardous waste management procedures set out in this plan. This will be further detailed in site waste management procedures.

The waste classification process will generate information that will be used to determine safe exposure levels for employees, as appropriate, for hazardous substances used or handled onsite, thereby protecting the health of workers. In particular, the following will be determined:

- The hazardous substances that are to be used or generated during different project activities and the associated risks these substances may pose to people's health;
- The precautions required before handling hazardous substances;
- The procedures required to prevent people being exposed to hazardous substances; where this is not reasonably practicable, procedures for controlling exposure levels will be developed;
- Training requirements with respect to handling hazardous materials to ensure that employees/workers are properly informed, trained and supervised.

In addition, the information will assist in the development of plans and procedures to deal with accidents, incidents and emergencies involving hazardous materials. Material Safety Data Sheets (MSDS) will be obtained for

all hazardous substances and held at sites generating or handling the respective wastes. The MSDSs will be readily accessible to all employees/ workers in local languages.

Waste Handling

All personnel who are involved in the handling of hazardous and non-hazardous waste will undergo specific training in:

- The procedures to be followed to ensure adequate segregation of wastes;
- The duty of care system and how to complete the documentation correctly;
- Waste handling;
- Waste treatment; and
- Waste storage.
- Waste Container Labelling

The relevant team will ensure that all waste containers are clearly identifiable and accurately describe the type of waste contained therein. Full descriptions of the waste are required to assist site and external personnel to handle the material safely and to ensure that non-compatible materials are not stored or transported together. Any unidentified wastes will be treated initially as hazardous and will be subject to the classification process outlined above.

All waste containers on-site (bins, skips, drums etc.) will be clearly labelled to show which wastes can be disposed into them and which wastes they contain. Any previous labelling will be removed or covered to avoid confusion.

Waste Storage and Segregation

The following general storage and segregation procedures will be observed:

- Different types of wastes require segregation. This will typically require separate storage areas or physical separation for hazardous and non-hazardous wastes and/or the segregation of different types of hazardous wastes;
- Voluminous waste as some construction waste will be stored in earmarked areas only;
- Wastes require covered storage, away from direct sunlight, wind and rain. In the case of non-hazardous wastes this requirement may be satisfied by the use of sealed containers such as 'wheeled bins'.
- Hazardous wastes, depending upon their form, may be stored either in similar containers or in tanks, drums or other smaller containers. In such cases storage under cover is important to protect the integrity of the container. Solid waste will be stored in such a way as to prevent it blowing away in high winds.
- Hazardous liquid wastes will be stored in bunded area with provision of spill collection, if any;
- Storage of non-hazardous general waste (except food waste), will be done in a manner to reduce health, safety and environment risks associated with the storage of this materials. The waste will be stored using either shipping containers or temporary earth bunding and will be designed in such a way to minimise leachate, odour and biogas generation;

- As far as practicable, the storage of waste will be kept to a minimum. This is both good housekeeping and, in the case of hazardous wastes, reduces the risks associated with the storage of large quantities of hazardous materials;
- Storage areas for waste will be secure from the general public, in particular children, and clearly marked so as to indicate the hazards of the stored material.
- Waste will be stored in a way to prevent, as far as possible, access by stray dogs and vermin. Waste will only be stored for as long as necessary before transferred off-site for appropriate treatment and disposal;
- Waste storage containers used will be appropriate in terms of volume, composition, shape, and opening for the material that is being stored. Only containers in a good condition will be used. Bungs and lids will be securely fastened or other forms of covering shall be provided;
- Containers that are susceptible to reaction with the wastes, which may lead to the release of harmful substances, must not be used;
- Only one category of hazardous waste may be placed in any one container. Solid and liquid wastes must not be mixed; and
- If a hazardous waste is mixed with other wastes the entire consignment will be considered as hazardous for disposal purposes.

Site Waste Collection Points

Waste Collection Points (WCPs) will operate at various activities areas. Here the waste will be segregated and stored temporarily prior to transfer to the Waste Storage Area (WSA) and final disposal sites.

The WCPs will typically comprise of a dedicated area, storage containers, and secondary containment for hazardous liquid wastes (oils etc.). Separate storage containers will be provided for prime recyclables (paper, cardboard, scrap metal), domestic waste, and hazardous waste requiring segregation including oils, oily solids, chemicals and batteries. Care will be taken to ensure that chemicals are kept in separate containers in order to avoid a chemical reaction.

Waste Storage Area (WSA)

WSAs will be created at appropriate locations. WSAs are secure compounds and comprise the following:
- Waste reception area for weighing or estimating waste volumes and masses, by weighing unit or volume-mass conversion chart (per waste type);
- Waste Segregation Area;
- Hazardous waste storage area, including secondary containment and roofing;
- Laydown areas (e.g., for skip laydown/storage);
- Absorbents for dealing with leaks/spillages from containers;
- Returnable (to original supplier) storage area (if possible);
- Reusable and recyclables storage area;

- Separate drainage, spillage control kerbs and sump;
- PPE store;
- Eyewash and emergency shower; and
- Emergency equipment including fire-extinguisher.

Secure storage will be provided for the interim storage of selected wastes for which there is a realistic expectation of future reuse or recycling. The facility will also be used for the temporary storage of wastes requiring special handling. Any unknown wastes that require repackaging prior to disposal would be handled in this area. Wastes may also be stored in this area should they require short-term, well-ventilated storage out of direct sunlight.

Transportation of Wastes

Strict measures will apply to the transportation of wastes. Contractors will be required, at a minimum, to cover the following issues:

- Disposal of hazardous waste will be done by engaging DOE approved waste management agencies or alternatively through appropriate agencies post background verification.
- Ensure that the nature, integrity and protection provided by packaging and containers used for transport are appropriate for the kind and quantity of material involved;
- Ensure adequate transport vehicle specifications, including enclosed compartments or incorporating cloth tarpaulins to facilitate odour control and ensure waste is not lost en-route;
- Consider routes used to minimise disturbance to local communities;
- Follow loading and unloading procedures to facilitate safe operations and avoid loss of wastes;
- Inform employees involved in transporting wastes of how to respond to accidents and emergencies;
- Provide the necessary means for emergency response.

Vehicles (including third party vehicles) will be checked for their suitability and maintenance and driver training will be in line with the Project driving requirements. Waste transportation contractors will be contractually required to comply with Project requirements and local legislation for vehicle maintenance and safety as these specific requirements will be included in their contractual agreements.

Drivers of vehicles used to transport hazardous wastes will have been trained to use spill clean-up materials. Vehicles will be provided with spill clean-up materials and, as appropriate, carry a MSDS, and hazardous warning signs in accordance with international standards.

Transfer Procedures

Transfer of waste from a WCP to a WSAs and/or to a third party facility will be fully documented on a Waste Transfer Note.

- At a minimum, the following will be recorded:
- Waste originator;

- Waste description and type(s);
- Consignment reference number;
- Form (e.g. solid, liquid, sludge);
- Quantity(ies) (weight) and units (e.g. number of containers, drums);
- Name and signature of originator;
- Name and signature of waste transporter plus receiving party and
- Verification details of the waste disposal/treatment/recycling agency.

Only authorized personnel (i.e. those that have received the appropriate training) will be able to complete the Waste Transfer Notes. Waste received at the WSAs will undergo any further sorting and segregation as required, prior to being transferred from the WSAs to final treatment and disposal facility or further interim storage site. The tracking steps listed above may be modified as appropriate to enhance the waste tracking process.

The EPC Contractor will maintain a register recording the details of all wastes generated, and the quantity of wastes sent to and received by the WSAs or final disposal/treatment facility. Wastes both received at the WSAs and despatched by the WSAs for disposal or interim storage will be recorded in a register held by the WSAs Site Supervisor (or delegate).

The register will record details of:
- Wastes received by the WSAs; and
- Wastes despatched by the WSAs for disposal or interim storage.
- The following information should be held in the register:
- Waste originator;
- Waste type(s) collected and delivered (hazardous/non-hazardous), including a general description of waste;
- Waste Transfer Note reference number (in and out);
- Form (e.g., solid, liquid, sludge);
- Quantity(ies) and units (e.g. number of containers or skips) collected and delivered;
- Transporter (e.g. truck) number and type;
- Date delivered to WSAs;
- Date despatched;
- Name of WSAs Site Supervisor (or delegate); and
- Waste receiver site (once despatched) and confirmation of receipt.

2.5.3 Final Disposal

An assessment of the Good Practicable Environmental Options (GPEO) for identification of best possible waste management solutions will be undertaken considering each waste stream and balancing such aspects as environmental impact, accident potential, technical standards, financial costs and local availability.

In line with the waste management hierarchy approach, the EPC Contractor and Project Company will investigate and implement, where practicable reuse, recycle and other options in preference to sending waste to landfill

and/or incineration, if required. Only those waste treatment companies that are approved by DOE for use by the Project will be utilised.

The following subsections detail waste management disposal options to be considered by the Project.

Reuse / Recycle

The EPC Contractor will identify different wastes which can be utilized for recycle/reuse. The following measures will be considered to minimise waste generation, and to promote reuse and recycling:

- Reduce material consumption (e.g. extending the useful life of consumables);
- Inventory control and management (e.g. reduce losses of materials due to expired shelf-life and improper storage conditions);
- Favour suppliers who use less packaging or practice 'take-back' schemes;
- Material substitution (e.g. where practicable, select non-hazardous replacements for hazardous materials to reduce the amount of hazardous wastes requiring disposal, recognising that this may not result in an actual reduction in the quantity of waste produced);
- Volume reduction (e.g., through material substitution and filtration);
- Reuse chemical containers; and
- Review establishment of food composting.

General Site Waste Management

The following actions/strategies will be put into practice to minimise the accumulation/generation of waste on site:

- All personnel working on the project are to undergo a site induction. The site induction will include the waste management practices on the Project.
- All waste areas are to be clearly identified as waste storage areas. This includes bins and other receptacles for domestic waste, and which would be marked according to the type of waste accepted, e.g. scrap metal, oil filters and oily rags, other recyclables, general waste, etc.
- Clear written instructions are to be erected at appropriate locations detailing recycling and waste separation information.

2.6 MONITORING, REPORTING AND REVIEW

Waste management data will be documented and reported to Project Company/ SMIIPCL. The information will include the quantities and type of waste removed off site for recycling or disposal, the contractor engaged to remove the wastes and the final destination for all waste products. Details will be provided on the implementation success of the WMP implemented and any areas that require improvement will be highlighted.

2.7 ACCOUNTABILITIES

All employees/ workers/ sub-contractors that are engaged by the EPC Contractor directly or indirectly to work in the Project will be responsible for:

- Ensuring the effective implementation of this Plan with respect to their work areas;
- Ensuring any potential or actual waste management issues, including environmental incidents, are reported to the HSE manager/supervisors;
- Ensuring that all wastes are placed into the appropriate storage areas or receptacles;
- Ensuring they comply with all on-site requirements;
- Ensuring they engage in safe work practices; and
- Undertaking work practices that comply with this WMP.

The EPC Contractor will define detailed responsibilities for activities required as per the WMP.

2.8 REPORTING AND REVIEW

The EPC Contractor team will present to the SMIIPCL management on a monthly basis the following:

- Inventories of waste, its disposal and management records;
- How is the waste being reused and recycled and what is the progress against the targets if any defined by SMIIPCL.
- Any issues that have come up in waste management, the root cause and actions taken;
- Any complaints or grievance from the local community of waste management issues and action taken. Time line for closing of the action.
- Any major issue emerging that will need SMIIPCL management inputs as well as budget for waste management.

3 TRAFFIC MANGEMENT PLAN (TMP)

3.1 INTRODUCTION

The proposed project site is located in Meghnaghat Power Hub. The power Hub is located at Mouza: Char *Ramjan Sonaullah*, Union: *Pirijpur* of Sonargaon Upazilla in Narayanganj District**.** The project site is approximately 10 km (aerial distance) east of Narayanganj District headquarters and about 28 km (aerial distance) south-east of Dhaka (Division headquarters). The Power Hub area can be accessed through Dhaka-Chittagong Highway. Meghna Rivers are important waterways for this industrial area. The Power Hub is connected with Dhaka-Chittagong Highway through a dedicated road to Power hub. This road is also used by the three existing power plants and residence of Asarichar village. The power hub has no alternative road.

This Framework Traffic Management Plan (TMP) has been prepared to address the environmental, health and safety impacts associated with the transportation of large quantity of construction material and equipment to the Project site by road including man and material transportation between the Project Site and construction laydown area/s.

This TMP builds on the conceptual information presented in the Project documents and applied to all transportation activities to be conducted during the site preparation and construction by the EPC Contractor.

3.2 SCOPE

Site preparation and Construction Phase: The responsibility to frame the detailed TMP and its implementation will be with the EPC Contractor selected by SMIIPCL for the phase.

Areas: Project site and associated facility areas, roads where any transportation activity will take place related to the Project.

Define: Roads connecting Project site, Jetty area, Labour accommodation, roads, lay down areas, material transport routes, batching plant, etc.

The TMP is to be read in conjunction with the other environmental management plans.

3.3 OBJECTIVES

The objectives of this framework management plan relates specifically to the following traffic and transport management issues:

- Traffic management,
- Driver training,

- Strengthening/ improvement of road infrastructure,
- Vehicle management and maintenance,
- Community liaison and safety and
- Emergency response.

3.4 APPLICABLE LEGISLATIONS AND REGULATORY STANDARDS

The following national regulations apply fully or partly on transport vehicle management and maintenance issues in the Project:

- The Vehicle Act, 1927
- The Motor Vehicle Ordinance, 1983
- The Bengal Motor Vehicle Rules, 1940
- The Environment Conservation Act, 1995
- The Environment Conservation Rules, 1997 and amendments thereof

Note: The EPC Contractor/SMIIPCL would be encouraged always to seek the guidance and advice of local Road Transport Authority or Bangladesh Road Transport authority , Narayanganj division, and Roads and Highway Department, which are responsible for maintenance and strengthening of the road infrastructure, on any clarifications, new legislation and latest amendments, especially on vehicular emission norms and maintenance, strengthening/widening of roads.

3.5 IMPACT AVOIDANCE AND IMPACT MITIGATION

The framework avoidance and mitigation measures will involve a combination of following management elements:

- Transport management planning,
- Route selection and management,
- Pre-condition survey,
- Traffic management implementation,
- Driver training,
- Road maintenance,
- Vehicle management and maintenance, and
- Community liaison and safety.

The essential features of each element are outlined below.

3.5.1 Traffic Management Planning

Movement of all heavy equipment and vehicles from Jetty to project site needs to be coordinated with the logistics team of SMIIPCL. Considering the laydown area on the other side of highway and heavy traffic movement on the national highway (Dhaka – Chittagong Highway) and Meghnaghat Power Hub Access Road, specific traffic management planning will be carried out by the EPC Contractor. The Traffic Management Plan aims to maximise optimum use of road based vehicles and reduced congestion as well as impact on community.

The Traffic Management Plan would cover arrangements for the following aspects:

- Sourcing or recruitment for drivers and number of qualified drivers needed,
- Driver training and approval,
- Hours of driving and rest periods,
- Driver, vehicle and load security arrangements,
- Driver communication with control point and vehicle equipment,
- Language/communication,
- Source of suitable vehicles,
- Vehicle quality and specification,
- Number of vehicles required,
- Vehicle preventative maintenance programme,
- Vehicle database relating to emission control and noise
- Vehicle routes, route planning and alternative routes,
- Placement of traffic stewards for smooth traffic movement
- Overall vehicle movements,
- Emergency recovery of vehicle,
- Community safety, and
- Spot checks and audit of the transport system.

3.5.2 Route Selection and Management

Route for transportation of construction material will be through the National Highway to Meghnaghat Power Hub Access Road to the Project site. The Traffic Management Plan will detail procedures to be adopted to ensure appropriate Project speed limits. The Project vehicles will not traverse through routes other than approved route/s. In the event of changing the route from the identified route, appropriate permit procedures will be followed to have a control on such events. In addition, all the vehicles engaged (owned/ contracted) will comply with all statutory vehicle limits (width, height, weight, loading, etc.).

3.5.3 Pre-condition Survey

The EPC Contractor will undertake a pre-condition survey to assess the existing road conditions, loading/ unloading and parking facilities. Photographs will be taken as a record of condition. Local authorities will also be consulted during the pre-condition survey.

3.5.4 Traffic Management Implementation

In order to minimise the disruption due to the heavy traffic movement, The EPC Contractor will adopt the following measures:

- Traffic flows will be timed and Project related traffic at peak traffic hours will be avoided to the extent possible;
- Clear signs, traffic stewards and signal posts will be set up as necessary; Appropriate supervision will be provided to control the flow of traffic while entering the national highway;

- Ensure that traffic activities requiring 'Heavy Vehicle Transport' will be in accordance with the regulatory requirements. The Road Transport Authority or Traffic Police shall be consulted on the procedures required to be followed;
- The Project traffic or any Project activity will not obstruct the access to neighbouring properties;
- Vehicles speed will be minimised during the periods children are travelling to and from school;
- In the unlikely event of a road closure, diversions will be planned and communicated to the authorities and affected communities in advance. All diversion will be constructed to the specifications of the applicable road authority and will be maintained in good drivable conditions until the completion of the re-instatement work;
- The enforcement of speed controls, and the implementation of further pollution control measures, such as damping down the key access roads that have suspended particulate matter levels going above NAAQS;
- Appropriate speed limits for HMVs will be determined as part of the management plan based on type of road available for the construction material transportation; and
- Avoidance of passage through and near settled areas during night time hours.

Where there is the potential for cumulative impacts from congestion and related impacts from Project traffic to settlements near or en-route to Project location, transport phasing will be carefully considered in order to minimise disturbance impacts.

3.5.5 Parking

Signposted parking facilities will be provided at Project Site. The parking of Project vehicles on footways, along single lane roads and double parking shall be avoided.

Temporary hard-standing areas will be provided on the Project site for the parking of emergency service vehicles. These areas will be kept free of other vehicles and will be appropriately signed.

Another potential impact in vehicles and construction equipment is the oil and fuel spillage/leakage. The vehicle maintenance procedures will address the oil and fuel spills due to leakage etc. Oil and fuel spill during parking or whenever the vehicle is idling will be addressed by providing readily available oil and fuel adsorbent materials or drip trays. Vehicles will not be allowed to park outside of dedicated areas. Project personnel will report any spillage and leakage for immediate rectification.

3.5.6 Driver Training

The EPC Contractor is required to ensure that all drivers and driver trainers are suitably trained in accordance with driver training requirements. Driver qualifications, skills of drivers and contractor's driving assessors will be

checked by the EPC Contractor in accordance with the approved training requirements. The EPC Contractor shall issue a specific permission to each driver and for each vehicle type after assessment and approval of driver's competency. Unauthorised passengers in Project vehicles are strictly prohibited.

The following issues and documents are to be addressed during driver training and in a language mostly appropriate to individual drivers:

- Journey Management Plan;
- Road to Better Driving Manual;
- Health and Safety Standards and Practices;
- National and local legal requirements to drive a vehicle; and
- Any additional requirements for Project drivers.

3.5.7 Road Maintenance

Throughout the construction period, The EPC Contractor will be responsible for monitoring the condition of roads used by Project traffic and for ensuring that they are maintained in a condition that is at least as good as the condition they were in before the start of the Project and to the satisfaction of the Project and road maintenance authorities. The EPC Contractor also need to liaison with the Road and Bridge (R&B) Department, Local Government Engineering Department (LGED) and the Bangladesh Bridge Authority (BBA) for strengthening and maintenance of roads (within the key project activity areas), which would be used for heavy vehicles movement for construction materials to the project site and return.

The EPC Contractor will aim to keep road free from debris by covering of all the construction transport vehicles carrying construction materials and rejects.

3.5.8 Vehicle Management and Maintenance

In order to ensure that accident rates and the overall transport fuel consumption are minimised, the Project shall ensure that the vehicle fleet working on the Project (whether directly for the contractor or for the contractor's subcontractors) is maintained according to the manufacturers' specifications, as well as mechanically maintaining vehicles to manufacturer specifications so as to minimise fuel consumption.

The following in respect of vehicle maintenance, noise and emission standards will be required:

- All vehicles shall be maintained so that their noise and emissions do not cause nuisance to workers or local people;
- An up to date database of all Project vehicles will be maintained and supplied on demand or for audit inspections. The database will contain details about the periodical maintenance, schedule of maintenance, vehicular emission and noise emission testing done as per regulatory requirements;

- New vehicles: vehicles/equipment purchased 'as new' after contract award shall comply with regulation noise and air quality emission standards in force on the purchase date;
- Method statements shall be produced to cover vehicle/equipment emission measurement and routine maintenance. Method statements shall require regular maintenance of diesel engines to ensure that emissions are compliant.
- Routine maintenance shall be to a high standard to ensure that vehicles are safe and that emissions and noise are compliant.
- Oil and fuel leaks must be addressed within specified time duration, from the time of observation or reporting.
- Vehicle maintenance and management parameters will form a critical component of reporting under this plan.

3.5.9 Community Liaison and Community Safety

Traffic safety in local communities must be a high priority for the Project. The Traffic Management Plan will have procedures that will minimise traffic impacts on communities.

The EPC Contractor along with SMIIPCL will ensure communities are advised in advance of Project progress where transport issues have the potential to impact local communities. The Project Stakeholder Engagement Plan will be utilised to communicate with the communities in this regard. The communications to the community will discuss the timing (*start, duration and finish of Project activities in their vicinity*) of traffic and transportation activities.

Traffic Management will include a programme of traffic safety awareness for inhabitants of villages affected by significant increases in Project related road traffic. The EPC Contractor will provide these communities with sufficient information on safety measures related to road traffic prior to commencement of work and continue to provide sufficient opportunity for community members to air and resolve traffic related complaints during Project period.

Efforts will be made to brief women particularly on safety measures. As the primary caretakers, women are well positioned to pass on safety information to their children. The CSR Team will carry out the traffic safety awareness programme as part of or separate to the comprehensive safety awareness programme. Any grievances will be recorded as per GRC framework specified in the ESIA Report or as further updated for the Project by SMIIPCL.

3.6 MONITORING, REPORTING AND REVIEW

Traffic management data will be documented and reported monthly to SCU. The information will include the traffic congestion, nuisances, incidents and accidents, training records, awareness programmes etc. Details will be provided on the implementation success of the TMP implemented and any areas that require improvement will be highlighted.

3.7 ACCOUNTABILITIES

All employees/workers/ sub-contractors that are engaged by the EPC Contractor for the transportation requirement will be responsible for:

- Comply with the road safety rules and regulations; and
- Ensure any potential or actual traffic management issues are reported to the Project Manager, Supervisor or Task Coordinator.

The EPC Contractor will be responsible for the following activities as described in the TMP:

- Approve appropriate resources for the implementation of this Plan;
- Ensure the effective implementation of strategies designed to reduce traffic induced impacts;
- Authorise internal and external reporting requirements of this Plan;
- Fortnightly/ monthly review of internal reports and incidents;

The EPC Contractor will define detailed responsibilities for activities required as per the TMP.

3.8 REPORTING AND REVIEW

The EPC Contractor team will present to SCU management on a monthly basis the following:

- Actions taken against the mitigation measures adopted for road safety and control of pollution due to use of heavy equipment within the site and transportation of raw materials
- Any issues that have come up in traffic management that has triggered a fine or a complaint by the government authorities, the root cause and actions taken;
- Any complaints or grievance from the local community on health and safety, pollution or noise and action taken. Time line for closing of the action.
- Any major issue emerging that will need management inputs as well as budget for traffic management-e.g. additional parking area/s, signage, noise barriers, etc.

4 EMERGENCY RESPONSE PLAN (ERP)

4.1 INTRODUCTION

This Framework Emergency Response Plan (ERP) has been prepared to address the emergency situations, which could arise during the construction phase of the Project as per the contractual requirements and effectively manages emergencies on site and off site by the EPC Contractor.

This ERP builds on the conceptual information presented in the Project documents and applied to all project activities to be conducted during the site preparation and construction by the EPC Contractor.

Note: SCL is also having an Emergency Response Procedure Framework as part of the Environmental and Social Management System (ESMS). Same shall also be taken into consideration while preparing the Emergency Response Plan for Construction Phase by the EPC contractor and SMIIPCL.

4.2 SCOPE

Site preparation and Construction Phase: The responsibility to frame the detailed ERP and its implementation will be with the EPC Contractor selected by SMIIPCL.

Areas: Project site and associated facility areas where any preparation/ construction activity is going on related to the Project.

Define: Project site, Jetty area, water pipeline, Labour accommodation, roads, lay down areas, batching plant, etc.

Activities: construction, transportation, etc. can be defined in detail to capture the coverage of ERP.

4.3 OBJECTIVES:

The ERP aims to ensure:

- Emergency Response Team (ERT) of the EPC Contractor as initial responder in case of any on-site and/or off-site emergency situation caused due to the project related activities;
- Provide mutual aid in case of any emergency situation arising due to other construction/ operations within the Meghnaghat Power Hub as well as any off-site facility;
- Coordination with the local fire, police and district administration, emergency medical services, the public health authorities, collectively referred to as the External Emergency Response Team (EERT).

The EPC Contractor will provide and sustain the required technical, human and financial resources for quick response during the construction phase of the project.

4.4 EMERGENCY RESPONSE

4.4.1 Approach

Emergencies can be categorised into three broad levels on the basis of seriousness and response requirements, namely:

a) Level 1: This is an emergency or an accident, which:

- can be effectively and safely managed, and contained within the site, location or installation by the available resources; and
- has no impact outside the site, location or installation.

b) Level 2: This is an emergency or an accident, which:

- cannot be effectively and safely managed or contained at the location or installation by available resource and additional support is alerted or required;
- is having or has the potential to have an effect beyond the site, location or installation and where external support of mutual aid partner may be involved; and
- is likely to be danger to life, the environment or to industrial assets or reputation.

c) Level 3: This is an emergency or an incident with off-site impact which could be catastrophic and is likely to affect the population, property and environment inside and outside the installation, and management and control is done by district administration. Although the Level-III emergency falls under the purview of District Authority but till they step in, it should be responsibility of the unit to manage the emergency.

Level 1 and Level 2 shall normally be grouped as on-site emergency and Level 3 as off-site emergency. In order to address any level of emergency situation;

The EPC Contractor will identify emergency situations and categorise them under Levels for planning response and training people accordingly.

4.4.2 Roles and Responsibilities

Roles and responsibilities in case of any emergency incident response are presented in Table 4.1.

Table 4.1 Roles and Responsibilities in Emergency Incident Response

S.N.	Entity	Responsibility

S.N.	Entity	Responsibility
1.	Emergency Response Team (ERT)	• Immediate response to the emergency situation • Prepare the emergency site to facilitate the response action, e.g. vacating, clearing, restricting, etc. • Communicate/ alert the EERT • When necessary and requested by the EERT, lends support/ provides assistance during the EERT's response operations. • Provide mutual aid in case of any emergency situation arises in the surrounding plant/s or construction site.
2.	Resources	• Provide and sustain the people, equipment, tools and funds necessary to ensure Subproject's quick response to emergency situations. • Maintain good communication lines with the EERT to ensure prompt help response and adequate protection, by keeping them informed of Subproject progress.
3.	External Emergency Response Team (EERT)	• Provide support to the ERT based on communication received from ERT for Level 1 and Level 2 type emergencies. • Immediate action in case of Level 3 type emergency situation/ accident. • Co-ordination with different agencies.

The ERT will be led by the senior EPC Contractor Engineer (designated ERT-Lead) on-site with a suitably trained site supervisor or junior engineer as deputy. Trained first-aiders and security personnel will be the core members of the ERT. The EPC contractor will ensure that ERT members are physically, technically and psychologically fit for their emergency response roles and responsibilities.

4.4.3 Pre-Start Up

Prior to the mobilization of civil works, the EPC Contractor through its Construction Manager, ERT-Lead, will meet with the ultimate response institutions to discuss the overall construction process, including, but not limited to:

- Project site, laydown areas, construction workers camp areas, temporary areas to be used for transportation of heavy lifts, etc., located within the project site and outside;
- construction time frame and phasing;
- any special construction techniques and equipment that will be used;
- any hazardous materials that will be brought to and stored in the construction premise and details on their applications and handling/management system;
- the Contractor's Emergency Management Plan; and
- names and contact details of the ERT members

The objective of this meeting is to provide the ultimate response institutions the context for:

- their comments on the adequacy of the respective Emergency Management Plans;
- their own assessment of what types, likely magnitude and likely incidence rate of potential hazards are anticipated; and

- the arrangements for coordination and collaboration with district administration and external agencies working on emergency response and disaster management.

To ensure effective emergency response, prior to mobilization of civil works, the EPC Contractor will:

- set up the ERT;
- set up all support equipment and facilities in working condition;
- made arrangements with the EERT;
- conducted proper training of ERT members, and encouraged and trained volunteers from the work force;
- conducted orientation to all construction workers on the emergency response procedures and facilities, particularly evacuation procedures, evacuation routes, evacuation assembly points, and self-first response, among others; and
- conducted drills for different possible situations.

To sustain effective emergency response throughout the construction Phase implementation an adequate budget shall be provided to sustain the capabilities and efficiency of the emergency response mechanism, the emergency response equipment, tools, facilities and supplies. Drills and reminders will take place regularly, the former at least every two months and the latter at least every month.

4.4.4 Alert Procedures

Means of communicating, reporting and alerting an emergency situation may be any combination of the following:

- audible alarm (siren, bell or gong);
- visual alarm (blinking/rotating red light or orange safety flag);
- telephone (landline);
- mobile phone;
- two-way radio; and
- public address system/loud speakers.

Some rules relative to communicating/alerting will be:

i. Whoever detects an emergency situation first shall immediately :
   - call the attention of other people in the emergency site,
   - sound the nearest alarm, and/or
   - report/communicate the emergency situation to the ERT.

ii. Only the ERT-Lead and, if ERT-Lead is not available, the Deputy ERT-Lead are authorized to communicate with the EERT. Exceptional cases to this rule may be necessary and should be defined in the Emergency Management Plans.

iii. When communicating/alerting an emergency to the EERT, it is important to provide them with at least:
   - the type of emergency situation;
   - correct location of the emergency;
   - estimated magnitude of the situation;

- time it happened;
- in case of a spill, which hazardous substance spilled; and
- in case of fire and explosion, what caused it.

Such details would allow the EERT to prepare for the appropriate response actions. For an effective reporting/alerting of an emergency situation:

i. The names and contact details of the relevant persons and institutions should be readily available in, or near to, all forms of communication equipment, and strategically posted (at legible size) in all Subproject sites and vehicles:
   - Most relevant construction/operations staffs namely, the ERTL, Deputy ERTL, first-aiders, supervising engineers, foremen
   - EERT institutions/organisations
   - Concerned Union authority/ies.

ii. Project site and activity areas outside (such as laydown area, construction workers camp, temporary jetty, water intake structure area, etc.) should have good access to any combination of audible and visual alarms, landline phones, mobile phones and two-way radio communication at all times.

iii. Contractor's construction vehicles should also be equipped with the appropriate communication facilities.

4.4.5 Emergency Response Situations

The following tables suggest general procedures that will be described in more detail in the Emergency Management Plans prepared by the EPC Contractor.

Table 4.2 Evacuation Procedures

S.N.	Procedure	Remark
1.	Move out as quickly as possible as a group, but avoid panic.	All workers/staff, sub-contractors, site visitors to move out, guided by the ERT.
2.	Evacuate through the directed evacuation route.	The safe evacuation shall have been determined fast by the ERT-Lead/ Deputy ERT-Lead and immediately communicated to ERT members.
3.	Keep moving until everyone is safely away from the emergency site and its influence area.	A restricted area must be established outside the emergency site, all to stay beyond the restricted area.
4.	Once outside, conduct head counts.	Foremen to do head counts of their sub-groups; ERT-Lead/Deputy ERT-Lead of the ERT.
5.	Report missing persons to EERT immediately.	ERT-Lead/Deputy ERT-Lead to communicate with the EERT.
6.	Assist the injured in evacuation and hand them over to the ERT first-aiders or EERT medical group	ERT to manage injured persons to ensure proper handling.
7.	If injury warrants special care, DO NOT MOVE them, unless necessary and instructed/directed by the EERT.	ERT-Lead/Deputy ERT-Lead communicates with EERT to get instructions/directions in handling the injured.

Table 4.3 Response Procedure during Medical Emergency

S.N.	Procedure	Remark
1.	Administer First Aid regardless of severity immediately.	Fundamentals when giving First Aid: • Safety first of both the rescuer and the victim. • Do not move an injured person unless: • victim is exposed to more danger when left where they are, e.g., during fire, chemical spill • it would be impossible for EERT to aid victims in their locations, e.g., under a collapsed structure • instructed or directed by the EERT. First AID to be conducted only by a person who has been properly trained in giving First Aid.
2.	Call the EERT emergency medical services and/or nearest hospital.	ERT-Lead/Deputy ERT-Lead or authorized on-site emergency communicator
3.	Facilitate leading the EERT to the emergency site.	ERTL/Deputy ERTL to instruct: • an ERT member on- site to meet EERT in access road/strategic location. He/she shall hold orange safety flag to get their attention and lead them to site. • Other ERT members to clear access road for smooth passage of the EERT.
4.	If applicable, vacate site and influence area at once, restrict site, suspend work until further notice.	Follow evacuation procedure.

Table 4.4 Response Procedure in Case of Fire

S.N.	Procedure	Remark
1.	Alert a fire situation	Whoever detects the fire shall immediately: • call the attention of other people in the site, • sound the nearest alarm, and/or • Foreman or any ERT member among the construction sub-group contacts the fire department (in this case it should be agreed on that it is alright for any ERT member in the sub-group to alert the fire department) • report/ communicate the emergency situation to the ERTL/Deputy ERTL.
2.	Stop all activities/operations and evacuate.	All (non-ERT) workers/staff sub-contractors, site visitors and concerned public to move out to safe grounds following the evacuation procedure.
3.	Activate ERT to contain fire/control fire from spreading.	Guided by the training they undertook, ERT members assigned to mitigate the fire shall assess their own safety situation first before attempting to control fire spread.
4.	Call the nearest fire and police stations and, if applicable, emergency medical services.	When alerting the EERT, ERTL will give the location, cause of fire, estimated fire alarm rating, any injuries.

S.N.	Procedure	Remark
5.	Facilitate leading the EERT to the emergency site.	ERT-Lead/Deputy ERT-Lead to instruct: • an ERT member to meet the EERT in the access road or strategic location and lead them to the site. He/she shall hold the orange safety flag to get their attention and lead them to the site. • some ERT members to stop traffic in, and clear, the access road to facilitate passage of the EERT.
6.	ERT to vacate the site as soon as their safety is assessed as in danger.	Follow appropriate evacuation procedure.

Other situation to be identified and details included by the EPC Contractor.

4.5 MONITORING, REPORTING AND REVIEW

Emergency situations will be identified, documented and reported to SMIIPCL. The information will include details of trainings, mock drills and the response. Any areas that require improvement will be highlighted. Any incidents will be immediately reported to SMIIPCL and further root cause analysis and preventive action taken to be intimated.

4.6 ACCOUNTABILITIES

All employees/ workers/ sub-contractors that are engaged by the EPC Contractor directly or indirectly to work in the Project will be responsible for:

- Ensuring the effective implementation of this Plan;
- Trained to respond as per requirements of the ERP;

The EPC Contractor will define detailed responsibilities for activities required as per the ERP.

4.7 REPORTING AND REVIEW

The EPC Contractor team will present to the SMIIPCL management on a monthly basis the following:

- Any emergency incidents on site and/ off site;
- Root cause analysis and prevention action taken;
- Timeline and responsibility for closing of the action.
- Any major issue emerging that will need SMIIPCL management inputs as well as budget for ERP.

5 CONSTRUCTION LABOUR MANAGEMENT PLAN

Summit Meghnaghat II Power Company Limited (SMIIPCL) will require an approximate workforce of 800 persons during the construction phase. During the transition phase between construction and operations phase, there will be gradual decline in workforce and it will come down to between 60 to 75 workers during the operation phase.

Activities associated with the Project are expected to induce an influx of employment and business seekers into project's area. This Construction Labour Management Plan (CLMP) has been compiled to address the specific impacts that are anticipated to occur as a result of the project and sets out a formal system by which the project proponent, i.e. SMIIPCL, will implement mitigation measures that will reduce the adverse impacts of project induced labour influx.

5.1 PURPOSE, SCOPE AND OBJECTIVES

The purpose of the CLMP is to provide a clear set of actions and responsibilities for the control of impacts linked to project induced migration, primarily within the area, especially near the project footprint in *Char Ramjan Sonaullah*, Pirijpur Union, Sonargaon Upazilla, Narayanganj District.

The scope of the CLMP includes all direct and third-party workers and their amenities that are put in place by SMIIPCL, their lead contractors and any sub-contractors.

The objectives of this CLMP are as follows:

- To monitor the scale of project-induced influx into project area and any specific migration "hotspots";
- To avoid unplanned and unmanaged influx into the area; and
- To mitigate and manage any adverse impacts and enhance any beneficial ones, especially impacts that may strengthen the local economy.

This CLMP should be read in the context of the Environmental and Social Management Plan of the ESIA for the Summit II Power Plant and will be implemented in conjunction with the Stakeholder Engagement Plan. Implementation of the Construction Labour Management Plan (CLMP) should also consider the Construction Management Plan and HSE Plan as outlined in Annexure K of Corporate Environmental and Social Management System (ESMS) for SUMMIT Corporation Limited.

5.2 APPLICABLE STANDARDS

The CLMP of the project is designed to demonstrate that Bangladesh Labour Act 2006 (as per the Bangladesh Labour Rules 2015) and international requirements (including International Labour Organization -ILO Conventions, ADB SPS 2009, IFC Performance Standard, 2012) are consistently applied throughout the construction and operations phase. A summary of the legal requirements and standards relevant to the CLMP are provided subsequently:

1. Based on preliminary review, there is no relevant national Bangladesh legislation relevant to the requirements related to the management of project-induced influx;
2. ADB SPS 2009 Prohibited Investment Activities List (Appendix 5) excludes production or activities involving forced and child labour from qualification for ADB financing;
3. The IFC Performance Standard 2 focuses on the protection of the basic rights of workers, fostering constructive worker-management relationships, as well as promoting safe and healthy workplace.
4. The IFC PS 4 on Community Health & Safety and Security includes references to avoidance or minimising the transmission of communicable diseases that may be associated with the influx of Project labour;
5. The CLMP has also considered building on from good practice references as provided in:
    a. "IFC's Handbook on Project Induced In-migration - Projects and People: A Handbook for Addressing Project-Induced In-Migration";
    b. IFC and EBRD Guidelines on Worker Accommodation.

5.3 LABOUR ACCOMMODATION DURING CONSTRUCTION AND OPERATION PHASE

A labour camp will be established near the project site which is about 500 m from the from the project site and will house labour workforce. The Contractor's staff camp is also expected to be at the same location. The project proponent will endeavour to maximise local employment, however, there will still be migrant workforce required depending on skill level available locally. The labour camp is expected to be of 10,000 sq.m. and will potentially house approximately 600-800 migrant labourers during peak construction phase. This number can be less based on availability of local skilled labourers.

SMIIPCL will not establish a project colony or provide leased accommodation for its staff during operations phase. The employees (~70 employees) will stay in Pirijpur Union in Sonargaon Upazila or Hossaindi Union in Gazaria Upazila or nearby town areas on a rental basis.

5.4 COMPONENTS OF THE CLMP

5.4.1 Summary of Key Impacts

Economic Implications

- Increased price inflation and economic vulnerability due to the arrival of migrants into the project area, which may result in additional demand for goods and services causing an increase in the cost of basic goods;
- Decreased food security through diminished communal and natural livelihood assets;
- Increased competition for natural resources, land occupation and use, such as the proliferation of informal settlements around the project location;
- Increase in business and entrepreneurial activities and opportunities near the labour camp and construction site in form of service providers like barbers, mechanics, carpenters, electricians, laundry, restaurant/food stall operators, vegetable and meat/fish shops, grocery stores etc.;
- Income earning opportunity through rent for owners of houses/flats in adjacent villages and towns within Pirijpur Union or Hossaindi Union where SMIIPCL employees may reside during the operations phase.

Pressure on Local Infrastructure

- Increased demand for potable water due to increased population sizes and proliferation of informal settlements in certain hotspots;
- Increased pressure on existing infrastructure, such as inadequate schools, health centres, waste disposal facilities and water supply network;
- Increased potential for the transmission of communicable diseases from immigrant populations to local communities, with potential for epidemics;
- The presence of migrants can lead to a large increase in the quantities of solid waste with impacts on environmental health conditions.

Social Implications

- Potential breakdown of traditional institutions, traditional leadership structures and cultural norms;
- Increased incidence of prostitution, increase in sexually transmitted diseases and specific anti-social behaviours (including violence against vulnerable social groups);
- Conflicts with community leaders and youth due to lack of knowledge of the local culture, beliefs, habits etc.

5.4.2 Key Interventions under the CLMP

Economic Interventions

- Employment of local labourers during the construction and operations phase will be given priority in order to reduce the need for a sizeable proportion of workforce to be recruited from outside the area. The project will seek maximum employment from local areas (within Narayanganj

District, precisely from Sonargaon, Meghna and Gazaria Upazila) to meet its construction workforce requirement Subject to availability and necessary skills;

- The project may tie-up with Industrial Training Institute (ITI), if any, locally situated, for intake of semi-skilled and skilled workers for project work. The ITI runs various skill development courses for electrical work and repair, carpentry, welding, plumbing etc. SMIIPCL will aim at upskilling the local workers to enable their engagement in specialized activities during construction and operations phase;
- Any requirements of semi-skilled and skilled workers will be first advertised in local newspapers to enable maximum intake of local workforce;
- Provide low-cost shopping opportunities at camp to prevent large scale price fluctuations and disequilibrium in demand and supply of important goods;
- Identify regional businesses that can supply the needs of the project. Consider packaging of contracts to enable local businesses to participate in supply of raw material, providing services and carrying out construction and operations related activities. This can be undertaken by:
    - Transparent bidding process for procurement of materials and upcoming bids and contract opportunities should be advertised in local newspapers;
    - Extra weightage to local businesses and contractors during bid qualification and selection. Furthermore, a list of pre-qualified local vendors can be prepared over time keeping in mind that scope for new entrants and healthy competition among local enterprises should be available;
    - Requirement of perishable food items and any other material available in *Char Ramjan Sonaullah* should be met locally;
    - Preference to enterprises or companies owned or operated by local women.

Site and Infrastructure Development

There will be one labour camp/worker accommodation and Contractor's staff camp located within 500 m from the project site. The Meghnaghat Power Hub region has witnessed development of several power plants and other industries within the Meghnaghat Industrial area. Therefore, local community has been introduced to labour influx in the area although with limited interactions with in-migrant workers as the labour camp was located inside the project site.

- The workers engaged by the Contractors and sub-contractors involved in manual labour and unskilled trades would reside in the construction workers camp established within 500m of the project site. The construction workers camp to be set up by SMIIPCL and its contactors would ensure adequate living conditions with basic amenities. The facilities to be provided in the camp would include:
- Canteen/mess facilities for food;

- Electricity;
- Rooms should be well-ventilated with adequate lighting and electrical connections;
- Beds and bedding;
- Potable water supply and monthly water quality testing;
- Provision of cooking fuel;
- Provision of separate toilets and bathrooms for men and women (although, it is expected that there will very few or no in-migrant female labourers);
- Emergency Response Plan, fire extinguishers;
- Grievance mechanism;
- Waste management in the camp;
- Pest Management and Fogging during rainy season to prevent malaria;
- Medical facilities and education facilities.

A labour accommodation monitoring checklist is provided in ***Appendix A*** of this document.

Additional interventions will be required to document and monitor the proliferation of settlements and work with the local district and upazilla and union authorities to upgrade community infrastructure.

Stakeholder Sensitisation

SMIIPCL will sensitise contractors and workers about the profile, characteristics and features of the local community as well as specific rules of conduct pertaining to substance abuse, avoidance of conflict etc. Specific interventions with the local agencies will also be explored to track influx.

The following table summarises the key interventions during the construction and operations phase:

Table 5.1 Influx Management Plan Measures

S. No	Objective	Management Measure	Monitoring	Responsibility
1	**Economic Interventions**			
1.1	Minimise influx of job seekers through clear communication of employment opportunities and human resources procedures.	Implement the following: • Plan recruitment and procurement to boost local benefits and avoid the in-migration of opportunistic in-migrants. • Implement employment policy forbidding informal labour hire; • Tie-up with local ITI or any other technical training institute and advertising of jobs in local newspapers • Options to introduce construction and operations skill related to courses in local ITIs to enable absorption of local workers in the project should be explored; • Deploy signage in local language related to project hiring, skill development programs etc. in relevant locations (away from areas identified to be sensitive to in-migration); • Engage new migrants' close to SMIIPCL worksites in a timely manner about hiring policies.	Register of local employment; Communication meetings and signage on local hiring policy Advertisements in local newspapers Number of workers sourced from local ITI and colleges	HR In-charge
1.2	Monitor food prices and rates of inflation	Monitor food prices through the review of the changing cost of a standardised basket of goods.	Database of price fluctuations	Procurement In-charge
1.3	Maximise local procurement strategies	• Develop an inventory on the type of goods required, their frequency and list of local vendors; • Undertake a quick check of local vendors on any child labour or forced labour and register them; • Develop a contracting strategy for consumables, equipment, services etc. and link to the CSR/Community Development activities.	Registration and spend on local vendors in Pirijpur Union	Procurement in-charge
2	**Site/Infrastructure Development**			
2.1	Minimise dependence of project workers on local resources	• Develop worker accommodation for construction with all facilities that prevent pressure on local resources, including potable water, sanitation etc. • During the operations phase, a project colony will be set up to avoid proliferation of settlements in the vicinity of the project area	Site plans, their maintenance and upkeep	HR In-charge
2.2	Monitor the rate of expansion in migrant hotspots in order to	Analysis of aerial / satellite imagery of the local settlements in order to assess their expansion. This assessment will focus	Database of historical aerial / satellite photography compiled	Community Liaison Officer

S. No	Objective	Management Measure	Monitoring	Responsibility
	understand the rate of influx	on Pirijpur and Hossaindi Unions.	and updated	
2.3	Prevention of informal settlements around the project site	• Develop buffer zones around SMIIPCL/contractor infrastructure, including worker accommodation. • Develop culturally appropriate signage, in partnership with local government inside buffers directing new arrivals to areas planned for new development.	• Record zoned areas in maps • Engagement records with traditional leaders to discuss approach to in-migration and Project buffers; • Engagement records with inhabitants of new settlements within buffers	EHS/Compliance
3	**Stakeholder Sensitisation**			
3.1	Engagement to understand concerns on influx	• Develop a detailed engagement plan and schedule related to informing stakeholders of increases in workforce and potential for influx. • Engage with Government authorities and Upazilla and Union Parishad on issues, risks, and opportunities regarding influx; • Engage with local communities to understand their concerns, raise awareness of risks and opportunities, and identify solutions to issues relating to in-migration; • Engage local formal and traditional authorities around the development of new settlements along the access routes to site; • Develop a feedback and grievance mechanism to collect any feedback or grievances related to in-migration.	• Records of engagement undertaken; • Stakeholder engagement minutes; • Database of feedback and grievances; • Presence of a feedback and grievance mechanism that is clearly documented; • Feedback and grievances accepted and responded to within targeted timeframe	EHS and Community Liaison Officer
3.2	Collaborate with Upazilla and Union Parishad and local NGOs government authorities to provide education and awareness programmes focused on diseases and health practices related to sanitation and hygiene as well as anti-social behaviour and substance abuse	Develop information, education and communication campaigns around diseases and health practices related to sanitation and hygiene for workers as well as adjoining local communities	• Presence of Education Health and Awareness Programmes • Record of engagements • Presentation of programme materials	Community Liaison Officer
3.3	Develop and implement a camp management policy in order to limit outsider workforce interaction with local population.	Develop a camp management policy stating and ensuring that the worker's camp and the project colony during operations phase are closed spaces with access restrictions in place. This will prohibit unauthorised visitors and mean all	Presence of camp management policy stating closed camp; Security records of workforce	EPC Contractor

S. No	Objective	Management Measure	Monitoring	Responsibility
		employees are restricted to camp during off-duty hours. This will be supported by appropriate engagement with workforce, signage and security / sign-in /out procedures	signing out	
3.4	Develop and implement an integrated capacity building programme designed to empower local /and regional government to manage in-migration	• Provide technical support to relevant government authorities with the aim of assisting them in effectively administering land development and land use changes as appropriate. • Provide support for the establishment and operation of In-Migration Committees in settlements identified to be at high risk from in-migration. These committees will take part in promoting spatial planning, monitoring in-migration, identifying arising issues, and promoting good relations between local people and in-migrants. • Work with local authorities and village leaders to actively manage in-migration and its impacts, particularly through registering newcomers and directing them to appropriate accommodation options. • Provide opportunities for local authorities and village communities to plan, prioritize, build and maintain necessary infrastructure.	• Presence of capacity building programme • Record of training and development activities • Record of government officials in attendance • Record of engagements with communities • Qualitative feedback from beneficiaries	Community Liaison Officer
3.6	Develop measures to screen and test worker health to manage potential health impact related to community-worker force interactions (which may be worsened by influx).	• Pre-employment medical check-up; • Community health baseline monitoring camps in the project area; • Regular/ongoing alcohol and substance abuse tests and sensitisation/awareness on the effects and impacts	Health check-up records; Disease profile in local health centres and onsite clinic	EHS/ Compliance

5.5 *INSTITUTIONAL SET UP*

The institutional set up proposed for influx management would come under the purview of SMIIPCL's Human Resources (HR) and Administration Department with reporting to the Construction Manager and the General Manager for Operations.

The Human Resources Manager at the site will coordinate with the Contractors' administration representatives and the Community Liaison Officers to monitor impacts at any hotspots where informal settlements come up and within the contractor worker areas and onsite worker facilities.

This core team will require support from representatives across civil engineering and utilities, EHS, Compliance and the Security Department to coordinate and implement measures identified for managing influx at site and for liaison with the government agencies.

5.6 *MONITORING*

In order to verify the management measures, SMIIPCL will require several monitoring systems as part of its overall ESMS which will include (but not be limited to) the following:

- Local employment and local procurement repository and vendor details;
- **Labour Accommodation Monitoring**: labour accommodation monitoring checklist is provided in ***Appendix A*** of this document.
- **In-Migration Database –** this will track the results of project induced influx monitoring including aerial / satellite imagery, wide-angle photographs of settlements, interview responses with traditional leaders, local residents and local stakeholders in the area of health, education, and local community infrastructure, food prices, signage developed, zoning maps, and mid-term baseline monitoring results;
- **Stakeholder Engagement Database –** this will be used to track and record the dates, minutes and attendance at engagement activities. In addition the database will be used to log relevant stakeholders and contact details;
- **Community Feedback and Grievance Mechanism –** this will log all grievances, issues and concerns raised during engagement sessions. The system will also include areas to record information on measures to address issues, timeframes, personnel responsible and any subsequent feedback that is required;
- **Worker transport –** this will be controlled through the use of (for example) ID/access card along with tracking information with local law and order enforcement agencies.

5.7 *REPORTING AND DOCUMENTATION*

SMIIPCL will comply with any Government of Bangladesh reporting requirements relating to influx management if any and as requested or ordered by the government. An internal reporting and monitoring program

relating to influx management will be put in place and management reports will be published at least annually.

A summary report will be developed and disclosed to the local community on an annual basis that will focus on outcomes of any community complaints and actions taken to remedy significant impacts. This will be undertaken in non-technical languages and in suitable local language in a culturally appropriate manner.

Local communities and other stakeholder will have access to the Grievance Redressal Mechanism that is put in place for the project to report any concern resulting due to influx of project labour and other informal settlers into the area or conflicts between the local community and migrant workforce.

The labour accommodation checklist aims to provide a basis for evaluation of the accommodation facilities provided to workers. The intent of this checklist is to ensure that the labour accommodations satisfy at least the minimum prescribed international standards for worker housing.

Primary Responsibility: HR department, EHS & S departments as necessary.

Labour Accommodation Checklist
Location:
Date of inspection:
Total Number of Labourers residing in the Labour Camp:
Type of Accommodation and Number of dwelling units:
Due Date of Inspection:
Name and Designation of Assessor:

	Yes	**No**	**NA**	**Remarks/Comments**
Labour Camp – General Requirements				
Is the location of the labour camp designed to avoid flooding or other natural hazards?	❒	❒	❒	
Is the labour camp location at significant distance from the nearby residential locality?	❒	❒	❒	
Is the project site adequately drained?	❒	❒	❒	
Is the labour camp designed as per approved plan ?	❒	❒	❒	
Is the building material used for the construction is safe and non-hazardous ?	❒	❒	❒	
Does labour camp provide sufficient thermal projection	❒	❒	❒	
Does labour camps are having proper access roads?	❒	❒	❒	
Sanitation Facilities	❒	❒	❒	
Does the labour camp have adequate sanitary and toilet facilities? If yes, are the number of toilets sufficient to suffice the number of labours.	❒	❒	❒	
Is the toilet facility provided with adequate supply of water is available?	❒	❒	❒	
Water, Wastewater and Waste Requirements	❒	❒	❒	
Are potable drinking water facilities available and provided to the labour camps? If yes, is it adequate for meeting domestic needs like bathing, washing and sanitation	❒	❒	❒	

	Yes	No	NA	Remarks/Comments
purpose?				
Is the drinking water storage covered to prevent water stored therein from becoming polluted or contaminated?	❒	❒	❒	
Is adequate storage capacity available to store water for domestic purposes (storage of 48 hours reserve supply is adequate)?	❒	❒	❒	
Are their separate arrangements for sanitation and bathing facilities for men and women (in case of engagement of women workforce)?	❒	❒	❒	
Are the sanitation facilities maintained in good condition ?	❒	❒	❒	
Does the site have a proper drainage system?	❒	❒	❒	
Are all streams of wastewater generated from the camps leading to treatment and disposal facility (septic tanks and soak pits etc.)?	❒	❒	❒	
Do the labour camps have adequate number of dustbins for waste collection and disposal?	❒	❒	❒	
Are wastewater, sewage, food and any other waste material adequately discharged and disposed in compliance with local standards and without causing any significant impacts on camp residents, the environment or surrounding communities?	❒	❒	❒	
Living Conditions	❒	❒	❒	
Do the worker camps have adequate spacing inside to accommodate allotted number of individuals?	❒	❒	❒	
Are the labor camps properly illuminated?	❒	❒	❒	
Is labour camp designed considering safety from rain ?	❒	❒	❒	
Are the labour camps equipped to provide proper thermal comfort during winter seasons?	❒	❒	❒	
Are the labour camps provided with proper facility to keep valuables such as cloak room etc .?	❒	❒	❒	
Are the labor camps properly ventilated?	❒	❒	❒	
Have separate area for cooking being constructed/allocated for workers and proper hygienic conditions being maintained?	❒	❒	❒	
Have the workers been provided or allocated with proper sleeping arrangement like cots, mattresses, blankets etc.?	❒	❒	❒	
Health and Safety	❒	❒	❒	

	Yes	No	NA	Remarks/Comments
Is the cooking facility separate from the living quarters to avoid any fire hazards and is the LPG cylinders (if used) stored in well-ventilated area?	❒	❒	❒	
Is the fire extinguisher been provided at the camps (If necessary)?	❒	❒	❒	
Are there adequate first aid facilities present at the camp and is it readily accessible at all times?	❒	❒	❒	
Are emergency contact numbers displayed prominently at the labour camp. The emergency contacts should include at least one number of principle employer?	❒	❒	❒	
Is a housekeeping register being maintained for the camps?	❒	❒	❒	
Are the workers sensitized on communicable diseases?	❒	❒	❒	
Are there staffs for general house keeping?	❒	❒	❒	
Vector Borne Disease control?	❒	❒	❒	
Are the workers provided with adequate personal protective equipment?	❒	❒	❒	
Community Related	❒	❒	❒	
Is the nearby community anyway getting affected by the labour camps and its activities?	❒	❒	❒	
What are the types of such activities?	❒	❒	❒	
Are there any sources through which there is a possibility of a disease spreading to the nearby community because of the unhygienic conditions at the labour camps? Has there been any? If yes, please specify and provide reasons.	❒	❒	❒	
Is the community getting affected due to the operation of any machinery in the labor camp premises?	❒	❒	❒	

6 STAKEHOLDER ENGAGEMENT PLAN

This Stakeholder Engagement Plan (SEP) has been prepared based on the guidelines outlined in the Stakeholder Engagement Framework (Annexure G) of Corporate Environmental and Social Management System (ESMS) for Summit Corporation Limited (SCL) in compliance with the international best practices.

6.1 PREAMBLE AND PURPOSE

A Stakeholder Engagement Plan (SEP) has been prepared for the SMIIPCL in order to ensure that a consistent, comprehensive, coordinated and culturally appropriate approach is taken to stakeholder engagement, information dissemination and grievance redressal through the life of the project.

SMIIPCL is committed to full compliance with all Bangladesh Regulations as well as aligning to the international standards, namely the IFC Performance Standards (2012) and ADB SPS (2009), and any other directly relevant policies of the IFC and ADB. In line with current international best practice, this SEP aims to ensure engagement that is free of manipulation, interference, coercion and intimidation.

It also aims to ensure that stakeholder engagement is conducted on the basis of timely, relevant, understandable and accessible information, in a culturally appropriate format. In this way, the SEP seeks to ensure that stakeholder groups are given sufficient opportunity to voice their opinions and concerns, and that these concerns influence project decisions.

The SEP is developed to assist the project proponent and the contractors to meet the objectives of identification of various stakeholders and draw means to address the potential concerns that may arise during the project life-cycle. The SEP is based on the socio-economic baseline, identification of stakeholder groups during the ESIA process and applies to all activities that may involve, impact, interest or engage these groups through the pre-construction, construction and operations phase.

6.2 OBJECTIVES OF THE SEP

The key objectives for this project-specific SEP are as follows:

- Maintaining positive legal compliance to applicable stakeholder engagement and disclosure regulations and standards;
- Compliance to the applicable stakeholder engagement commitments in the ESMP and associated framework management plans;

- Providing an engagement mechanism to undertake meaningful consultations and mitigate any reputational risk arising from site activities and their impacts;
- Establishing and maintaining a social license to operate;
- Identifying engagement methods, in keeping with the profile of the stakeholders and principles of inclusiveness, transparency and cultural appropriateness;
- Allowing for information disclosure and stakeholder grievance resolution in a timely and culturally appropriate manner, to allow for informed and meaningful engagement; and
- Establishing clear accountability by assigning adequate resources and responsibilities for effective stakeholder engagement.

While identifying the objectives of the Stakeholder Engagement Plan, it is noted that this is a living document that will evolve over the course of the project lifecycle and the changes in the local community as well as the socio-economic context within which the project will operate. Thus, the Stakeholder Engagement Plan will have to be periodically reviewed and updated.

6.3 PRINCIPLES OF STAKEHOLDER ENGAGEMENT

The implementation of the SEP, its review and update will be aligned and guided by the following principles:

- Interests, influence, issues and concerns of the relevant stakeholders will inform the project's engagement levels and methods;
- All engagement levels and methods will be developed around the principles of inclusiveness and transparency. Where required, mechanisms on Stakeholder and Community Engagement will be tailored to stakeholder needs and modified for cultural appropriateness;
- SMIIPCL will ensure informed consultation and participation of all stakeholder groups that are impacted and/or interested by the Company's environmental and social impacts, including land procurement, community health & safety, ecosystem services and influx management;
- SMIIPCL commits to promote awareness of this Policy for its employees, partners and contractors through training and communication; and
- SMIIPCL commits to documenting, monitoring and reporting on its stakeholder engagement performance;
- The engagement activities undertaken shall be in cognizance of the cultural norms and practices of the stakeholder groups as well as the differences in social position of the various groups;
- The stakeholder engagement process should demonstrate a commitment and persistence in the efforts to achieve real outcomes on the challenging issues and opportunities;
- As the project/site lifecycle progresses through the various stages, the engagement activities will evolve on the basis of the experiences and learnings from the previous engagement undertaken.

6.4 STAKEHOLDER MAPPING

Stakeholder mapping is a process of examining the relative influence that different individuals and groups have over a project as well as the influence of the project over them. The purpose of a stakeholder mapping is to:

- Identify each stakeholder group;
- Study their profile and the nature of the stakes;
- Understand each group's specific issues, concerns as well as expectations from the project that each group retains.
- Gauge their influence on the Project;

On the basis of such an understanding, the stakeholders are categorised into High Priority, Medium Priority and Low Priority. The stakeholders who are categorized as high influence are those who have a high influence on the project or are likely to be heavily impacted by the project activities, and are thus high up on the project proponent's priority list for engagement and consultation. Similarly, the stakeholders categorized as medium priority are those who have a moderate influence on the project or even though they are to be impacted by the project, it is unlikely to be substantial and is thus neither high nor low in the project proponent's list for engagement. On the other hand, the stakeholders with low influences are those who have a minimal influence on the decision making process or are to be minimally impacted by the project and are thus low in the project proponent's engagement list.
The following table provides brief profiles of the various stakeholders in the project as discussed in the previous sub section along with their key concerns in association of the project and their degree of influence.

The following table provides plan for engaging with the various stakeholders in the project to discuss issues, concerns related to the project and progress of the project as per their degree of influence.

Table 6.1 Stakeholder Consultation and Engagement

Stakeholder	Objective of Engagement	Methods of Consultation and Engagement	Frequency of Consultation & engagement
Sub-contractors	To appraise about labour working condition and compliance EHS	• Monthly Meetings (for the purpose of information dissemination, including information regarding labour laws, local employment opportunities, safety measures and discussions of grievances),	• Meetings and monthly reporting in the operations phase
		• Information dissemination regarding welfare provisions for labourers, employment opportunities, grievances,	• As and when required

Stakeholder	Objective of Engagement	Methods of Consultation and Engagement	Frequency of Consultation & engagement
		EHS and CSR activities though notice board and display of key messages on billboard1	
Contractual Labourers	To appraise about labour working condition	• Information dissemination regarding welfare provisions for labourers	• As and when required
		• Grievances Redressal Mechanism (GRM) and EHS though notice board and display of key messages on billboard,	• Regularly
		• open interactions as and when required	• Open discussion as per the requirement but at least quarterly, (when hired during the operations Phase)
Union Parishad/s	For necessary information disclosure of SEP As Part of GRM Ensured involvement in CSR activities and local procurement if required	• Consultations, meetings (FGD and individual interview) and Discussions;	• At least on an annual basis;
		• sharing of documents as part of the disclosure mechanism;	• As and when required;
		• Grievances Redressal Mechanism (GRM)	• Regularly
		• Attendance at Panchayat meetings and participation in CSR activities.	• Regulatory requirements
Regulatory Authorities	Compliance to regulatory requirements	• Meetings and Discussions	• As per the regulatory requirements or as and when required
District Administration	Regular engagement Participation in CSR Activities	• Regular meetings and participation in CSR events	• As and when required;
Land Sellers	To Seek support if required	• Attendance in plant functions/occasions, or seek their support as and when required	• Meeting and invitation in events
Local Community	Information disclosure, Managing and ensuring participation in CSR activities As part of and GRM	• Half Yearly Open Meetings,	• Half Yearly
		• interactions with community at Gram Panchayat,	• at least annually or as and when required
		• sharing of CSR reports and other documents as part of the disclosure mechanism and the GRM and	• at least annually
		• Involvement in CSR activities	• As and when required

(1) [1]The information to be posted on the bulletin boards is to include information pertaining to the project activities and the time schedule for the same, safety norms and precautions mandatory in the project, CSR activities to be undertaken, local employment opportunities and any other announcements/information relevant to the sub-contractors and labourers.

Stakeholder	Objective of Engagement	Methods of Consultation and Engagement	Frequency of Consultation & engagement
Agricultural Labourers	For necessary information Managing and ensuring participation in CSR activities As part of GRM	• Open Public Consultations	• at least annually
		• sharing of reports and other documents as part of the disclosure mechanism (Provisioning of reports in Hindi/local language	• at least annually
		• Involvement in CSR activities	• As and when required
Vulnerable Community	Managing and ensuring participation in CSR activities As part of GRM	• Discussions, FGD, Open meetings and consultations with each category,	• At least Half Yearly
		• Grievances Redressal Mechanism (GRM)	• at least annually
		• Involvement in CSR activities	• As and when required
Village Institution (School & PHC)	Managing and ensuring participation in CSR activities	• Discussions, Consultations and Open Meeting and discussions, FGDS ; and	• at least annually or as and when required
		• Involvement in planning and implementation of CSR activities	• As and when required
Political Parties	Regular engagement	• Meetings with the local representatives as and when required	• As and when required
Media	Regular engagement	• disclosure of information and meetings (as and when required)	• As and when required

Source: Corporate Environmental and Social Management System (ESMS) – SUMMIT Corporation Limited

6.5 ENGAGEMENT MECHANISMS

The range of stakeholder groups identified within the ESIA can be grouped into the following:

- Project affected communities;
- Local communities;
- Local elected councils;
- Local Ups, Upazila and District authorities ;
- Other interested entities, including civil society organisations.

The engagement activities undertaken shall be aligned to the business objectives, priorities and the identified issues/impacts/risks associated with the project. This will also result in a variation in the engagement activities undertaken, across the various phases of the project/ business lifecycle, depending upon the impacts and risks associated with each phase.

As part of the planning, the engagement activities shall be prioritized on the basis of their material significance to immediate and long-term interests of the Stakeholder Engagement Plan.

Table 6.2 Stakeholder Engagement Plan

Stakeholder Group	Issue/ Relevance	Themes and Focus Areas for Engagement	Engagement Strategies	Tools, Methods and Frequency
Project Affected Communities	• The community in the study area is primarily dependent on agriculture and livestock rearing for their livelihood, followed by wage labour, fishing and other activities etc. • There is anticipation that the project will generate adequate local employment. The unskilled workforce are of the opinion that they might get some temporary employment as labourers.	• Priority in local employment, especially for hiring of unskilled workers; • Project development timelines and milestones; • Grievance management; • Impacts and community feedback on mitigation	• The project could offer suitable employment, to the local unskilled workforce stakeholder group within company or refer the unemployed to other suitable employment opportunities in case there is lack of prospects within the project. By doing this the stakeholders will become a part of the project and the company will have strong support from the affected families by having their representation in project operations. • The grievance redress mechanism should be disclosed with the community such that for any concern, they can easily approach the project authorities.	• Quarterly information disclosure through public meetings at each village; • Informal discussions during village visits; • Participatory decision making processes through SMIIPCL and contractor; • Grievance Redressal Mechanism • Consensus building processes;
Vulnerable Communities	Vulnerable groups comprise of the traditionally backward and marginalized communities, women headed households, differentially abled people, old, infirm and vulnerable households.	The primary concerns of these stakeholders pertain to the formulation of community development and mitigation measures in such a manner while keeping in mind their specific needs and vulnerabilities attached to economic and social capital.	• The mid-term impact evaluation should engage with the identified vulnerable groups and assess the implementation of safeguards developed for vulnerable households. • Family Members vulnerable households should be given priority in appropriate employment opportunities during construction period	• Informal discussions during village visits; • Participatory decision making processes through SMIIPCL and contractor; • Grievance Redressal Mechanism • Consensus building processes
Fishing community	There are a few households identified in the project area who are engaged in fishing either only during peak season or throughout the year. The main fishing settlements in terms of fishermen	The primary concerns of these stakeholders pertain to the impacts of the industries on their livelihood in terms of river flow, fish count and catch, access issues during	• Profiling of fishing practices and households engaged in fishing;. • Formation of fishing representative groups or associations as per location and villages to engage with them in a	• Informal discussions during village visits; • Participatory decision making processes through SMIIPCL; • Information disclosure during

Stakeholder Group	Issue/ Relevance	Themes and Focus Areas for Engagement	Engagement Strategies	Tools, Methods and Frequency
	population are closer to Char Balaki, Islampur	construction and operations phase, size of fishes in operational phase and adequacy of the mitigation measures to be undertaken by SMIIPCL.	collective manner.	construction phase and operations phase for dredging, barge construction and operations of Jetty vis-à-vis health and safety • Grievance Redressal Mechanism • Consensus building processes
Union Parsihads and Upazila administration	Union Parishads are lowest levels of local governance and consists of nine wards. The two (2) Unions Parishads Pirijpur and Hossaindi are within the core area. Remaining UPs are equally important as UPs are representatives of local community and in order for the smooth and proper functioning of the project, the support of the UPs is imperative.	The primary concerns of these stakeholders pertain to the impacts of the project on the villages, adequacy of the mitigation measures to be undertaken by SMIIPCL.	• Engagement with UP and Upazila committee members in terms of upcoming development and welfare scheme and opportunities to partner with the government bodies in community development measures.	• Forma meetings and discussions; • Consensus building processes

6.6 MONITORING, REPORTING AND REVIEW

The Human Resources Department/Community Liaison Officer of SMIIPCL or an equivalent on-site team shall be responsible for identification of the stakeholders, documentation and maintenance of the database of all the engagement activities undertaken in the lifecycle of the site/business. In certain cases, documentation may be required by the applicable reference framework, in which case, the documentation guidelines prescribed shall be followed.

It is the responsibility of the Stakeholder Engagement Cell to ensure the efficacy of the engagement efforts in terms of stakeholder groups covered and the purpose of engagement and to allow for the identification of any key issues or risks that may emerge during the engagement process. The team shall allow for revision of the SEP or the engagement plan as required during the lifecycle of the site/business.

6.7 ACCOUNTABILITIES

The leadership and overseeing of the implementation of the SEP shall be at the senior level of the SMIIPCL Company Management. An Internal Task Force shall be appointed as a temporary body for the development of the SEP at the company level. For the implementation of the SEP, a Stakeholder Engagement Cell (SEC) shall be established.

6.8 REPORTING AND REVIEW

The documentation of the stakeholder engagement carried out shall include the following key aspects –

- Total number of stakeholders engaged in each group;
- Geographical location of such engagement activities;
- Key concerns and risks identified and reasons for the same;
- Actions to address these concerns and report back to the people in the next engagement phase;
- Grievances, type, category and their resolution;
- Examples of how engagement has worked or where engagement needs strengthening; and
- Recommendations.

The report should be presented to the SMIIPCL management on a quarterly basis or based on urgency.

7 GRIEVANCE REDRESSAL PLAN

The grievance redress mechanism provides a formal forum to the aggrieved or interested stakeholders to deal with issues arising out of environmental and social related issues linked to the project. The proposed Grievance Redress Mechanism (GRM) has been developed for the Project to promote amicable dispute settlement through mediation to reduce/avoid the escalation of such issues to litigation. This project specific GRP is related to the ESIA conducted for the Summit M2 project and is related to the ESMF.

This project specific Grievance Redressal Plan (GRP) should be read along with the Grievance Redressal Framework of Summit Corporation Limited (SCL) that is responsible for addressing responses timely, based of grievances and complaints received from external and internal stakeholders.

7.1 OBJECTIVE OF GRIEVANCE REDRESSAL PLAN

The key objectives for this project – specific GRP may be attributed to the objectives specifies in Corporate Environmental and Social Management System (ESMS) for SUMMIT Corporation Limited:

- To allow stakeholders the opportunity to raise comments and concerns related to the project;
- To structure and manage the handling of comments, responses and grievances and allow monitoring of effectiveness of the mechanism; and
- To ensure that comments, responses and grievances are handled appropriately in a fair and transparent manner, in compliance with international best practices.

7.2 STRUCTURE OF GRIEVANCE REDRESS MECHANISM

There will be a project-level Grievance Redress Cell (GRC) that will seek to resolve disputes arising out of various matters related to the implementation of the project. The GRC will comprise of the following:

- Representatives of SMIIPCL and the EPC contractor;
- Representatives of the local Union Parishads (Pirijpur and Hossaindi Unions) ;
- Representatives of local community in Pirijpur and Hossaindi Union.

The GRC meetings will be held in SMIIPCL's site office and the same will be widely publicised in project area for the knowledge of general public.

The responsibilities of the GRC will include:

- Review, consider and resolve grievances related to social and environmental aspects received by the Project and its internal stakeholders (including investors, employees, contractors and third-party workers);
- Entertain grievances of indirectly affected persons and/or persons affected during project implementation;
- Resolve grievances within a period of two weeks at the GRC level and communication of the resolution to the aggrieved party;
- The GRC shall not engage in any review of the legal standing of an "awardee" nor shall deal with any matters pending in the court of law;
- The GRC will not prevent or prohibit access to legal redress that is enshrined in the judicial system of Bangladesh ;
- Arrive at decisions through consensus, failing which resolution will be based on majority vote. Any decision made by the GRC must be within the purview of Environmental and Social Management Plan, Corporate EHS and Social Policies of SMIIPCL or any such documents of relevance of that matter;
- In case the grievance relates to environmental monitoring results or engineering matters, the GRC will validate the information available to it, as provided by SMIIPCL's Project management team/ environmental monitoring team. However, GRC will not be in a position to question the validity of the data provided to it. The GRC team shall meet at least twice a month for review of grievances registered and the resolution vetted out to the concerned parties. The frequency of meeting may increase or decrease depending on the number grievances received;
- If needed, may undertake field visits to verify and review the issues, dispute or other relevant matters.

7.3 PRINCIPLES OF GRIEVANCE MANAGEMENT

- SMIIPCL will ensure proactive stakeholder engagement practices in order to avoid, wherever possible, a situation where a grievance may occur;
- Grievance mechanisms shall acknowledge and address concerns over both real and perceived impacts in the same way and with the same level or care;
- Grievance mechanisms shall address complaints, both formal and informal to avoid escalation into serious grievances;
- The engagement methods and mechanism will follow a transparent and easily understandable process along with access to several means of raising concerns;
- All grievance mechanisms that are put in place will incorporate the provision to raise concerns anonymously;
- No grievance mechanisms shall impede access to or seek to take the place of legal remedies, in case all the options are already exhausted; and
- All grievance mechanisms shall be readily accessible, culturally appropriate and proactively communicated to employees and other external stakeholders as appropriate.

7.4 GRIEVANCE REPORTING

An aggrieved person, a group of persons or a community will be able to file grievances without any fear and intimidation. The grievances can be submitted in either in writing or may be submitted orally/ telephonically to the GRC; the whole purpose is to make the GRM easily accessible to the affected population.

Once the complaint is received, acknowledgement of the same will be made to the complainant, and tentative date of hearing may be communicated to him/her in advance. The complainant may be represented by him/her or appointed agent for hearing of grievance.

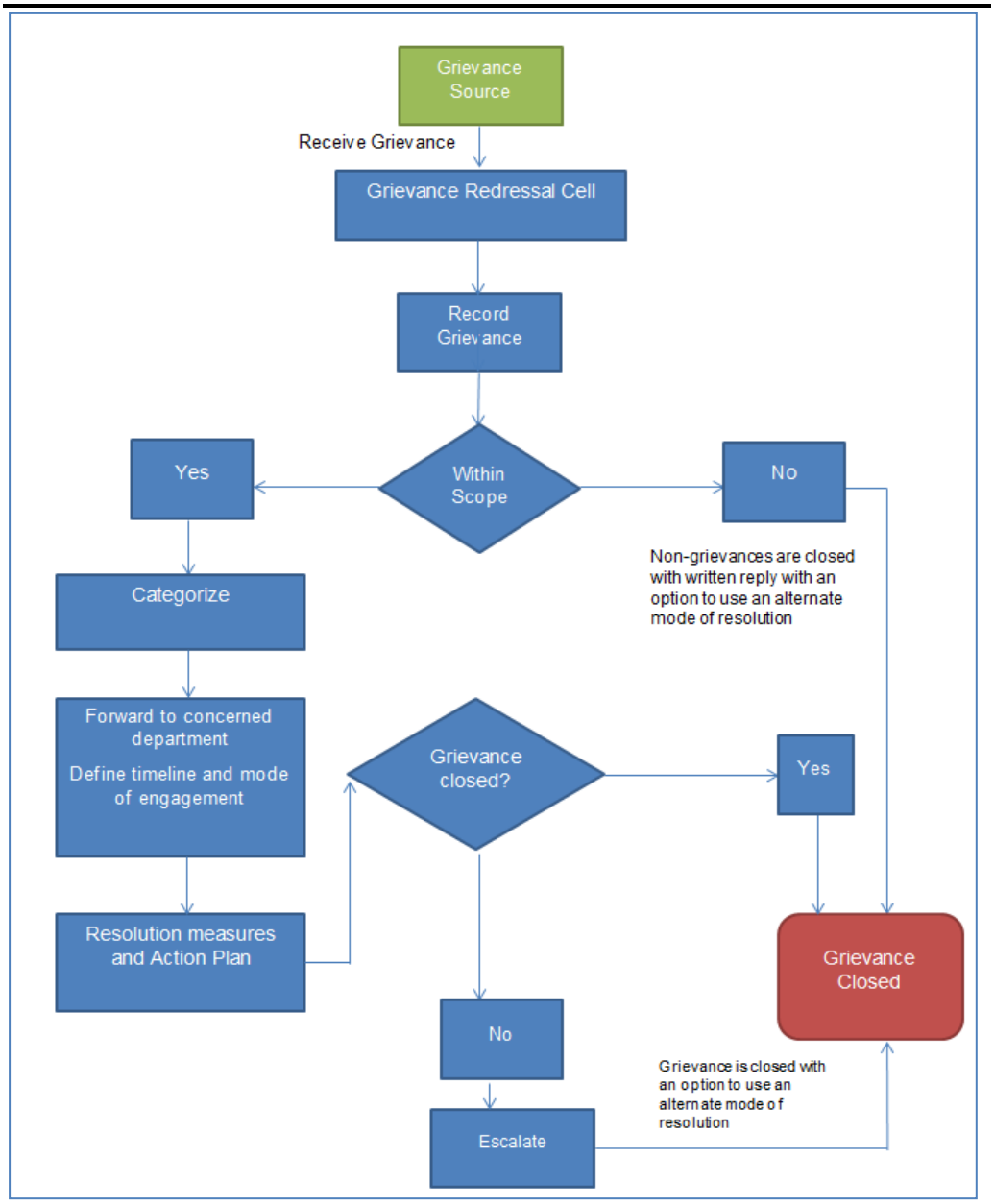
The decision made by GRC will be communicated to the concerned person/group/community in writing. If dissatisfied, with the decision of the GRC, the person/ group/ community may register the grievance at the administrative level in case there are necessary channels for the same.

There may be situations where for a variety of reasons, the concerned party/parties may be reluctant to openly raise or discuss them with company representatives. The intention of constituting this grievance redressal mechanism (GRM) is to encourage such party/parties to raise their concern as a first step to moving towards resolution and restoring maintaining trust in SMIIPCL to deal with their complaints, concerns or grievances in a fair and just manner. This will also help bring transparency in the process of grievance redressal.

7.5 REDRESSAL PROCESS

The grievance redress procedure will include the stepwise procedure, to deal with any grievance that comes for redress before the GRC. A schematic representation of the grievance redresses procedure to be followed is illustrated subsequently:

Figure 7.1 Grievance Schematic



Grievances primarily related to any serious event such as accidents involving the community, labour related major disputes such as non-payment of wages or work related injuries or fatalities, major intrusion of project on any community resource, and other issues for which the aggrieved party in his or her free will wants to register a grievance or complaint.

The process followed will follow the following steps:

- On receipt of complaint the GRC shall give an acknowledgement to the complainant with date, time and venue of hearing of his/her grievance;
- The GRC shall prepare a brief note on the grievance for discussion on scheduled date. On the given date, the GRC shall hear the complainant and give its decision. A written copy of decision shall be provided to the complainant. If the complainant is satisfied with the decision, an acknowledgement of same shall be obtained from him on the decision

copy and the case shall be closed. If not then the grievance should be escalated to senior management and a resolution measure should be decided with engagement with the aggrieved;

- While every effort shall be made to resolve the complaint amicably, if the complainant is not satisfied with the outcome of GRC's decision, he or she can opt for any grievance redress forum available at the administrative level or any other arbitration mechanism with mutual agreement. If these alternative mechanisms of resolution of conflict fails, then the aggrieved person may take legal recourse However, every effort shall be made to resolve the case amicably without resorting to legal course of action. While the process continues, a proper documentation of the records shall be maintained by SMIIPCL, pertaining to each of the grievance in a proper grievance register or record.

GRM procedures and operational rules will be publicized widely through community meetings and pamphlets in the local language so that people are aware of their rights and obligations, and procedure of grievance redress. The procedures adopted, as well as resources allocated will be determined by the extent of impacts and perceived risk at a particular point of time. In general, grievances are minimal at the pre-construction stage, peak during construction, and will be comparatively moderate during operation. Accordingly, the decision on the scaling of the GRM shall be taken.

7.6 MONITORING, REPORTING AND REVIEW

The Human Resources Department/Community Liaison Officer of SMIIPCL or an equivalent on-site team shall be responsible for receiving, documentation and maintenance of the database of all the complaints or grievances lodged in the lifecycle of the project. Monitoring and review of the complaints in regular intervals will allow to take effective measure to address the issues.

SUMMIT

SUMMIT CORPORATION LIMITED

Environmental Policy

Summit Corporation Limited including its subsidiaries will manage its power plants operations in a manner that ensures compliance with local laws, International Finance Corporation's (IFC) Performance Standards and good international industry practices. Summit will strive to safeguard the environment and natural resources and promote resource efficiency in its operations. Following will be the core objectives in achieving the above.

At the corporate level, the Company endeavors to:

- Fully implement the requirements of Environment Conservation Rules 1997 and its subsequent amendments, any rules, regulations imposed/ issued by Department of Environment, Bangladesh and any concerned authority of Bangladesh.
- Fully implement the requirements of World Bank Group EHS guidelines and in particular the IFC Performance Standards.
- Assess and manage the adverse environmental and social impacts in accordance with IFC Performance Standards.
- Ensure that its operations consider the impact on biodiversity and implement appropriate mitigation measures;
- Provide support and assistance to plant operations through Summit Group Turbine Division and Summit Power Limited.
- Report regularly on the environmental systems and performance of the power plants to the Board.

Our Commitment is to:

- Conduct business in compliance with all applicable environmental laws, regulations and commitments and seek to apply international standards where relevant;
- Make environmental considerations a priority in business planning and in the operation of our power plants;
- Review emissions, effluents and wastes and continually strive to reduce their impact wherever feasible;

- Encourage employees and contractors to take individual responsibility for their actions with respect to the environment through appropriate communications and training;
- Ensure preparedness to respond in a timely and appropriate manner to environmental incidents resulting from plant operations;
- Designate one employee of each facility as coordinator to prepare a plant specific environmental management program with applicable procedures based on the Company's guidelines and conforming to the ISO 14001:2004 standard and implement appropriate training and record keeping;
- Set annual environmental objectives and targets and commit to continuous improvement;
- Demonstrate visible leadership, commitment and involvement towards achieving the Company's E&S objectives;
- Carry out an audit and management review of environmental management systems at least once every two years.

Authorized Signature

REVISION	DATE OF ISSUE
1ST	06.06.2011
2ND	01.08.2016

SUMMIT

SUMMIT CORPORATION LIMITED

SOCIAL POLICY

Summit Corporation Limited (Summit) is committed to address and recognize its (including its subsidiaries) social responsibility within its sphere of influence. Company will contribute and respond immediately where there are scopes of social progress within its sphere of influence.

Reference frame

In appraising such power plants, the Company will be guided by the standards resulting from the following laws, statute, conventions, principles and standards:

i. Environment Conservation Rules 1997 and its subsequent amendments, any rules, regulations imposed/ issued by Department of Environment, Bangladesh and any concerned authority of Bangladesh

ii. Corporate Social Responsibility (CSR) of Summit Group

iii. The standards of World Bank Group and in particular, the International Finance Corporation (IFC) Performance Standards

The policy should be implemented to:

1. Ensure that full compensations and benefits are given to project displaced and affected persons which they are entitled to.
2. Identify and engage community and different level of stakeholders.
3. Address and proper management of any sort of grievances resulting from the construction and operation works of the Company.
4. Restore the livelihood of the Project Affected People (PAP), vulnerable groups within the area of influence of the Company.
5. Enhance the economic status of the community by providing means of income and support.
6. Participate within the process of women empowerment by introducing new programs dedicated to community women.
7. Maintain an effective practice of Community Consultation and Participation so that the communication and channel with the community is adequately maintained. The practice of Informed Consultation and Participation (ICP) can be a key to this process.

8. Prioritize the community people in the case of any decision making process.

9. Introduce and perform regular monitoring and review system to address the effectiveness of the policy.

Exceptions

By the time of emergency, or any event which poses greater threat to the society, the Company should respond immediately irrespective of its Social Policy.

Authorized Signature

Revision	Date of Issue
1st	01.08.2016
2nd	

SUMMIT

SUMMIT CORPORATION LIMITED

Health and Safety Policy

Summit Corporation Limited including its subsidiaries will manage its power plants operations in a manner that protects the health and safety of its employees, customers, contractors and the public, while fully complying with applicable laws, regulations and other standards to which the asset facilities subscribes. Summit will strive to continuously improve Health & Safety performance with a goal of zero incidents by following good international industry practices (other local laws, IFC Performance Standards and relevant EHS guidelines), maintaining industrial hygiene & best process/practices of occupational health/safety. Following will be the core principles in achieving the above.

Guiding Principles:

- Full implementation the requirements of the Environment Conservation Rules 1997 and its subsequent amendments, any rules, regulations imposed/ issued by Department of Environment, Bangladesh and any concerned authority of Bangladesh.
- Full implementation the requirements of the World Bank Group EHS guidelines and in particular the International Finance Corporation (IFC) Performance Standards .
- Health & Safety excellence is mandatory for our long-term success.
- Health & Safety excellence requires the commitment and personal involvement of all levels of management and all employees.
- Employees have the obligation and the ability to prevent accidents.
- Incidents and non-compliance are unacceptable.
- All employees and contractors are responsible and accountable for understanding and complying with all regulations, company requirements and procedures relating to their job performance.

The Company is committed to:

- Improve Health and Safety compliance and performance through the implementation of Health & Safety Management Systems which will be conformant to OHSAS 18001 standards.
- Integrate Health & Safety concerns into all business and operational planning and decision making.
- Provide a safe work environment and training for all employees.
- Achieve upper quartile performance in all key Health & Safety metrics for the industry in which we operate.

- Involve the same level of commitment and performance for contractors that work in our facilities as we do from our employees.
- Utilize materials, natural resources and energy efficiently to produce our product and service.
- Respond in a timely and appropriate manner if an incident resulting from operations does occur.
- Work proactively with legislators, regulators, concerned groups, and industry peers to develop and advance effective approaches to human health and safety protection.
- Communicate regularly on Health and Safety issues, expectations and performance with employees, contractors, customers and regulators and to management and all concerned of any unlawful or unsafe works conditions, other lapses including those of security.
- Demonstrate visible leadership, commitment and involvement towards achieving the Company's H&S objectives.
- Ensure availability of effective crisis management and emergency response capabilities to respond to incidents and/or situation akin to emergency across our power plants facilities.
- Audit assets and operating practices regularly, and take appropriate corrective actions.
- Revise this policy on a regular basis to ensure its continued relevance, effectiveness and suitability to the business.

Authorized Signature

REVISION	DATE OF ISSUE
1ST	06.06.2011
2ND	01.08.2016

Annex I

Risk Assessment Study of Liquid Fuel Storage at Summit M1 Project Site

7.1 INTRODUCTION TO RISK ASSESSMENT

Risk is defined as the unwanted consequences of a particular activity in relation to the likelihood that this may occur. A state or condition having the potential to cause a deviation from uniform or intended behavior which, in turn, may result in damage to property, people or environment, is known as hazard. The word “hazard” does not express a view on the magnitude of the consequences or how likely it is that the harm will actually occur. A “major hazard” is associated with Loss of Containment and has the potential to cause significant damage or multiple fatalities. Again, the term does not imply that such events are likely. Risk is the combination of the likelihood and the consequences of such incidents. More scientifically, it is defined as the likelihood of a hazard occurrence resulting in an undesirable event. The likelihood may be expressed either as a frequency (i.e. the rate of events per unit time) or a probability (i.e. the chance of the event occurring in specified circumstances). The consequence is defined as an event or chain of events that result from the release of a hazard. The impact or effect is the degree of harm caused by the event.

Safety is the inverse of risk. The higher the risk for an occupation or installation, the lower is its safety. The popular understanding of safety sometimes appears to be “zero risk”, but this is impossible in an intrinsically hazardous activity.

7.2 QUANTITATIVE RISK ASSESSMENT (QRA)

Estimation of individual risk or consequence of a single accident scenario depends on a number of factors. Probability of a certain accident depends on probability of failure of a plant component including human error/ failure and failure of designed counter measures. Probability of a certain consequence depends on the probability of wind direction, probability of ignition in case of a fire or explosion and finally probability of being injured or killed which depends on the damage criteria. Quantitative risk assessment (QRA) is a means of making a systematic analysis of the risks from hazardous activities, and forming a rational evaluation of their significance, in order to provide input to a decision-making process.

The first stage in a QRA is defined as system definition where the potential hazards associated with a facility or activities are to be analyzed. The hazard identification

consists of a qualitative review of possible accidents that may occur, based on previous accident experience or judgment were necessary. Once the potential hazards have been identified, the frequency analysis estimates how likely it is for the accidents to occur, based on the type and number of equipment components included in the defined failure cases. The component failure frequencies to be used are usually derived from an analysis of historical accident experience, or by some form of theoretical modeling.

In parallel with the frequency analysis, consequence modeling evaluates the resulting effects if the accidents occur, and their impact on people, equipment and structures, the environment or business, depending on the defined scope of the QRA study. Estimation of the consequences of each possible event often requires some form of computer modeling. Consequence analysis requires the modeling of a number of distinctive phases, i.e. discharge, dispersion, fires and explosions (for flammable materials). Refer **figure no.7.1** for flow chart of Quantitative risk analysis.

The impact is also related to meteorological conditions which are mainly the ambient temperature and wind speed. Depending upon the meteorological condition different levels of atmospheric stability occurs. **Table 7.1** gives the Pasquill's Stability Chart which is followed for the present computations.

Table 7.1: Meteorological Conditions that Define the Pasquill Stability Classes

Surface wind Speed		Daytime incoming solar radiation			Nighttime cloud cover	
m/s	mi/h	Strong	Moderate	Slight	> 50%	< 50%
< 2	< 5	A	A – B	B	E	F
2 – 3	5 – 7	A – B	B	C	E	F
3 – 5	7 – 11	B	B – C	C	D	E
5 – 6	11 – 13	C	C – D	D	D	D
> 6	> 13	C	D	D	D	D
Note: Class D applies to heavily overcast skies, at any windspeed day or night						

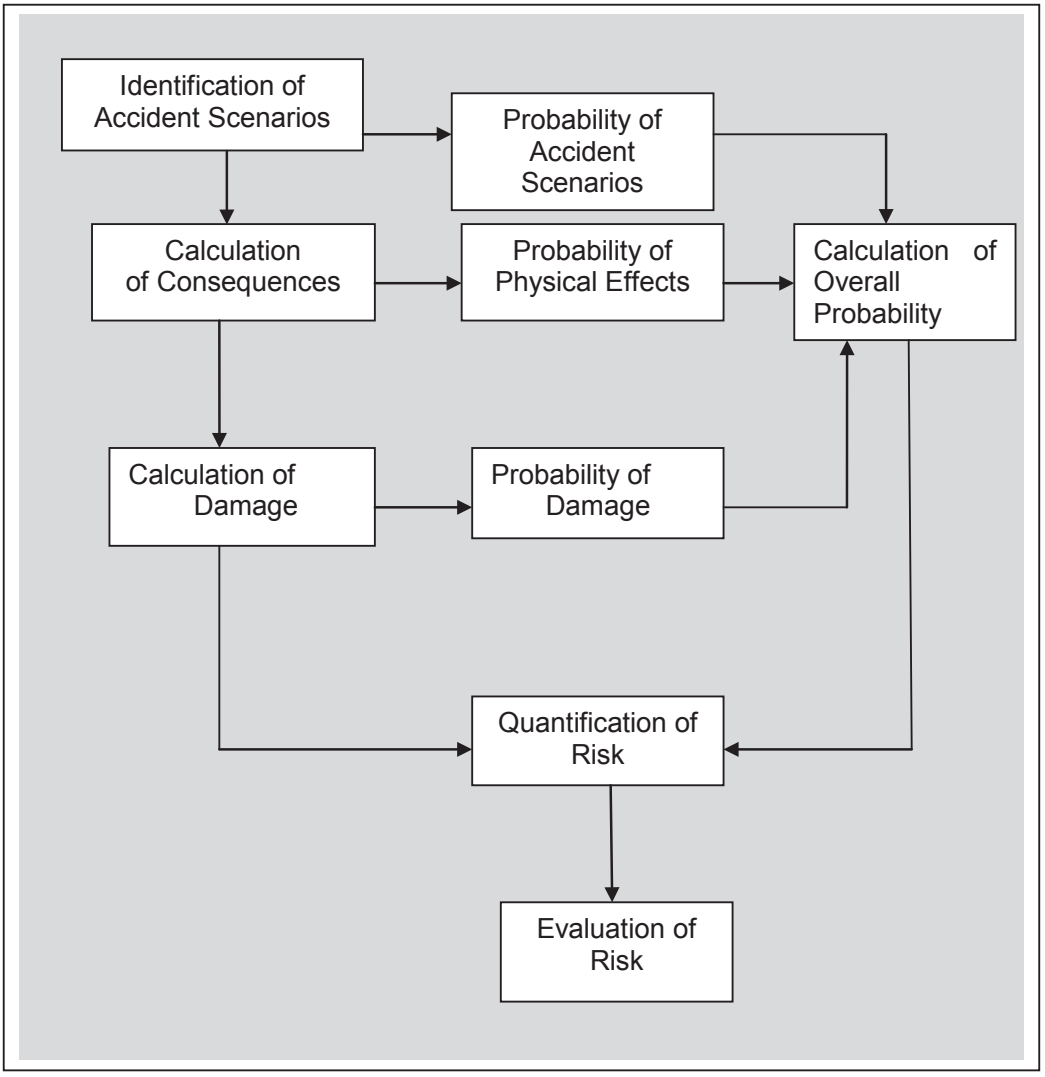


Figure 7.1: Quantitative Risk Analysis

Two main scenarios considered for release of fuel oil and natural gas is pool fire and jet fire respectively. There can be Pool fire due to rupture of liquid outlet pipe from the storage vessel. As the released oil forms a pool and if the vapor above the pool catches fire, a pool fire will take place. Jet fire occurs when the gas catches fire just after release and the heat radiated by it cause damage around the flame.

Closely liaised with the consequence assessment is the impact assessment, i.e. how does the fire, explosion or toxic cloud affect human beings. When the frequencies and consequences / impact of each modeled event have been estimated, they can be combined to produce risk results. Various forms of risk presentation may be used,

commonly grouped as follows: - Individual risk - the risk experienced by an individual person.

The consequence modeling is performed using the TNO's proprietary software EFFECTS (9.04). EFFECTS is a consequence and impact assessment module integrated within TNO's risk calculation software RISKCURVES. The consequence calculations done by TNO's Riskcurves involve use of many models simulation the effects of accidents involving hazardous materials. Many of these models are published in the Yellow and Green books which were compiled by TNO for the Dutch government, and are acknowledged and used worldwide for effects and consequence calculations.

Thermal Damage

The hazards will cause different levels of damage and its area of concern will also be different. It is therefore useful to decide on the damage criteria relevant to each type of hazard. For the present study only thermal damages are being considered.

Pool fire, jet flame, flash fire will generate heat radiation. The following **Table 7.2** has been given as the heat flux levels important for hazard analysis.

Table 7.2: Effect of Heat Radiation

Heat Radiation	Effect
37.5 kw/m2	Damage to equipment
12.5 "	Melting plastic
4.0 "	Blistering
1.6 "	Severe hot feeling

Thermal damage is a function of amount of heat flux as well as exposure time. This is true both for plant equipment and people. The variation of the effects on humans due to heat flux and duration of exposure have been developed in the form of a probit equation, which gives following values in **Table 7.3** for human fatality levels.

Table 7.3: Heat Radiation and Fatality

	Exposure time in seconds for % fatality		
Radiation Level (kw/m2)	**1 %**	**50%**	**99%**
1.6	500	1300	3200
4.0	150	370	930
12.5	30	80	200
37.5	8	20	50

Total exposure is expressed by a quantity obtained by the following equation. (Radiation) E+1.333x Time. For 1% human fatality this value is about 1000.

7.3 RISK CRITERIA

The next stage is to introduce criteria, which are yardsticks to indicate whether the risks are acceptable, or to make some other judgment about their significance. Risk assessment is the process of comparing the level of risk against a set of criteria as well as the identification of major risk contributors. The purpose of risk assessment is to develop mitigation measures for unacceptable generators of risk, as well as to reduce the overall level of risk to As Low as Reasonably Practical (ALARP).

The UK HSE Individual Risk Criteria was considered to assess the risk for the Summit Meghnaghat Power Plant.

Risk criteria for Individual Risk for on-site are as follows (Refer **Fig. 7.2** for the same):

- Individual risk levels above 1 x 10^{-3} per year will be considered unacceptable and will be reduced, irrespective of cost
- Individual risk levels below 1 x 10^{-6} per year will be broadly acceptable
- Risk levels between 1 x 10^{-3} and 1 x 10^{-6} per year will be reduced to levels as low as reasonably practicable (ALARP). The risk within this region is tolerable only if further risk reduction is considered impracticable because of the cost required to reduce the risk is grossly disproportionate to the improvement achieved.

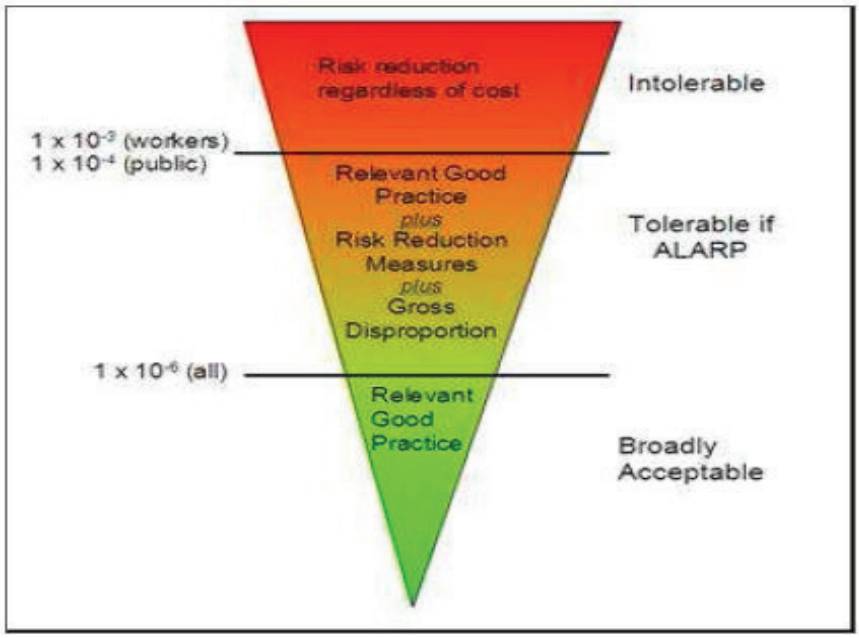


Figure 7.2: Risk Criteria

7.4 RISK ASSESSMENT - OIL TANK FARM

Failure Case Scenarios

The below **Tables 7.4** and **7.5** gives the following scenarios identified for the Oil Storage Tanks sizes and failure frequencies.

Table 7.4: Oil Storage Tank Sizes

Tank No.	Height(m)	Volume (m^3)	Service
1	16.969	3000	Treated Heavy Fuel Oil
2	16.969	3000	Treated Heavy Fuel Oil
3	16.969	3000	Treated Heavy Fuel Oil
1	15.578	7650	Heavy Fuel Oil
2	15.578	7650	Heavy Fuel Oil
3	15.578	7650	Heavy Fuel Oil

Table 7.5: Failure frequencies in Oil Tank of the Identified Scenarios

S. No.	Tank No.	Frequencies (/yr)			
		Small	Medium	Large	Rupture
1	1 (Treated Heavy Fuel Oil Tank)	1.20E-05	1.10E-06	1.10E-06	3.20E-07
2	2 (Treated Heavy Fuel Oil Tank)	1.20E-05	1.10E-06	1.10E-06	3.20E-07
3	3 (Treated Heavy Fuel Oil Tank)	1.20E-05	1.10E-06	1.10E-06	3.20E-07
4	1(Heavy Fuel Oil Tank)	1.20E-05	1.10E-06	1.10E-06	3.20E-07
5	2 (Heavy Fuel Oil Tank)	1.20E-05	1.10E-06	1.10E-06	3.20E-07
6	3 (Heavy Fuel Oil Tank)	1.20E-05	1.10E-06	1.10E-06	3.20E-07

Consequence Results

The consequence modeling is performed using the TNO's proprietary software EFFECTS. EFFECTS is a consequence and impact assessment module integrated within TNO's risk calculation software RISKCURVES. The **Table 7.6** below shows the different consequences and their impact distances for different meteorological conditions.

Table 7.6: Consequence Results Related to Oil Tanks

Description	Accident Scenario	Release Rate and Duration	Event	Impact Criteria	Consequence Distance (m)		
					B3	D5	D9
Treated Heavy Fuel Oil Tank No.1	Small	2.37E-001 kg/s & 1800 s	Pool Fire	4 kw/m^2	8.47	9.88	9.88
				12.5 kw/m^2	2.82	7.05	8.47
				37.5 kw/m^2	NR	NR	NR
	Medium	5.94 kg/s & 1800 s	Pool Fire	4 kw/m^2	18.34	18.34	18.34
				12.5 kw/m^2	12.7	13.56	12.7
				37.5 kw/m^2	8.47	9.88	9.88
	Large	23.74 kg/s & 1800 s	Pool Fire	4 kw/m^2	39.51	35.27	34.12
				12.5 kw/m^2	26.81	25.4	25.59
				37.5 kw/m^2	16.93	18.34	18.48
	Rupture	211.75 kg/s & 1800 s	Pool Fire	4 kw/m^2	88.53	102.37	98.11
				12.5 kw/m^2	72.51	75.36	72.51
				37.5 kw/m^2	42.66	41.23	45.55

Description	Accident Scenario	Release Rate and	Event	Impact Criteria	Consequence Distance (m)		
Treated Heavy Fuel Oil Tank No. 2	Small	2.37E-001 kg/s & 1800 s	Pool Fire	4 kw/m^2	8.47	9.88	9.88
				12.5 kw/m^2	2.82	7.05	8.47
				37.5 kw/m^2	NR	NR	NR
	Medium	5.94 kg/s & 1800 s	Pool Fire	4 kw/m^2	18.34	18.34	18.34
				12.5 kw/m^2	12.7	13.56	12.7
				37.5 kw/m^2	8.47	9.88	9.88
	Large	23.74 kg/s & 1800 s	Pool Fire	4 kw/m^2	39.51	35.27	34.12
				12.5 kw/m^2	26.81	25.4	25.59
				37.5 kw/m^2	16.93	18.34	18.48
	Rupture	211.75 kg/s & 1800 s	Pool Fire	4 kw/m^2	88.53	102.37	98.11
				12.5 kw/m^2	72.51	75.36	72.51
				37.5 kw/m^2	42.66	41.23	45.55
Treated Heavy Fuel Oil Tank No. 3	Small	2.37E-001 kg/s & 1800 s	Pool Fire	4 kw/m^2	8.47	9.88	9.88
				12.5 kw/m^2	2.82	7.05	8.47
				37.5 kw/m^2	NR	NR	NR
	Medium	5.94 kg/s & 1800 s	Pool Fire	4 kw/m^2	18.34	18.34	18.34
				12.5 kw/m^2	12.7	13.56	12.7
				37.5 kw/m^2	8.47	9.88	9.88
	Large	23.74 kg/s & 1800 s	Pool Fire	4 kw/m^2	39.51	35.27	34.12
				12.5 kw/m^2	26.81	25.4	25.59
				37.5 kw/m^2	16.93	18.34	18.48
	Rupture	211.75 kg/s & 1800 s	Pool Fire	4 kw/m^2	88.53	102.37	98.11
				12.5 kw/m^2	72.51	75.36	72.51
				37.5 kw/m^2	42.66	41.23	45.55
Heavy Fuel Oil Tank No. 1	Small	2.27E-001 kg/s & 1800 s	Pool Fire	4 kw/m^2	8.47	9.88	9.99
				12.5 kw/m^2	4.23	5.64	7.14
				37.5 kw/m^2	NR	NR	NR

Description	Accident Scenario	Release Rate and	Event	Impact Criteria	Consequence Distance (m)		
	Medium	5.69 kg/s & 1800 s	Pool Fire	4 kw/m^2	21.16	19.75	18.34
				12.5 kw/m^2	12.7	14.11	12.7
				37.5 kw/m^2	7.05	11.29	11.29
	Large	22.767 kg/s & 1800 s	Pool Fire	4 kw/m^2	45.15	42.33	38.39
				12.5 kw/m^2	26.81	29.63	28.44
				37.5 kw/m^2	15.52	15.62	19.91
	Rupture	204.18 kg/s & 1800 s	Pool Fire	4 kw/m^2	108.06	112.32	103.79
				12.5 kw/m^2	75.36	82.47	85.31
				37.5 kw/m^2	46.92	42.66	49.76
Heavy Fuel Oil Tank No. 2	Small	2.27E-001 kg/s & 1800 s	Pool Fire	4 kw/m^2	8.47	9.88	9.99
				12.5 kw/m^2	4.23	5.64	7.14
				37.5 kw/m^2	NR	NR	NR
	Medium	5.69 kg/s & 1800 s	Pool Fire	4 kw/m^2	21.16	19.75	18.34
				12.5 kw/m^2	12.7	14.11	12.7
				37.5 kw/m^2	7.05	11.29	11.29
	Large	22.767 kg/s & 1800 s	Pool Fire	4 kw/m^2	45.15	42.33	38.39
				12.5 kw/m^2	26.81	29.63	28.44
				37.5 kw/m^2	15.52	15.62	19.91
	Rupture	204.18 kg/s & 1800 s	Pool Fire	4 kw/m^2	108.06	112.32	103.79
				12.5 kw/m^2	75.36	82.47	85.31
				37.5 kw/m^2	46.92	42.66	49.76
Heavy Fuel Oil Tank No. 3	Small	2.27E-001 kg/s & 1800 s	Pool Fire	4 kw/m^2	8.47	9.88	9.99
				12.5 kw/m^2	4.23	5.64	7.14
				37.5 kw/m^2	NR	NR	NR
	Medium	5.69 kg/s & 1800 s	Pool Fire	4 kw/m^2	21.16	19.75	18.34
				12.5 kw/m^2	12.7	14.11	12.7
				37.5 kw/m^2	7.05	11.29	11.29
	Large	22.767 kg/s & 1800 s	Pool Fire	4 kw/m^2	45.15	42.33	38.39
				12.5 kw/m^2	26.81	29.63	28.44

Description	Accident Scenario	Release Rate and	Event	Impact Criteria	Consequence Distance (m)		
				37.5 kw/m^2	15.52	15.62	19.91
	Rupture	204.18 kg/s & 1800 s	Pool Fire	4 kw/m^2	108.06	112.32	103.79
				12.5 kw/m^2	75.36	82.47	85.31
				37.5 kw/m^2	46.92	42.66	49.76

NR – Not Reached

For all these accident scenarios impact zones for each case can be presented graphically. Two such scenarios are presented in **figure 7.3** and **figure 7.4**. Similar impact zone figures are given in the **Annexure 10**.

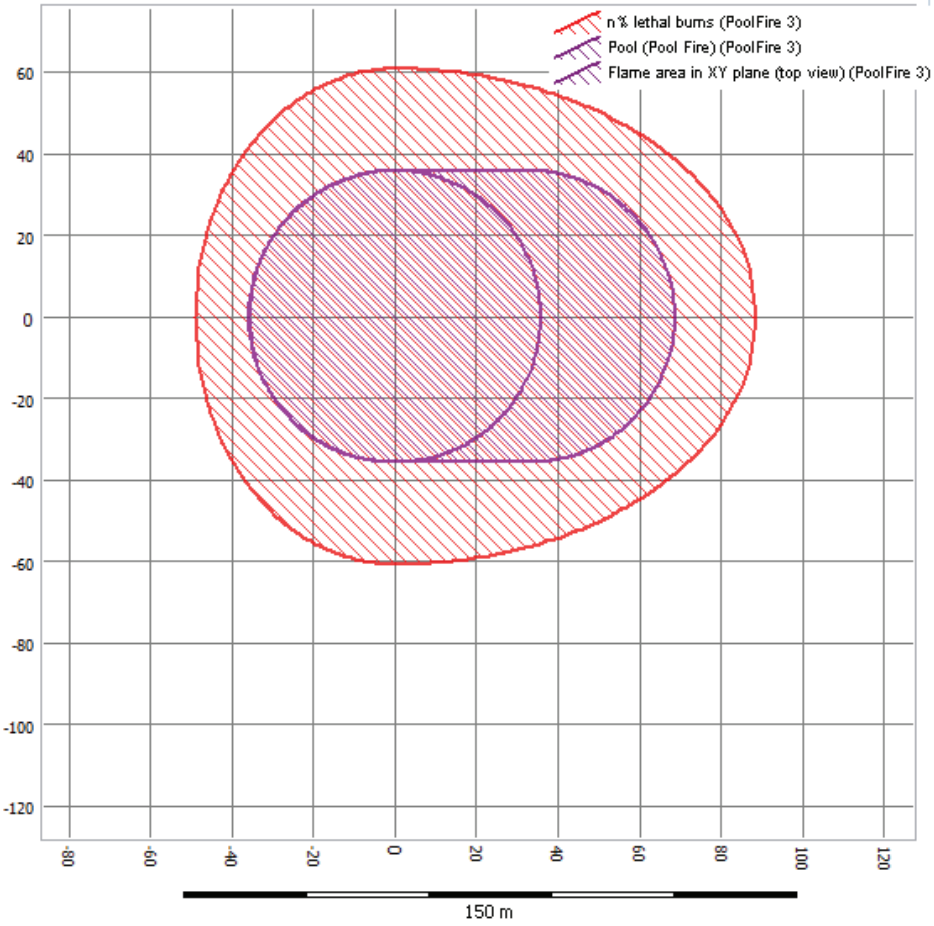


Figure 7.3 : HFO Tank 1 Rupture Impact Zone

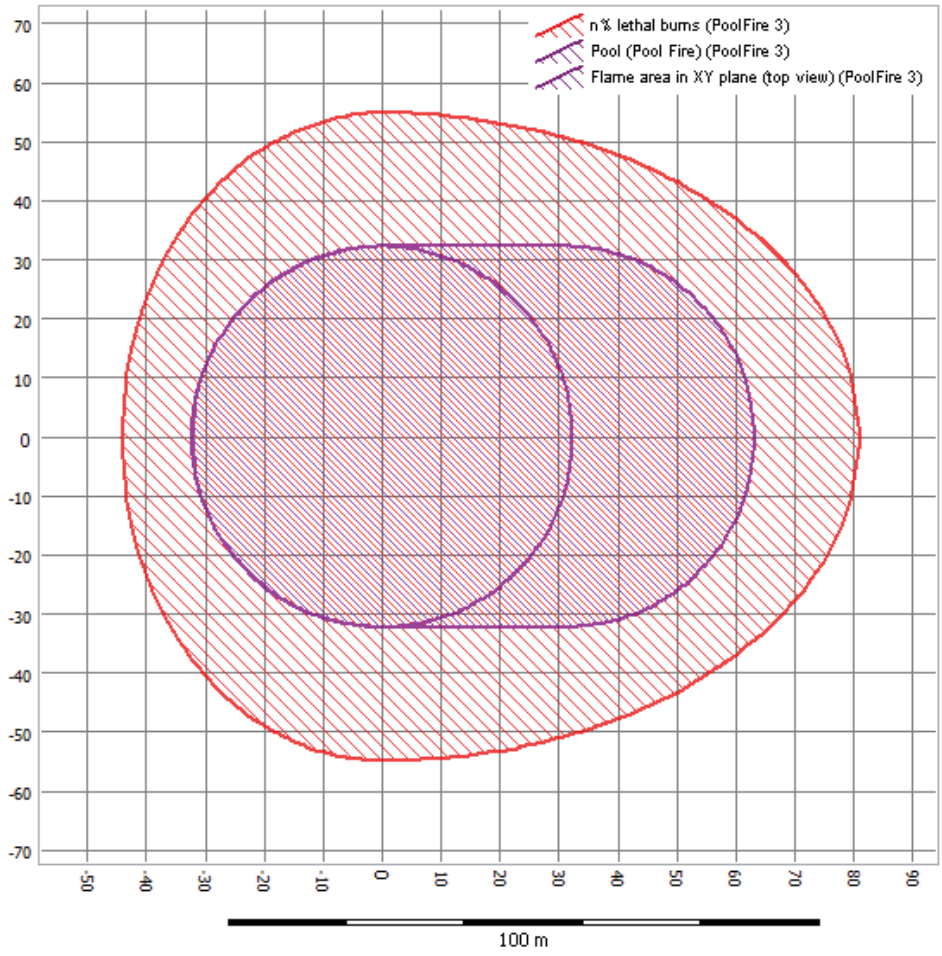


Figure 7.4: Treated HFO Tank 1 Rupture Impact Zone

Risk Results

TNO's proprietary software, Riskcurves is used for the main risk calculation in the study. Riskcurves combines consequence results from the EFFECTS module with a range of risk-related information in order to produce risk results.

Risk Assessment

The risk can be assessed and risk contour can be developed for each oil tanks and for each scenario. Also several scenarios are considered to take place together. **Table 7.7** represents the summary of risk assessment results of oil storage tanks.

Table 7.7: Risk Assessment Results for Oil Storage Tanks

Description	Total Individual Risk	Contributing Events
Analysis Point 1	7.14E-07 /yr	RUPTURE (T HFO TANK 3) LARGE (T HFO TANK 3) RUPTURE (T HFO TANK 2) RUPTURE (T HFO TANK 1) RUPTURE (HFO TANK 1)
Analysis Point 2	4.80E-07 /yr	RUPTURE (T HFO TANK 1) RUPTURE (T HFO TANK 2) LARGE (T HFO TANK 1) RUPTURE (HFO TANK 1) RUPTURE (T HFO TANK 3)
Analysis Point 3	5.69E-07 /yr	RUPTURE (HFO TANK 2) RUPTURE (HFO TANK 1) RUPTURE (HFO TANK 3) LARGE (HFO TANK 2) RUPTURE (T HFO TANK 1) RUPTURE (T HFO TANK 2)
Analysis Point 4	2.77E-07 /yr	RUPTURE (HFO TANK 3) RUPTURE (HFO TANK 2)

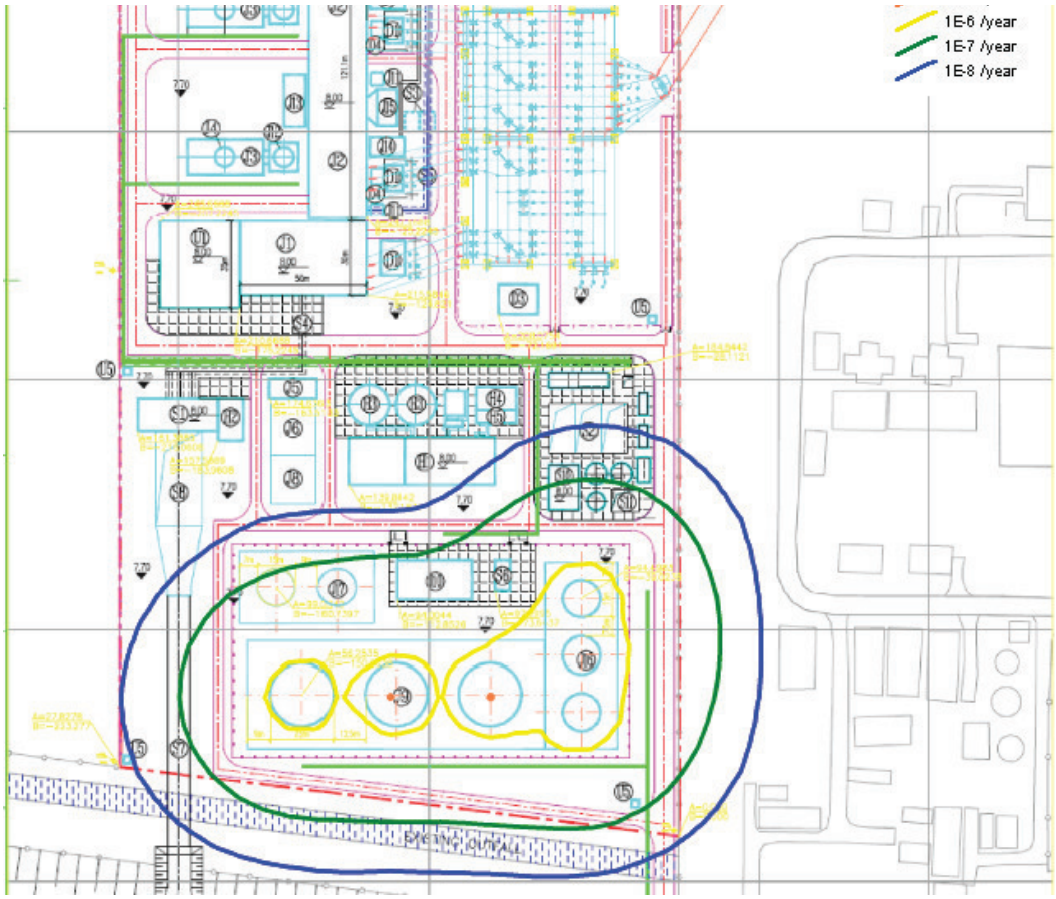


Figure 7.5: Risk Contour around Oil Storage Tanks

7.5 RISK ASSESSMENT - NATURAL GAS SUPPLY PIPELINE

Failure Case Scenarios

The identified following scenario are shown in **Tables 7.8** and **7.9** respectively for failure and frequency of occur for the Natural Gas pipeline inside the plant.

Table 7.8: Failure case scenario for NG pipeline

Scenario	Temperature (°C)	Pressure (psi)	Diameter (mm) & Length (m)	Phase	Service
Natural Gas Pipeline (within plant boundary)	32	610	DN500~508 & 311.94	GAS	Natural Gas

Annex J

Procedure for Liquid Fuel Transfer – Summit M1 Project

LIQUID FUEL TRANSFER SYSTEM

SMPCL-OP-021

Prepared By : Md. Mushfuqur Rahman
Verified By : Operation GM

Revision	Description	By	Date	Approved Signature	
02	Approved	Jung Yee Ryang	July 13, 2016		Jung Yee Ryang

AMENDMENT RECORD

Revision	Description	Date	Approved
01	• 'Pre Bunkering check list form' and 'Bunkering valve alignment check list form' are modified as per ISO standard in sections 3.4 & 3.5 respectively. • 'Service fuel tank change over operation' is included in section 5.7 • 'Fuel handling witness form' is included in section 6.3	January 21, 2016	Jung Yee Ryang
02	'Periodic sludge removal operation from LDO storage tanks' is included in section 5.8	July 13, 2016	Jung Yee Ryang

OVERALL TABLE OF CONTENTS

Part	Description	Page
	AMENDMENT RECORD	2
	OVERALL TABLE OF CONTENTS	3
	LIST OF ABBREVIATIONS	4
	GLOSSARY OF TERMS	5
1.0	PURPOSE	6
2.0	SYSTEM OVERVIEW	9
3.0	PREREQUISITES	14
4.0	START UP	24
5.0	OPERATION	29
6.0	SHUTDOWN	40
7.0	APPENDICES	45

ABBREVIATIONS

Abbreviation	Description
LDO/HSD	Liquid Distillate Oil / High speed diesel
DCS	Distributed control system
DP	Differential Pressure
HP	High Pressure
MOV	Motor operated valve
NRV	Non return valve
PI	Pressure indicator
PT	Pressure transmitter
GT	Gas Turbine

GLOSSARY OF TERMS

Viscosity	The viscosity of liquid is a measure of its resistance to flow
Pour point	The pour point of a fuel is the temperature at which it will barely flounder standard conditions
Flash Point	The flash point of a fuel is the temperature at which fuel vapors will flash when ignited by an external
Thermal Stability	The thermal stability of oil is a measure of its ability to resist breaking down when heated to form deposits of resins and sludge.

PART 1.0

PURPOSE

TABLE OF CONTENTS

Part	Description	Page
1.0	PURPOSE	8
1.1	SCOPE	8

1.0 PURPOSE

The purpose of this procedure is to provide the systems alignment settings and operating procedure for the Liquid Fuel Transfer system at Summit Meghnaghat Power Company Limited (SMPCL).The operating instructions within this procedure detail the step by step method to carry out the task of alignment settings checks, startup, operation, shutdown and emergency procedures for this equipment and/or system according to the manufacturer's recommendations.

1.1 SCOPE

This procedure is provided for all operations people at SMPCL and should be used as a guide for aligning and operating the equipment on a regular basis. General Manager (operation) required to verify the accuracy of this procedure by filling out the Operation Procedure Validation Form in Appendix7.1 and signing it for Release of Operation.

PART 2.0

SYSTEM OVERVIEW

TABLE OF CONTENTS

Part	Description	Page
2.0	SYSTEM OVERVIEW	11
2.1	LIQUID FUEL UNLOADING SYSTEM	11
2.2	LIQUID FUEL OIL TRANSFER SYSTEM FROM STORAGE TANKS	11
2.3	INTER TANKS LIQUID FUEL TRANSFER SYSTEM	13

2.0 SYSTEM OVERVIEW

2.1 LIQUID FUEL UNLOADING SYSTEM

In this facility LDO/HSD will be used as liquid fuel oil. Fuel oil can be unloaded from lorry or tanker vessel. There are two tanks each with the capacity of 7000 m^3 and five tanks each with 2000 m^3 capacity for storage of LDO/HSD. During unloading from tanker vessel, the vessel's own pumping arrangement will be used for transferring fuel oil to storage tanks. While for unloading from lorry, this facility has two sets of pumps to transfer the fuel oil to the storage tanks.

2.2 LIQUID FUEL OIL TRANSFER FROM STORAGE TANKS

Liquid fuel transfer operation from storage tank includes:

1. Liquid fuel transfer to gas turbine.
2. Liquid fuel transfer to auxiliary boiler oil tank
3. Liquid fuel transfer to all diesel generators oil tank
4. Liquid fuel transfer to diesel fire pump oil tank

In this facility there are two sets of gear pump dedicated for transferring LDO from storage tanks to auxiliary systems like auxiliary boiler, diesel generator oil tank and diesel fire pump oil tank. Whereas liquid fuel transfer to gas turbine includes two major systems- fuel forwarding system & filtration system.

2.2.1 Liquid fuel forwarding system

The liquid fuel forwarding system is a factory–assembled pumping unit. It is used to transfer distillate fuel oil from an above–ground storage facility to the gas turbine at the pressure, temperature and flow rate required by the turbine fuel system. All components of the system are mounted on a separate off–base platform referred to as a fuel skid. Major components of this distillate fuel forwarding skid includes:

1. Duplex Strainer
2. Pressure differential switch 63LF–2
3. Two AC–motor driven centrifugal fuel pumps, 88FD–1, –2
4. Solenoid–operated stop valve 20FD–1
5. Pressure relief valve VR51–1
6. Pressure regulating valve VPR53–1
7. Flow-meter FM–1
8. Pressure switch 63FD–2
9. Isolation valves, thermometer and pressure

2.2.2 Liquid fuel filtration and distribution system

The liquid fuel (distillate oil) system pumps and distributes fuel supplied from the off–base fuel forwarding system to the fuel nozzles of the combustion system. The fuel system filters the fuel and divides the fuel flow into equal parts for distribution to the combustion chambers at the required pressure and flow rates. When starting on liquid fuel, the fuel forwarding pump is automatically started when the unit is given a start signal. Unless gas fuel is selected by the operator, the unit will always start using liquid fuel. The position of fuel pump bypass valve VC3 regulates the amount of fuel input to the turbine combustion system by varying the amount of bypassed fuel. If the valve closes, less fuel is recirculated around the pump and more fuel goes to the combustors. If the valve opens, more fuel is bypassed around the pump and less goes to the combustors. The position of the bypass valve is a linear function of a fuel stroke reference (FSR) generated by the SPEEDTRONIC control system. The fuel system is comprised of the following major components plus several other control devices, switches, and gauges.

1. Low–pressure fuel filter FF1–1
2. Fuel oil stop valve VS1–1
3. Liquid fuel pump PF1–1
4. Fuel pump discharge relief valve VR4–1
5. Fuel bypass valve VC3–1
6. High–pressure fuel filter FF2–1
7. Flow divider FD1–1
8. Fuel line check valves VCK1–1 to –10
9. Fuel nozzle assemblies
10. False start drain valves VA17–1,3 and –5

2.3 INTER TANKS LIQUID FUEL TRANSFER SYSTEM

The facility is equipped with inter tank liquid fuel oil transfer system. Two sets of transfer pump with a duplex filter arrangement can be used in case of emergency to transfer fuel oil from one storage tank taking suction through the drain or delivery pipeline and can feed to another tank through the filling pipe line.
Noted that tank delivery line cannot be used for LDO transfer while GTs in service.

PART 3.0

PREREQUISITES

TABLE OF CONTENTS

Part	Description	Page
3.0	PREREQUISITES	16
3.1	SYSTEM VERIFICATION	16
3.1.1	LIQUID FUEL OIL UNLOADING FROM DEPOT TO	16
3.1.2	LIQUID FUEL UNLOADING FROM VESSEL TO	16
3.1.3	LIQUID FUEL STORAGE SYSTEM	17
3.1.4	LIQUID FUEL TRANSFER SYSTEM	17
3.1.5	INTER TANK FUEL TRANSFER SYSTEM	17
3.2	ELECTRICAL ENERGIZATION	18
3.2.1	FUEL UNLOADING SYSTEM	18
3.2.2	FUEL TRANSFER SYSTEM	18
3.2.3	INTER TANK FUEL TRANSFER SYSTEM	18
3.3	SYSTEM ALIGNMENT	19
3.3.1	FUEL UNLOADING SYSTEM	19
3.3.2	FUEL TRANSFER SYSTEM	19
3.3.3	INTER TANK FUEL TRANSFER SYSTEM	20
3.4	PRE BUNKERING CHECK LIST	21
3.5	BUNKERING VALVE ALIGNMENT CHECK LIST	22

3.0 PREREQUISITES

Before starting any liquid fuel unloading operation, storage tanks selection and manpower allocation must be planned in accordance with quantity of fuel to be unloaded.

3.1 SYSTEM VERIFICATION

3.1.1 Liquid Fuel Oil Unloading From Depot Shore Tank To Vessel

After getting notification from the supplier SMPCL representative and third party surveyors shall attend and witness unloading operation at oil depot to ensure quality and quantity of fuel to be supplied. In order to prevent contamination of fuel, tanker vessel must be made clean by the supplier before loading and inspected by SMPCL representative.
SMPCL representative shall verify the quality certificate for the fuel to be supplied which must meet SMPCL's required specification.

3.1.2 Liquid Fuel Oil Unloading System From Vessel to SMPCL Tank

3.1.2.1 Verify the fire fighting system is ready.

3.1.2.2 Verify no HOT WORK is going in the vicinity of LDO storage tank and unloading area.

3.1.2.3 Verify oil spillage containment kits ready.

3.1.2.4 Verify LDO storage tank's vent open and no obstruction in the vent pipes.

3.1.2.5 Verify LDO storage tank drain valve closed.

3.1.2.6 Verify LDO storage tank level low enough to receive the unloading fuel quantity.

3.1.2.7 Verify LDO storage tank heater kept off.

3.1.2.8 LDO unloading line flow-meter is healthy.

3.1.2.9 Verify LDO storage tank level gauges and transmitters are healthy.

3.1.2.10 Verify all pressure gauges and transmitters in the unloading pipe line are healthy.

3.1.2.11 Verify all flange connections in the unloading pipe line are secured.

3.1.2.12 Verify radio communication between unloading jetty and control room is active.

Verify that the pre-bunkering checklist is completed.

3.1.3 Liquid Fuel Storage System

3.1.3.1 Verify LDO storage tank's vent open and no obstruction in the vent pipe.

3.1.3.2 Verify LDO storage tank drain valve closed

3.1.3.3 Verify LDO storage tank heater kept off.

3.1.3.4 Verify LDO storage tank level gauges and transmitters are healthy.

3.1.3.5 Drain periodically and check water content.

3.1.4 Liquid Fuel Transfer System

3.1.4.1 Verify LDO storage tank level normal

3.1.4.2 Verify Instrument air pressure healthy.

3.1.4.3 Verify 88FD-1&2 suction and discharge side PI healthy

3.1.4.4 Verify LDO forward system filter not dirty.

3.1.4.5 Verify LDO flow-meter and flow transmitter is healthy.

3.1.4.6 Verify all pressure indicator and transmitter is healthy.

3.1.4.7 Verify all temp indicator sand transmitter is healthy.

3.1.4.8 Verify fuel check valves (VCK1-1to14) cooling water supply ok.

3.1.5 Inter Tank Fuel Transfer System

3.1.5.1 Verify LDO storage tank level low enough to receive the transfer fuel quantity.

3.1.5.2 Verify no fuel unloading operation from vessel in progress since same line will be used to transfer

3.1.5.3 Verify gas turbine is not in service (in case of using tank delivery line). Tank drain line can be used irrespective of GT operation.

3.1.5.4 Verify duplex filter element in clean condition.

3.1.5.5 Verify fuel unloading pipeline depressurized to a low level tank and the isolation

valve near unloading line flow meter to make tank side isolated from jetty side kept closed.

3.1.5.6 **Verify the isolation valve at the downstream of jetty area flexible hose kept open to allow the expansion of LDO as the downward slopped portion cannot be drained.**

3.1.5.7 **Verify the jetty main isolation valve kept closed with lock**.

3.2 ELECTRICAL ENERGIZATION

3.2.1 Fuel Unloading System

3.2.1.1 0.4 kv supply is normal.

3.2.1.2 Fuel storage tank inlet MOV power supply normal.

3.2.1.3 Fuel unloading pump (for unloading from lorry) motor supply normal and breaker in remote position.

3.2.2 Fuel Transfer System

3.2.2.1 Fuel storage tank outlet MOV power supply normal.

3.2.2.2 Fuel storage tank return oil line (from fuel filtering skid) MOV power supply normal.

3.2.2.3 Fuel storage tank return oil line (from discharge of LDO supply pump for auxiliary boiler) MOV power supply normal.

3.2.2.4 88FD-1&2 breaker power supply normal and breaker in remote position.

3.2.2.5 LDO supply pump (for auxiliary boiler) motor supply normal and breaker in remote position.

3.2.2.6 88FM power supply normal and breaker in remote position.

3.2.3 Inter Tank Fuel Transfer System

3.2.3.1 0.4 kv supply is normal.

3.2.3.2 Fuel storage tank inlet MOV power supply normal.

3.2.3.3 Fuel transfer pumps motor supply normal.

3.3 SYSTEM ALIGNMENT

3.3.1 Fuel Unloading System

3.3.1.1 Fire fighting system is ready.

3.3.1.2 LDO storage tank (which will receive fuel oil) inlet isolation manual valve open.

3.3.1.3 LDO storage tank (which will receive fuel oil) inlet isolation MOV open.

3.3.1.4 LDO storage tank (which will receive fuel oil) outlet isolation manual valve close.

3.3.1.5 LDO storage tank return oil line (from fuel filtering skid) manual isolation valve close.

3.3.1.6 LDO storage tank return oil line (from discharge of LDO supply pump for auxiliary boiler) manual isolation valve close.

3.3.1.7 LDO unloading line flow-meter isolation valve open.

3.3.1.8 LDO unloading line flow-meter bypass isolation valve close.

Verify that the pre-unloading valve alignment checklist is completed
Before starting fuel unloading operation from tanker vessel- density, temperature and water content of bunker fuel should be measured from random sampling and vessel's tanks initial sounding should be taken

3.3.2 Fuel Transfer System

3.3.2.1 LDO storage tank (which one will be in service) outlet isolation valve open.

3.3.2.2 LDO storage tank (which one will be in service) outlet isolation MOV open.

3.3.2.3 LDO storage tank (which one will be in service) return oil line (from fuel filtering skid) isolation valve open.

3.3.2.4 LDO storage tank (which one will be in service) return oil line (from discharge of LDO supply pump for auxiliary boiler) isolation valve open.

3.3.2.5 LDO storage tank (which one will be in service) return oil line (from fuel filtering skid) isolation MOV open.

3.3.2.6 LDO storage tank (which one will be in service) return oil line (from discharge of LDO supply pump for auxiliary boiler) isolation MOV open.

3.3.2.7 LDO storage tank (which one will be in service) filling isolation valve close.

3.3.2.8 LDO forward pump 1 suction & discharge valve open.

3.3.2.9 LDO forward pump 2 suction and discharge valve open.

3.3.2.10 LDO transfer pump for auxiliary boiler upstream and downstream valve open if it is necessary to fill auxiliary boiler fuel storage tank/black start diesel engine fuel tank/ emergency diesel engine fuel tank/ fire pump fuel tank)

3.3.2.11 Open Filling valve of the only intended tank (auxiliary boiler fuel storage tank, black start diesel engine fuel tank, emergency diesel engine fuel tank, fire pump fuel tank).

3.3.3 Inter Tank Fuel Transfer System

3.3.3.1 The storage tank from which oil will be transferred, delivery valve and MOV open **(in case of GT shut down condition)** and delivery valve of other tank must close. If drain line is chosen to use in transfer then only the intended tank drain valve should be open and other tank drain valve must close.

3.3.3.2 Open manual isolation valve for fuel transfer from tank delivery header near tank 2-1 boundary (in case of GT shut down condition). Or open manual isolation valve for transfer through drain header in front of tank 2-1.

3.3.3.3 Open duplex filter upstream isolation valve

3.3.3.4 Open vent valve and vent air from the system

3.3.3.5 Open duplex filter downstream valve.

3.3.3.6 Open filling isolation valve and MOV of the storage tank which will be filled.

3.3.3.7 **Fuel unloading line isolation valve at jetty and before flow meter must be in close condition to prevent oil flow in jetty direction.**

3.4 PRE-BUNKERING CHECK LIST

SUMMIT MEGHNAGHAT POWER COMPANY LTD.	Document No: SMPCL-OPN-F-042
	Revision No:00
TITLE: PRE BUNKERING CHECK LIST	Effective Date:10 Jan 16
	Page 1 of 1

PRE BUNKERING CHECK LIST

It is required that all questions be answered affirmatively (√).In case of a negative answer or where any question is not considred to be applicable, a note to that effect should be answered in the remarks column. The operation shall not be carried out without the signatures and conformity from both parties.

SL	QUESTIONS	SMPCL TANKS	TANKER VESSEL	REMARKS
1	Are the scuppers in place?	( )	( )	
2	Are the decks free of water?	( )	( )	
3	Are adequte precaution being taken to avoid air locks ?	( )	( )	
4	Are oil trays under manifolds cleaned and plugged?	( )	( )	
5	Has it been ensured not to carry out HOT WORK in the surrounding area?	( )	( )	
6	Has no smoking sign been posted in prominent places?	( )	( )	
7	Are portable fire extinguishers, fire pumps, hoses and equipment ready?	( )	( )	
8	Has it been ensured not to allow unauthorized personel?	( )	( )	
9	Are the pressure gauges and cocks in good working condition?	( )	( )	
10	Can the bunker valve be operated without dificulty?	( )	( )	
11	Are valve indicators accurate?	( )	( )	
12	Are the tank level indicators and alarms working satisfactory?	( )	( )	
13	Have sufficient men been assigned in bunker operation?	( )	( )	
14	Do they understand tank change over procedure?	( )	( )	
15	Do they understand bunker loading plan clearly?	( )	( )	
16	Is there a plan to deal with spillage and pollution if they occur?	( )	( )	
17	Are spill containment and cleanup equipment ready?	( )	( )	
18	Has preparation been made for collecting sample?	( )	( )	
19	Has step been taken not to load in tank that is in use?	( )	( )	
20	Is the bunker specification acceptable?	( )	( )	
21	Is the tanker securedly moored?	( )	( )	
22	Is the tanker vessel going to be ready to move under its own power during the whole operation?	( )	( )	
23	Has opening sounding been recorded?	( )	( )	
24	Has the maximum pressure / pumping rate been agreed?	( )	( )	
25	Has agreement been reached for control of flow during topping up?	( )	( )	
26	Are emergency procedure steps established and understood?	( )	( )	
27	Is there an effective communication between vessel and SMPCL?	( )	( )	
28	Will bunker manifold be under proper supervision through out the operation?	( )	( )	
29	Will frequent checks be made on tanks which already been topped up?	( )	( )	
30	Will checks be made on tanks that are not involved in loading?	( )	( )	

For SMPCL	For Tanker Vessel (MT_____)
Name:_____	Name: _____
Designation:_____	Designation:_____
Signature:_____	Signature:_____

Time:_____

Date:_____

3.5 BUNKERING VALVE ALIGNMENT CHECKLIST

SUMMIT MEGHNAGHAT POWER COMPANY LTD.	Document No:SMPCL-OPN-F-043
	Revision No:00
TITLE: BUNKERING ISOLATION VALVE ALIGNMENT CHECK LIST	Effective Date:10 Jan 16
	Page 1 of 2

BUNKERING ISOLATION VALVE ALIGNMENT CHECK LIST

	Description of valve	Tag	Open	Close	Remarks
Tank 2-1	LDO Filling isolation valve (Manual)	00ENA20AA005			
	LDO Filling isolation valve (MOV)	00ENA20AA004			
	LDO Delivery isolation valve (Manual)	00END11AA001			
	LDO Delivery isolation valve (MOV)	00END11AA002			
	LDO return (from GT) isolation valve (manual)	00END71AA004			
	LDO return (from GT) isolation valve (MOV)	00END71AA003			
	LDO return (recycle line) isolation valve (manual)	00END91AA004			
	LDO return (recycle line) isolation valve (MOV)	00END91AA003			
	LDO line from oil treatment unit isolation valve (manual)	00END81AA006			
	LDO line from oil treatment unit isolation valve (MOV)	00END81AA005			
	Drain isolation valve	00ENR31AA705			
Tank 2-2	LDO Filling isolation valve (Manual)	00ENA20AA007			
	LDO Filling isolation valve (MOV)	00ENA20AA006			
	LDO Delivery isolation valve (Manual)	00END11AA003			
	LDO Delivery isolation valve (MOV)	00END11AA004			
	LDO return (from GT) isolation valve (manual)	00END71AA002			
	LDO return (from GT) isolation valve (MOV)	00END71AA001			
	LDO return (recycle line) isolation valve (manual)	00END91AA002			
	LDO return (recycle line) isolation valve (MOV)	00END91AA001			
	LDO line from oil treatment unit isolation valve (manual)	00END81AA008			
	LDO line from oil treatment unit isolation valve (MOV)	00END81AA007			
	Drain isolation valve	00ENR31AA701			
Tank 2-3	LDO Filling isolation valve (Manual)	00ENA20AA0##			
	LDO Filling isolation valve (MOV)	00ENA20AA0##			
	LDO Delivery isolation valve (Manual)	00LBG91AA0##			
	LDO Delivery isolation valve (MOV)	00ERB32AA010			
	LDO return (from GT) isolation valve (manual)	NO KKS			
	LDO return (from GT) isolation valve (MOV)	00ERB32AA010			
	LDO line from oil treatment unit isolation valve (manual)	N/A			
	LDO line from oil treatment unit isolation valve (MOV)	N/A			
	Drain isolation valve	00END11AA0##			
Tank 2-4	LDO Filling isolation valve (Manual)	00ENA20AA0##			
	LDO Filling isolation valve (MOV)	00ENA20AA0##			
	LDO Delivery isolation valve (Manual)	00LBG91AA0##			
	LDO Delivery isolation valve (MOV)	00ERB32AA010			
	LDO return (from GT) isolation valve (manual)	NO KKS			
	LDO return (from GT) isolation valve (MOV)	00ERB32AA010			
	LDO line from oil treatment unit isolation valve (manual)	N/A			
	LDO line from oil treatment unit isolation valve (MOV)	N/A			
	Drain isolation valve	00END11AA0##			

BUNKERING ISOLATION VALVE ALIGNMENT CHECK LIST

Tank 2-5	LDO Filling isolation valve (Manual)	00ENA20AA0##			
	LDO Filling isolation valve (MOV)	00ENA20AA0##			
	LDO Delivery isolation valve (Manual)	00LBG91AA0##			
	LDO Delivery isolation valve (MOV)	00ERB32AA010			
	LDO return (from GT) isolation valve (manual)	NO KKS			
	LDO return (from GT) isolation valve (MOV)	00ERB32AA010			
	LDO line from oil treatment unit isolation valve (manual)	N/A			
	LDO line from oil treatment unit isolation valve (MOV)	N/A			
	Drain isolation valve	00END11AA0##			
Tank 7-1	LDO Filling isolation valve (Manual)	00ENA20AA009			
	LDO Filling isolation valve (MOV)	00ENA20AA008			
	LDO Delivery isolation valve (Manual)	00END12AA001			
	LDO Delivery isolation valve (MOV)	00END12AA002			
	LDO return (from GT) isolation valve (manual)	00END71AA006			
	LDO return (from GT) isolation valve (MOV)	00END71AA005			
	LDO line from oil treatment unit isolation valve (manual)	00END81AA004			
	LDO line from oil treatment unit isolation valve (MOV)	00ERD81AA003			
	Drain isolation valve	00ENR32AA701			
Tank 7-2	LDO Filling isolation valve (Manual)	00ENA20AA011			
	LDO Filling isolation valve (MOV)	00ENA20AA010			
	LDO Delivery isolation valve (Manual)	00END12AA003			
	LDO Delivery isolation valve (MOV)	00END12AA004			
	LDO return (from GT) isolation valve (manual)	00END71AA008			
	LDO return (from GT) isolation valve (MOV)	00END71AA007			
	LDO line from oil treatment unit isolation valve (manual)	00END81AA002			
	LDO line from oil treatment unit isolation valve (MOV)	00ERD81AA001			
	Drain isolation valve	00ENR32AA705			
Filling line header	Unloading pipe drain v/v-1 & v/v-2 (near jetty)				
	Unloading pipe vent v/v-1 & v/v-2 (near foot over bridge)				
	Unloading pipe drain v/v-1 & v/v-2 (near LDO tank-2)				
	Unloading pipe vent v/v-1 & v/v-2 (near LDO tank-2)				
	Unloading pipe to filling header manual isolation v/v	00ENA11AA012			
	Filling header vent v/v-1 & v/v-2 (near LDO tank-2)				
	Filling header manual isolation v/v (near LDO tank-1)	00EN20AA001			
	Filling header manual isolation v/v (near LDO tank-1)	00ENA20AA002			
	Filling header manual isolation v/v (near LDO tank-1)	00ENA20AA003			
	ling header manual isolation v/v(after track unloading platfor				
	Filling header drain v/v(after track unloading platform)				
	illing header vent v/v (Discharge line of track unloading pump				
	Filling header manual isolation v/v (near LDO tank-4)				

Checked By		Reviewed By	
Designation		Designation	

PART 4.0

STARTUP

TABLE OF CONTENTS

Part	Description	Page
4.0	STARTUP	26
4.1	LIQUID FUEL UNLOADING OPERATION	26
4.1.1	UNLOADING FROM DEPOT TANK TO VESSEL	26
4.1.2	UNLOADING FROM VESSEL TO SMPCL TANK	26
4.2	LIQUID FUEL TRANSFER OPERATION	27
4.2.1	LIQUID FUEL TRANSFER TO AUXILIARY SYSTEM	27
4.2.2	LIQUID FUEL TRANSFER TO GAS TURBINE	28
4.3	INTER TANK FUEL TRANSFER OPERATION	28

4.0 STARTUP

4.1 LIQUID FUEL UNLOADING OPERATION

4.1.1 Unloading from depot shore tank to vessel

4.1.1.1 Verify tank level measurement completed.

4.1.1.2 Verify shore tank fuel oil water content, temperature and density measurement completed in presence of surveyor and SMPCL representative and found satisfactory.

4.1.1.3 Verify in tanker vessel all tanks are cleaned properly and sea chest valves closed and sealed in presence of surveyor.

After verifying the above, unloading operation can be started which will be controlled by the Depot authorities.

4.1.2 Unloading From vessel to SMPCL tank

4.1.2.1 Verify system valve alignment is completed.

4.1.2.2 Verify oil filling line drain check and priming work completed.

Initial time pipeline oil quality and priming is the requirement of the supplier as SMPCL and the supplier agreed that initially SMPCL shall fill the filling pipeline with oil from its own storage tank and finally after completion of pumping the supplier shall again fill the pipeline with the supplied oil. This agreement was done to eliminate the scope of water charging after completion of LDO unloading. Due to the height of the unloading pipe, the storage tank which shall be used for priming must have at least six meters of LDO level for proper priming and complete filling. As there is no convenient way to measure the quantity in the partially empty portion of pipe line, if priming cannot be done properly, Supplier may not agree to supply fuel or SMPCL may loss line quantity amount which is around 24635 m^3.
To avoid such circumstances, LDO unloading plan should be taken such that at least one storage tank has sufficient level for initial priming and the tank to be filled will have the final level more than six meters.

4.1.2.3 Verify all storage tank level measurement is completed and initial print out taken from DCS.

4.1.2.4 Verify tanker vessel oil quantity, water content, temperature and density measured and all seal checked (seal applied in depot).

4.1.2.5 Verify SMPCL tank's oil (which will be filled) water content, temperature and density measured.

4.1.2.6 Verify unloading flexible hose firmly connected with lorry or tanker.

4.1.2.7 Verify liquid fuel unloading isolation valve open.

4.1.2.8 Verify fuel sampling valve partially open and collecting bucket placed.

4.1.2.9 Verify plant and grid condition normal.

4.1.2.10 Verify the flow-meter initial reading is taken.

After verifying above these unloading operation can be started as per following

4.1.2.11 Start liquid fuel unloading pump.

4.1.2.12 Purge air through the vent valve.

4.1.2.13 Observe the pump discharge pressure normal and it should be stable.

4.1.2.14 Observe flow-meter showing flow and cumulative reading is changing.

4.1.2.15 Observe storage tank level (which one to be filled, it is safe to fill at least two Tank at a time) whether it is increasing.

4.1.2.16 Observe other storage tank (which are not intend to fill) level to detect any valve passing.

4.1.2.17 Verify there is no leakage at any point.

Initially unloading pump discharge flow should be kept low to check leakage or any abnormalities, and then flow can be increased gradually.

4.2 LIQUID FUEL TRANSFER OPERATION

4.2.1 **Liquid Fuel Transfer To Auxiliary System (Auxiliary Boiler Oil Tank, Fire, Black Start Diesel Engine Oil Tank, Emergency Diesel Engine Oil Tank)**

4.2.1.1 Verify that all lockout/tag out devices that may prevent the startup of the system is removed.

4.2.1.2 Verify the system alignment is completed.

4.2.1.3 Verify filling isolation valve for the intended system is open and all other filling valve for other system is closed.

4.2.1.4 Start the LDO transfer pump for auxiliary system

4.2.1.5 Observe the change of level in the intended tank of auxiliary tank

4.2.1.6 Observe level of other tank which may increase in case of valve passing.

4.2.2 **Liquid Fuel Transfer To Gas Turbine**

4.2.2.1 Verify that all lockout/tag out devices that may prevent the startup of the System is removed.

4.2.2.2 Verify the system alignment is completed.

4.2.2.3 Start LDO forward pump

4.2.2.4 Observe discharge the pressure which should be normal and stable.

4.2.2.5 Observe the filter condition. If DP is high then change over the filter.

4.2.2.6 Observe for is any leakage in the system.

Note: Liquid fuel transfer to gas turbine will be started automatically as Per GT start-up sequence or when fuel mode transfer command (from natural gas to liquid fuel) active.

4.3 Inter tank fuel transfer operation

4.3.1 Verify the system alignment is completed

4.3.2 Start LDO transfer pump

4.3.3 Observe discharge the pressure which should be normal and stable.

4.3.4 Observe the filter condition. If DP is high then change over the filter.

4.3.5 Observe for any leakage in the system.

PART 5.0

OPERATION

TABLE OF CONTENTS

Part	Description	Page
5.0	OPERATION	31
5.1	UNLOADING OPERATION	31
5.2	LIQUID DISTILLATE OIL SPECIFICATIONS	31
5.3	FUEL TRANSFER OPERATION	33
5.4	GT LIQUID FUEL SYSTEM COMPONENTS FUNCTIONAL DESCRIPTION	33
5.5	INTER TANK FUEL TRANSFER OPERATION	37
5.6	TROUBLE SHOOTING	37
5.7	SERVICE FUEL TANK CHANGEOVER OPERATION	38
5.8	PERIODIC SLUDGE REMOVAL OPERATION FROM LDO STORAGE TANKS	39

5.0 OPERATION

5.1 UNLOADING OPERATION

5.1.1 Frequently check fuel level increase in the storage tank during filing operation.

5.1.2 Frequently check flow-meter reading.

5.1.3 Frequently check unloading pump's discharge pressure.

5.1.4 In case of major leakage in the unloading system, immediately stop the operation.

5.1.5 Frequently check unloading filter differential pressure.

5.1.6 **It is safe to fill two storage tanks at a time.**

5.1.7 **When one storage tank filling is about to complete, at first open another storage tank filling valve and then close the already filled tank's filling valve.**

5.1.8 Sample collection should be made through out the operation for representative sampling.

5.2 LIQUID DISTILLATE OIL SPECIFICATIONS

The Specifications for High Speed Diesel (HSD) are as given below:

Test	Method	Limit
Density at 15°C, Kg/L	ASTM D 1298	Min. 0.820 Max. 0.870
Color, ASTM	ASTM D 1500	Max. 3.0
Neutralization Value: Strong Acid No, mg KOH/gm Total Acid No, mg KOH/gm	 ASTM D 664 ASTM D 974	 Nil Max. 0.2
Ash, % mass	ASTM D 482	Max. 0.01
Carbon Residue (Conradson) On 10% bottom, % wt	ASTM D 189	Max. 0.2

Cetane Number		ASTM D 613	Min. 45
Cetane Index Calculated)		ASTM D976	Min. 45
Pour point, °C		ASTM D 97	Max. 9 (Winter)
			Max.12 (Summer)
Copper Strip Corrosion (3 hours at 100°C)		ASTM D 130	Max. No.1
Flash point, PM(cc) 1Abel:C		ASTM D93/ IP 170	Min. 32
Kinematic viscosity at 38 °C,cst		ASTM D445	Max. 9.0
Sulphur total, % mass		ASTM D 4294	Max. 0.25
Sediment, % mass		ASTM D 473	Max.-0.01
Water content, % vol		ASTM D 95	Max. 0.1
Distillation: 90 % volrecovery.T;		ASTM D 86	Max. 375
Sediments and particulates for light distillate	Total	D6217 / DlN	Max. 20
	d<10 µm	EN12662	Max. 18.0
	10 < d < 25 µm	DlN51575	Max. 2.0
	d > 25µ m		Max. 0
Ash		D482 / IS06245 DIN51575 / DIN EN 2645	Max. -100
Vanadium		DIN 51790 ASTM D 3605	< 1
Lead		DIN 51790 ASTM D 3605	Max. 1
Zinc		DIN 51790 ASTM D 3605	Max 2.0
Total of Sodium + Potassium		DIN 51790 ASTM 0 3605	< 1
Calcium		DIN 51790 ASTM 0 3605	Max. 10
Nitrogen (FBN = Fuel Bound Nitrogen)		ASTM D 4629	Max. 0.015
Sulphur		D3246 / D5453/ IS06326	Max. 0.2
Calorific value Kcal/Kg			Max 10280

5.3 FUEL TRANSFER OPERATION

5.3.1 **Auxiliary System (Auxiliary Boiler Oil Tank, Fire Fighting Pump Oil Tank, Black Start Diesel Engine Oil Tank, Emergency Diesel Engine Oil Tank)**

5.3.1.1 Closely monitor filling tank level to prevent spillage.

5.3.1.2 Closely monitor pump's discharge pressure.

5.3.1.3 When filling is complete, first stop the transfer pump then shut the filling valve.

5.3.2 **GAS TURBINE**

5.3.2.1 Observe forward pump pressure closely.

5.3.2.2 Observe main fuel oil pump pressure closely

5.3.2.3 Observe flow divider pressure closely

5.3.2.4 Observe filter differential pressure

5.3.2.5 Verify no significant leakage in the system.

5.3.3.6 Closely monitor storage tank level, In case of low level change over the tank.

While changing over fuel storage tank, first open the delivery valve and return valve of the new tank, only then close the delivery valve and return valve of the empty tank.

5.4 GT LIQUID FUEL SYSTEM COMPONENTS FUNCTIONAL DESCRIPTION

5.4.1 Liquid fuel forwarding system

5.4.1.1 Duplex Strainer:
to remove dirt particles from the fuel before it reaches the pump(s).

5.4.1.2 Pressure differential switch, 63LF–2:
will initiate an alarm if the pressure drop across the strainer reaches 0.34 bars (5.0 psi).

5.4.1.3 **Two AC–motor driven centrifugal fuel pumps, 88FD–1, –2:**
supply the fuel oil to the turbine through a lead/lag system. Using the SPEEDTRONIC control panel either pump may be selected to be the 'lead', or main, pump. The lead pump is activated whenever liquid fuel is required. If pressure switch 63FD–2 senses low pressure when the lead pump should be operating, the 'lag' (back–up) pump will be started; in this application, 63FD–2 will indicate low pressure at 4.15 bar (60 psig). System operation continues until the gas turbine no longer requires liquid fuel due to fuel transfer or turbine shutdown. The pumps are stopped automatically by the SPEEDTRONIC control system. Check valves in the discharge piping of each pump prevent back pressure to the inoperative pump during system operation.

5.4.1.4 **Solenoid–operated stop valve, 20FD–1:**
Normally–closed solenoid stop valve 20FD–1 is installed at the outlet of the forwarding skid and operates in conjunction with the on–base fuel oil stop valve to shut off fuel flow when liquid fuel is not required.

5.4.1.5 **Pressure relief valve, VR51–1:**
protects the system from excessive pressure; in this application it will relieve at 6.90 bar (100 psig).

5.4.1.6 **Pressure regulating valve, VPR53–1:**
is used to ensure that the fuel pressure does not exceed design conditions of 4.48 bar (65 psig).

5.4.1.7 **Flow-meter, FM–1:**
is installed to monitor the amount of fuel being consumed by the turbine.

5.4.2 Liquid fuel filtration and distribution system

The liquid fuel (distillate oil) system pumps and distributes fuel supplied from the off–base fuel forwarding system to the fuel nozzles of the combustion system. The fuel system filters the fuel and divides the fuel flow into equal parts for distribution to the combustion chambers at the required pressure and flow rates. When starting on liquid fuel, the fuel forwarding pump is automatically started when the unit is given a start signal. Unless gas fuel is selected by the operator, the unit will always start using liquid fuel. The position of fuel pump bypass valve

VC3 regulates the amount of fuel input to the turbine combustion system by varying the amount of bypassed fuel. If the valve closes, less fuel is recirculated around the pump and more fuel goes to the combustors. If the valve opens, more fuel is bypassed around the pump and less goes to the combustors. The position of the bypass valve is a linear function of a fuel stroke reference (FSR) generated by the SPEEDTRONIC control system. The fuel system is comprised of the following major components plus several other control devices, switches, and gauges.

5.4.2.1 **Low–pressure fuel filter, FF1–1:**

Low pressure fuel oil from the fuel forwarding system is filtered by the low pressure (primary) fuel oil filter. The filter consists of five–micron pleated–paper elements with oversize contamination capacity. A differential pressure gauge monitors the pressure differential across the filter; the filters should be changed when the differential reaches 15 psig (1.03 bar).

5.4.2.2 **Fuel Oil Stop Valve, VS1–1:**

The fuel oil stop valve is operated by the SPEEDTRONIC protection system to shut off the supply of fuel to the turbine during normal and/or emergency shutdowns. This stop valve is a special–purpose, hydraulically operated, two–position (open or closed) valve with a venturi disc and valve seat. When the turbine is shut down in either the normal sequence or by an emergency trip, the fuel oil stop valve will fully close within a 0.5 second total elapsed time. During normal operation of the turbine, the stop valve is held open by trip oil (OLT). Trip solenoid valve 20HD is located in the trip oil supply line to the stop valve, and is controlled by the SPEEDTRONIC control system. When the trip oil pressure should be zero, as in the case of normal or emergency shutdown, 20HD is in its de–energized state. This position dumps the trip oil in the stop valve actuating cylinder to the lube oil reservoir and isolates the actuating cylinder from the hydraulic supply. The closing spring in the stop valve assembly then closes the valve.

5.4.2.3 **Fuel Pump, PF1–1:**

The fuel pump is a rotary pump driven by the turbine through the accessory gearbox. The pump is disengaged when not in use by a clutch controlled solenoid 20CF. The fuel pump discharge flow at any given turbine speed is greater than the turbine combustion requirements at that speed.

5.4.2.4 **Fuel pump discharge relief valve, VR4–1:**

Fuel pump discharge relief valve VR4 is located in a parallel loop between the discharge and inlet of the pump. The valve prevents the fuel oil pressure from

getting high enough to rupture any lines in the event of a flow divider malfunction or seizure. This valve is set to operate at a nominal 1050 psig (72.4 bar) and relieves back to the pump inlet.

5.4.2.5 **Fuel bypass valve, VC3–1:**

The fuel bypass valve is in a loop parallel to the fuel pump. It diverts the excess fuel delivered by the pump back to the pump inlet, bypassing the combustion system. Components of this assembly include the bypass valve body, the hydraulic cylinder, and electro-hydraulic servo valve 65FP. Servo valve 65FP controls the bypass valve position according to a fuel stroke reference (FSR) signal generated by the SPEEDTRONIC control system. The servo valve uses high pressure hydraulic oil (OH) to actuate the hydraulic cylinder and thus position the bypass valve.

5.4.2.6 **High–pressure fuel filter, FF2–1:**

Fuel oil at pump discharge pressure passes through high–pressure fuel filter FF2 as it flows from the fuel pump to the flow divider. This full–flow, high–pressure filter contains several five–micron removable, pleated paper cartridge elements with a large contamination capacity. This filter helps to assure that contaminants are retained and prevented from entering the flow divider, thereby preventing possible damage or improper operation of this component.

5.4.2.7 **Flow divider, FD1–1:**

The flow divider divides the single stream of fuel from the pump into separate streams, one for each combustor. The continuous–flow, free– wheeling flow divider consists of gear pump elements interconnected by splined couplings and having a common inlet. This timing gear serves to maintain true synchronous speed of each pumping element with all other elements. The flow divider is driven by the pressure differential between its inlet and its outlet. The speed of the flow divider pumping elements is directly proportional to the fuel flow through the flow divider. Magnetic pickup assembly's 77FD–1, 77FD–2, and 77FD–3, fitted to the flow divider, provide a flow feedback signal to the SPEEDTRONIC control panel where it is used in the fuel control system. For a dual fuel (gas/liquid) turbine, the flow divider should be operated for a minimum of one half hour every month to prevent binding of the elements. This is best achieved by operation of the turbine on liquid fuel for a minimum of one half hour per month.

5.4.2.8 **Fuel line check valves, VCK1–1 to –10:**

There is a check valve in each line between the flow divider and the fuel nozzles, mounted near the input connection for each nozzle. These valves serve as 'anti–dribble' valves to prevent fuel oil from continuing to flow after the fuel pump is

disengaged. This results in a clean cutoff of fuel to the nozzle. They also prevent purge air from entering the liquid fuel system.

5.4.2.9 **Selector Valve Indicator**
A position selector valve and pressure gauge assembly is located at the output of the flow divider to allow monitoring of fuel oil pressure in a selected line.

5.4.2.10 **False Start Drain Valve, VA17–1,2 and 5:**
In the event of an unsuccessful start, fuel oil that accumulates in the combustion cans, turbine, and/or exhaust plenum is drained through false start drain valves (VA17–1 and –5). The false start drain valves are actuated by compressor discharge pressure and are normally open. As unit speed increases, compressor discharge pressure increases and closes the valves. When the unit is shutdown, compressor discharge pressure decreases as unit speed decreases and the valves close.

5.5 INTER TANK FUEL TRANSFER OPERATION

5.5.1 Check change of oil level in both tanks periodically.

5.5.2 Check filter condition periodically.

5.6 TROUBLE SHOOTING (GT FUEL TRANSFER)

5.6.1 Fuel oil pressure low

5.6.1.1 **Cause:**

-The transfer pump 88FD for fuel oil front module is insufficient.

-The filter for fuel oil front module is blocked.

-The inlet pressure alarm switch 63FL-2 of main fuel oil pump has miss activation.

-The fuel oil stop valve VS1 has leakage.

-The output of main fuel oil pump PF1 is insufficient.

-The fuel oil bypass component VC3 has miss-activation.

-The bypass regulating valve VR4 is malfunction when the bypass of fuel oil is used.

-The indication of limit switch 33FL-1 of fuel oil stop valve VS1 abnormal.

-The inlet/outlet pressure difference is large due to blockage of fuel oil filter FF2

5.6.1.2 **Measures:**

Check the outlet pressure of main pump PF1 and booster pump 88FD to make sure whether they are working normally.

Check whether the fuel oil pipeline is leaking.

Check the pressure difference of fuel oil filter FF2, and clean if the difference is large.

5.7 SERVICE FUEL TANK CHANGEOVER OPERATION

5.7.1 Service fuel tank changeover operation required when present service tank level becomes too low for GT forward pump suction and at least three nos of operating persons should involve in that operation. One person shall constantly monitor forward pump suction pressure; other two persons shall take position in the service fuel tank and the incoming fuel tank.

5.7.2 First make sure the delivery line and return line MOV at the incoming fuel tank is fully open.

5.7.3 Open return line isolation valve of the incoming fuel tank.

5.7.4 Partially open (25%) the delivery isolation valve of the incoming fuel tank and closely observe the suction pressure change at the forward pumps. Normally it should start increasing.

5.7.5 If forward pump suction pressure found normal and stable, then open delivery isolation of the incoming fuel tank gradually up to 100% and simultaneously close the delivery isolation valve of the present service tank.

5.7.6 Again check forward pump suction pressure.

5.7.7 Close the return isolation valve of the present service tank.

5.8 PERIODIC SLUDGE REMOVAL OPERATION FROM STORAGE TANKS:

To prevent accumulation of oily sludge at the bottom of the storage tanks, regularly tank bottom draining shall be carried out. Storage tank 2-1 shall be used to accumulate the drained sludge from other tanks. When tank 2-1 sludge level will become high, those can be disposed through approved contractor as determined by SMPCL.

For calculating daily stock, tank 2-1 oily water/sludge quantity need to be measured. Difference in measurement shall be recorded in the daily fuel inventory in separate column and drained quantity shall be added to daily fuel consumption.

PART 6.0

SHUTDOWN

TABLE OF CONTENTS

Part	Description	Page
6.0	SHUTDOWN	42
6.1	NORMAL SHUTDOWN (LIQUID FUEL UNLOADING)	42
6.2	NORMAL SHUTDOWN (LIQUID FUEL TRANSFER)	44
6.3	FUEL HANDLING WITNESS FORM	44

6.0 SHUTDOWN

6.1 NORMAL SHUTDOWN (LIQUID FUEL UNLOADING)

6.1.1 Unloading from Depot shore tank

After completion of pumping, shore tank sounding shall be taken to identify amount of fuel oil transferred and then vessel sounding, temperature, density and water content to be measured and one sample to be taken for future reference.

6.1.2 Unloading from vessel to SMPCL tank

6.1.2.1 When the required quantity of fuel in the tanker delivered to the plant storage tank, roughly Verify purchased quantity of fuel unloaded.

6.1.2.2 Take the flow-meter reading.

6.1.2.3 Close main isolation valve for unloading.

6.1.2.4 Check sea chest valve seal condition at tanker vessel.

6.1.2.5 After stopping LDO unloading pump, must wait at least two hours for settling storage tank level. During this time Jetty side main isolation valve must be closed and storage tank isolation valve should be in open condition.

6.1.2.6 Measure residual quantity of fuel at tanker vessel.

6.1.2.7 After two hrs of settling, unloading drain line should be made open in front of tank 2-1, 2-2 and 2-3 and also open unloading hose flange at jetty area to check presence of water or sludge. If those impurities found then continuously draining required until fresh oil comes.

6.1.2.8 After getting satisfactory drain oil sample, unloading line priming should be started from vent line in front of 2-2 tank and then at jetty area. When air bubbles are completely eliminated from the unloading line, vent line can be closed. **Noted that for proper venting from the large unloading line, storage tank final level must be at least six meters. Unloading pipelines contain around 24635 liters of LDO as pipe dimension were measured in presence of the LDO supplier. Since before start pumping, unloading pipelines are to be made full as per supplier requirement, If the pipeline cannot be make full after unloading, the remaining amount will be considered as a loss for SMPCL as there is no convenient way to determine the partial quantity in the pipeline. To avoid**

such loss, unloading plan should be made in such way that the tank final level will become more than six meters.

6.1.2.9 Apply seal with identification number at sampling bottles. Total four nos of bottles:

one for SMPCL, one for the supplier, one for surveyor and one for the laboratory test

6.1.2.10 After completion of drain line check and priming work, final sounding to be taken at the storage tank. During final sounding water level, fuel temperature and specific gravity also need to measure without error.

6.1.2.11 Take final print out of storage tank level.

6.1.2.12 From the difference of final and initial tank level, Observed quantity of LDO received in m^3 will be derived with the help of SMPCL tank calibration chart. From observed specific gravity, we will get the quantity in metric ton. Final Calculation documents shall be signed by the representative of supplier, vessel representative, SMPCL and third party surveyor.

6.1.2.13 Disconnect flexible hose from the tanker or lorry.

Note: Representatives from all interested parties like LDO Supplier, vessel staff, SMPCL owner and SMPCL O&M team should present and witness all the sensitive events like Unloading line drain check, priming work, tank level measurement, density and temperature measurement, quantity calculation work and finally sign on the fuel handling witness form.

6.1.3 Activities after completion of LDO Unloading work:

6.1.3.1 Close the filling line isolation valve for the storage tank (which just received fuel)

6.1.3.2 Depressurize the whole unloading line to a storage tank which level is low; preferably less than 4 meters. After depressurizing, close the header vent valve and the same tank filling isolation valve.

6.1.3.3 Again make sure the main isolation valve at jetty is closed and locked. Since the LDO at the downward slopped portion of jetty area unloading pipe cannot be drained, to allow for expansion the isolation valve downstream of flexible coupling need to keep open.

Note: In case of unloading pipeline flexible hose damage at jetty area or the main isolation valve passing, the isolation valve downstream of flexible hose should be closed Immediately.

6.1.3.4 To prevent from failure of all flexible hoses (filling, delivery and return) associated with storage tanks resulting from excessive sunlight, MOVs shall be kept always open, only isolation valve shall be kept closed if necessary.

6.2 NORMAL SHUTDOWN (LIQUID FUEL TRANSFER)

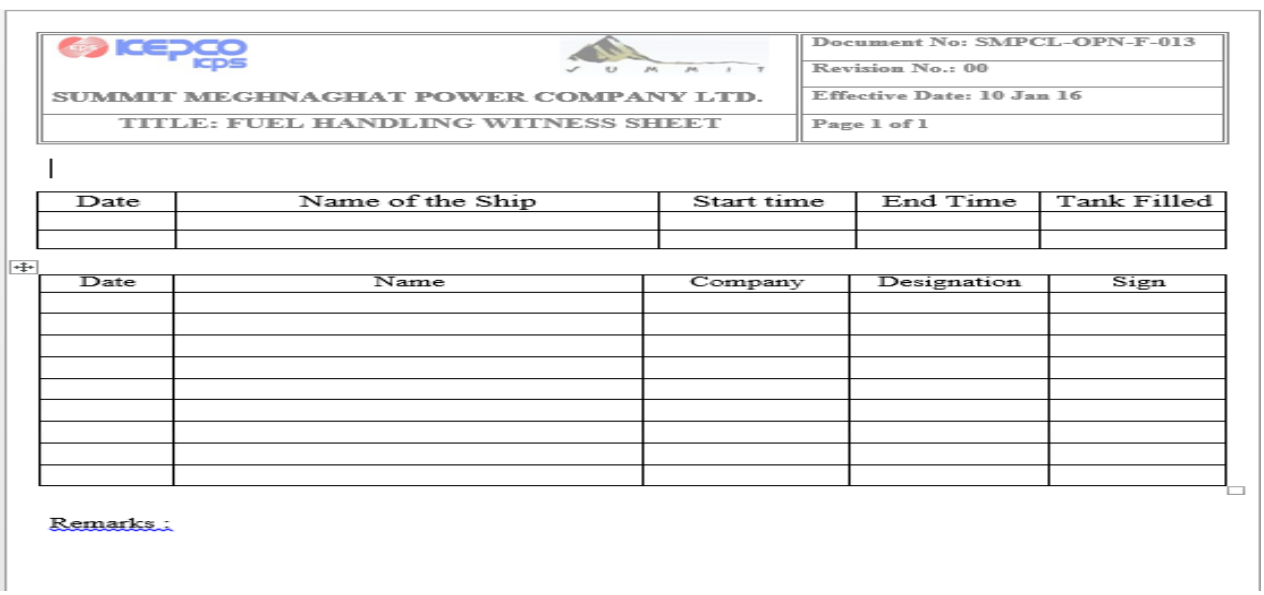
6.2.1 First shut down the transfer pump

6.2.2 After making sure no pressure at the pump discharge pipe, close the filling valve.

6.2.3 Note down the quantity filled in the tank.

Note: Liquid fuel transfer to gas turbine will be stopped automatically as Per GT shut down sequence or when fuel mode transfer command (from liquid fuel to natural gas) active.

6.3



SUMMIT MEGHNAGHAT POWER COMPANY LTD.	Document No: SMPCL-OPN-F-013
	Revision No.: 00
	Effective Date: 10 Jan 16
TITLE: FUEL HANDLING WITNESS SHEET	Page 1 of 1

Date	Name of the Ship	Start time	End Time	Tank Filled

Date	Name	Company	Designation	Sign

Remarks :

PART 7.0

APPENDICES

TABLE OF CONTENTS

Part	Description	Page
7.0	APPENDICES	47
7.1	OPERATIONAL PROCEDURE VERIFICATION FORM	47

7.0 APPENDICES

7.1 OPERATIONAL PROCEDURE VALIDATION FORM

Name of General Manager (Operation): Youngho Kim (Raymond)
Equipment or Systems Name: LIQUID FUEL TRANSFER SYSTEM
Date: July 13, 2016
Please check the alignment settings of this procedure and verify the accuracy and/or correctness.
I have reviewed this procedure and can validate the alignment settings for its accuracy. This procedure can therefore be released for operation for this equipment and/or system. **Signed:**_____ **General Manager (Operation)**

Annex K

Emergency Response Plan – Summit M1 Project

SUMMIT MEGHNAGHAT POWER COMPANY LTD.

Document Type: EHS PROCEDURE	Location: EHS OFFICE	Procedure Type: EMERGENCY RESPONSE PROCEDURE	Document No: SMPCL-EHS-004	
Revision: 02	**Date: September 23, 2013**		**Change:**	**Date:**

EMERGENCYRESPONSE PROCEDURE

SMPCL-EHS-004

Prepared By : Md. MIZANUR RAHMAN
Verified By : A&P GM

Revision	Description	By	Date	Approved Signature	
02	Approved	Jung Yee Ryang	**28/04/2016**		Jung Yee Ryang

AMENDMENT RECORD

Revision	Description	Date	Approved
1	Occupational Exposure Limit & Acute Exposure Guide lines are included in "Chlorine Emergency Response" Section.	18/08/2015	Seo-IL-Young
2	Isolation and Evacuation Action Plan is included in Section **7.2.2**	28.04.2016	Jung Yee Ryang

OVERALL TABLE OF CONTENTS

Part	Description	Page
	AMENDMENTRECORD	2
	OVERALLTABLEOFCONTENTS	3
	LISTOFABBREVIATIONS	4
	GLOSSARY OF TERMS	5
1.0	PURPOSEANDSCOPE	8
2.0	EMERGENCYRESPONSEPLAN	10
3.0	FIREANDEXPLOSION	30
4.0	MEDICALEMERGENCYRESPONSEAND EVACUATION	34
5.0	HAZARDOUSMATERIAL RELEASE	37
6.0	EARTHQUAKERESPONSE	40
7.0	CHLORINEEMERGENCYRESPONSE	44
8.0	BOMBTHREAT	59
9.0	SEVEREWEATHER PLAN	65
10.0	SPILL RESPONSE DURING TRANSPORTATION & TRANSFER	69
11.0	TRAININGANDEXERCISE DRILLS	69
12.0	HIGH VOLTAGE EMERGENCY RESPONSE	72
13.0	APPENDICES	78

ABBREVIATIONS

Abbreviation	Description
AEGL 1	Acute Exposure Guideline levels 1, the airborne concentration in ppm. Microgram/m3, could experience notable discomfort, irritation, or certain asymptomatic no sensory effect
AEGL 2	Acute Exposure Guideline levels 1, the airborne concentration in ppm. Microgram/m3, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape
AEGL 3	Acute Exposure Guideline levels 1, the airborne concentration in ppm. Microgram/m3, could experience life-threatening health effects or death
Cl2	Chlorine
HSE	Health Safety and Environment
IC	Incident Commander
HRSG	Heat Recovery Steam Generator
SMPCL	Summit Meghnaghat Power Company Limited
OSHA	Occupational Safety and Health Administration
NIOSH	US National Institute for Occupation Safety & Health
PAP	Project Affected People
SCBA	Self Contained Breathing Apparatus
LEL	Lower Explosive Limit
PEL	Permissive Exposure Limit
REL	Recommended exposure Limit.
UEL	Upper Explosive Limit
FP	Flash Point
FACP	Fire Alarm Control Panel
CCB	Central Control Building
CCR	Central Control Room
HR	Human Resource

HVAC	Heat Venting and Air Conditioning
IDLH	Immediately dangerous to life or health
TLV	Threshold Limit Value

GLOSSARY OF TERMS

NOT APPLICABLE

PART 1.0

PURPOSE AND SCOPE

TABLE OF CONTENTS

Part	Description	Page
1.0	PURPOSE AND SCOPE	10

1.0 PURPOSEANDSCOPE

Summit Meghnaghat Power Company Limited takes savory responsible attitude toward safety and environmental protection. Proper emergency planning and response are important element for every health, safety and environmental (HSE) program. To help minimize employee exposure to injury a written emergency response plan is implemented to handle possible emergencies such as fire, hazardous spills, severe weather conditions, and emergency evacuation

This plan is intended for the safety and well being of the employees of SMPCL. Training is to be provided so that all employees understand this plan.

PART 2.0

EMERGENCY RESPONSE PLAN

TABLE OF CONTENTS

Part	Description	Page
2.0	EMERGENCYRESPONSEPLAN	13
2.1	FACILITY INFORMATION	13
2.2	RESPONSEMANAGEMENT SYSTEM	13
2.3	SUMMIT MEGHNAGHATPOWER COMPANYLIMITED EMERGENCY TEAM	18
2.4	COREPLANELEMENTS	19
2.5	WASTE DISPOSAL	24
2.6	POST-EMERGENCY PROCEDURES	25

2.0 EMERGENCY RESPONSE PLAN

2.1 FACILITY INFORMATION

Summit Meghnaghat Power Company Limited, has been operating 337~305 MW combined cycle power plant located at Meghnaghat, Sonargaon, Narayanganj, at a distance of approximately 28 km South-East of Dhaka City. The plant is built on 25 acres of leased land developed by Bangladesh Power Development Board (BPDB) on the North Bank of the Meghna River. The plant comprises of two GE PG9171E gas turbines, each having capacity of 123.0 MW, two Honzu heat recovery steam generators (HRSG) and one Herbin steam turbine having capacity of 125 MW and delivers 450 MW net electrical output to national grid.

2.2 RESPONSEMANAGEMENT SYSTEM

2.2.1 Plant Manager

The Plant Manager is ultimately responsible for ensuring the proper procedures are developed and followed. The Plant Manager is also responsible for ensuring that the proper agencies are notified in case of an emergency. He / she must ensure that the applicable corporate office personnel are notified.

2.2.2 EHS / HSE Manager

The HSE Manager is primarily responsible for preparing the Emergency Response Plan and any required procedure. The HSE Manager will periodically review site procedures and make any required changes. He / she will ensure all employees are trained on this plan and interface with local emergency response agencies and provide them with all the necessary information that is requested. He/ She will assist Incident commander during any emergency.

2.2.3 Incident Commander

The Incident Commander shall be the Operations Manager and in his or her absence the Operations Shift Charge Engineer shall perform the duties of Incident Commander. The incident commander shall:

Ensure all Personnel in the plant, including contractors and visitors are accounted for during an emergency.

Take charge of the plant during actual emergency and direct activities.

Be responsible for securing plant equipment as per outlined procedures during an emergency.

Take charge of the plant during actual emergency and direct activities.

Be responsible for securing plant equipment as per outlined procedures during an emergency.

Establish liaison with outside agencies as needed.

He/ She will take the necessary action plan during any emergency period and mobilize the available emergency team according to the responsibility of different team members and meet the emergency and play the dynamic role in response

2.2.4 Emergency Coordinator

Control Room Engineer (or his designee) will act as emergency coordinator. The primary functions of emergency coordinator include the following:

- Collect and process situation information.
- Determine information and reporting requirements.
- Provide input to the incident commander.

- Coordinate with any needed outside agency.

2.2.5 Assembly point coordinator

Assembly point coordinator will play the active role in head counting and report to Incident commander. The SMPCL employees who will report first in any assembly point have a radio to communicate or in absence of employee any security officer/supervisor will be the assembly point coordinator.

2.2.6 Search and Rescue Team

Search and rescue team will move first to assess the emergency and if any person missing in head counting will search for him/her and rescue victim from emergency site, team members of this team will be consist of (considering office time):

- Four person from Maintenance team
- Operator

Name of the maintenance team member in this group are listed in Summit Meghnaghat Power Company Limited Emergency Team list posted in every assembly points & different notice board in the various department of the plant.

Considering only the shift personnel at the plant the team member will be

- BOP Engineer
- Operator

Incident commander will select the search and rescue team leader from the available team member of the list. Team leader will keep communication with IC and based on the situation IC will give necessary direction and team will be in action.

2.2.7 Emergency Response Team

Emergency response team is the first line of defense in emergencies and will consist of the following members (considering office time):

- Power block engineer
- BOP engineer.
- Six members from maintenance team

Name of the emergency team member listed in Summit Meghnaghat Power Company Limited Emergency Team list mentioning the specific responsibility and hanged on every assembly points & different notice board in the various department of the plant.

Considering only the shift personnel at the plant the team member will be

- Power Block Engineer
- BOP Engineer

Incident commander will select a team leader and he/she will lead the Emergency response with the assistance of available team members. Base on the feedback from search and rescue team IC will deploy the emergency team member to face the emergency.The role of the emergency team to take necessary action to meet the emergency according to this procedure for different types of situation.

2.2.8 Support Team

Emergency response team is the first line of defense in emergencies and will consist of the following members (considering office time):

- Power block engineer
- BOP engineer.
- Six members from maintenance team

Name of the emergency team member listed in Summit Meghnaghat Power Company Limited Emergency Team list mentioning the specific responsibility and hanged on every assembly points & different notice board in the various department of the plant.

Considering only the shift personnel at the plant the team member will be

- Power Block Engineer
- BOP Engineer

Incident commander will select a team leader and he/she will lead the Emergency response with the assistance of available team members. Base on the feedback from search and rescue team IC will deploy the emergency team member to face the emergency. The role of the emergency team to take necessary action to meet the emergency according to this procedure for different types of situation.

2.2.9 Administration Section Responsibility

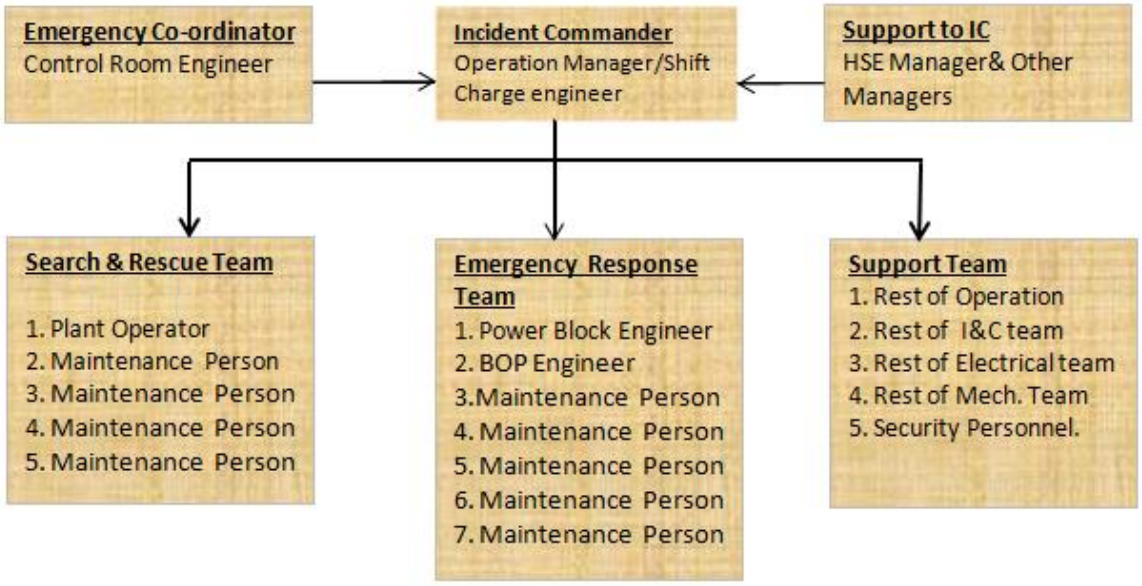
HSE Manager and HR & /or Admin Manager shall be responsible for this section.

Procurement of services and/or supplies from different sources

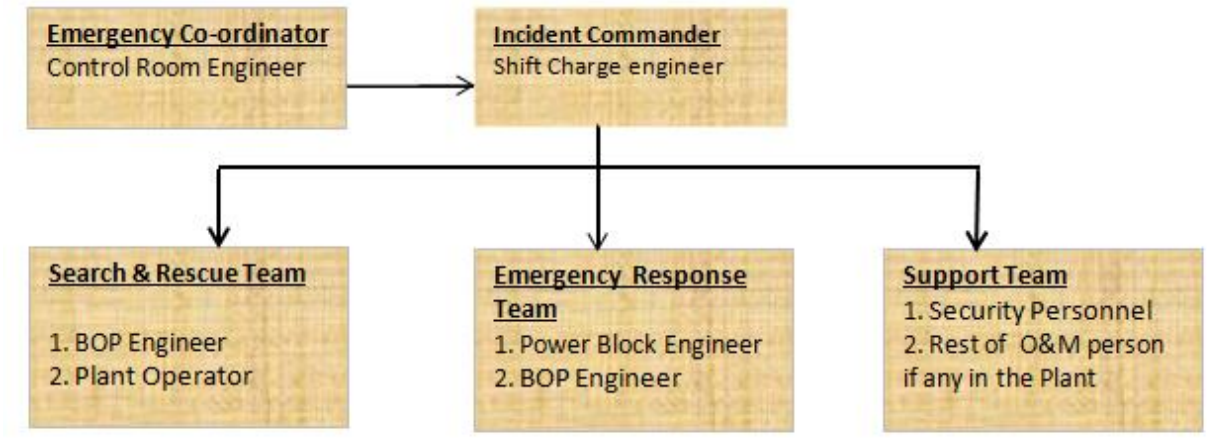
- Document all financial cost
- Analyze and manage legal risk for the incident
- Documentation for compensation and claims for injuries

2.3 SUMMIT MEGHNAGHAT POWER COMPANY LIMITED EMERGENCY TEAM

During Normal Day shift



During Night shift & Holiday



2.4 CORE PLAN ELEMENTS

The primary concern in any emergency situation is to protect SMPCL personnel, contractor personnel, and local residents from harm. The phases of emergency response as included in this core plan include the following:

- Discovery procedure
- Initial response
- Sustained actions
- Termination and follow-up actions
- Fire and explosion response
- Gas fire
- Medical emergency response and evacuation
- Oil Spill Response and Hazardous materials release
- Chlorine emergency response
- Severe weather response
- Earth quake response
- Bomb threat response

2.4.1 DISCOVERY PROCEDURES

The discovery phase begins with the initial actions taken by the individual(s) discovering an incident. The types of incidents include the following:

- Fire and/or explosion
- Medical or rescue emergency
- Oil spill or Chemical product release (inside or outside of secondary containment)
- Chlorine leak
- Severe weather response
- Bomb threat response

The employee or witness is to avoid entering the incident area (other than medical emergency) if at all possible when gathering incident information. Employee and community safety are the priority in any action taken during an emergency. As quickly as possible up on discovery, notification must be made to the control room.

Take the following actions upon discovery of an incident

- ImmediatelynotifytheControlRoomand/ortheHSEManagerthatanincidenthas occurred
- Prevent others from entering the area
- Cease any hot work in the area in the event of release of a flammable material
- If possible remain on the scene until help arrives. If not, safely evacuate the area.

2.4.1.1 Initial Response

Initial response begins with the notification of the Control Room and/or HSE Manager regarding the incident. During this internal notification procedure, information collected during the incident discovery will be relayed to the Shift charge Engineer. Shift Charge engineer will assess the incident and activate the emergency response system. For further response actions specific to the type of incident, refer to Section 3.0 (Fire & Explosion),4.0 (Medical Emergency

Response), 5.0 (Hazardous Materials Release, including oil), 6.0 Earth quake response, 7.0 Chlorine Emergency response, 8.0 Bomb threat response, 9.0 Severe Weather Response.

2.4.2ContactingKeyPersonnel

Upon notification that an emergency situation exists, Control Room personnel will sound the plant-wide audible alarm. The Shift Charge Engineer will notify all key plant personnel including the Plant Manager. This notification may be accomplished using the plant's public address system, radios, or horn system. Response teams will be activated, as needed, and will proceed to the incident area by IC.

2.4.2.1 Employee Notification

The Shift Charge Engineer will notify personnel in the incident area or areas that may potentially be affected via the emergency alarm and the plant public addresses system and/or radios.

External Notification

The Plant Manager or a designee is responsible for making all external notifications. Because of the time it takes to make notifications, the first external call should be to any needed emergency responder. Agency notifications shall be made as soon as possible following an initial assessment and notification of first responders. Refer to attachment Appendix 11.3 emergency contacts. This contact list will be post in different place in plant site and will update at least by annually.

2.4.2.2 Agency Notifications

Plant Management will be responsible for notifying the appropriate regulatory agencies

2.4.3 EVACUATION PROCEDURE

In the event of an emergency the plant alarm will sound.

During emergency, Central Control Room will be used as emergency control centre. All activities like evacuation, rescue, firefighting etc will be controlled from here.

Assembly points are as follows:

Assembly points 1 - CCR:

During emergency CCR will be used as Emergency Control Centre (ECC). Assembly point coordinator: Incident commander and/or Shift Charge Engineer

Assembly point 2 - CCB front:

All members of emergency response team will gather here.

Assembly point coordinator: First SMPCL person reporting at this point

Assembly point 3 - Gate House:

Guards, contractors and visitors will gather here. Security person at the gatehouse will be the contact person during emergency.

Assembly point coordinator: Security Supervisor

Assembly point 4 – Jetty Area:

All operation & maintenance personnel along with BPC/Fuel supplier personnel.

Assembly point coordinator: First SMPCL person reporting at this point

Note: If designated assembly point is not in accessible then other points should be availed. Contractor, visitor will gather to their nearest assembly point among

The plant Engineer will secure the plant if necessary and depending on the severity of the emergency.

Following the announcement of an alarm, radio traffic will confined to emergency communications only.

Telephone lines will be used only by those authorized to use them for the purpose of dealing with emergency.

Incident commander will appoint Assembly point coordinator as soon as practicably

Assembly point coordinators will do the headcount and inform Emergency Coordinator who will check if there is any person missing.

The total number of people inside the plant will be obtained from the installed security software for headcount. If an employee is found to be missing, his name and last known location will be given to the Plant Manager and HSE Manger.

2.4.3.1 Warning

Do not return to the area until the all clear signal has been sounded and it is safe to do so.

Maps indicating evacuation routes and list of emergency telephone numbers shall be developed by the HSE/EHS Manger and posted in conspicuous places on the project.

2.4.3.2 Community Evacuation

In a serious emergency some residents in the vicinity of the plant may be required to evacuate their homes. Potential incidents that could result in evacuation orders include a chlorine release, fire, or an explosion.

Evacuation will be carried out with the help of Local government representative, police department and fire department.

HSE Manager and IC to arrange schedule meeting (representative committee of community people),

2.4.4 Termination And Follow-Up Actions

2.4.4.1Termination

Termination of any emergency response includes the successful containment of the emergency (fire, spill, etc.), and restoration of the affected area to a point where it can be safely inhabited again. The determination that safe re-entry will be made by the Incident Commander and will be announced through the public address system. Before leading employees back into the affected area, emergency response team leader will confirm the area status with the incident commander.

With respect to fires, safe to inhabit means the fire is out and the threat of re-ignition has been eliminated. For medical emergencies, bodily fluids must be removed and the area disinfected as per procedure on Blood Borne Pathogens. If a piece of equipment or other circumstance led to the medical emergency, that situation must be corrected prior to resumption of occupation. For chemical spills, the spilled material must be containerized, and the spill area decontaminated such that the potential for dermal or inhalation exposure does not exist beyond what is normal for the area.

2.4.5 MOCK DRILL

To familiar with the ERP (Emergency Response Plan), four times mock drill will be conducted in SMPCL in a year. After mock drill completion, a review meeting will be conducted with the participant to address the scope of development in response/action. If further any procedural revision is required then this issue will be discussed in the EHS meeting for further action.

2.5 WASTE DISPOSAL

2.5.1 RECYCLABLE WASTE

Upon termination of emergency response activities, a thorough effort will be made to recycle or reuse waste materials where feasible. The primary example of such recycling concerns the reuse of spilled chemicals. If material contamination will not impair the ability of the chemical to perform its function, the material will be reused. If the material can't be used by SMPCL, an effort will be made to find a potential offsite user whose product specifications allow for some contamination.

2.5.2 WASTE MANAGEMENT

All wastes generated during emergency response activities will be evaluated for hazardous characteristics per Environmental regulations of Bangladesh then dispose as per SMPCL waste management procedure.

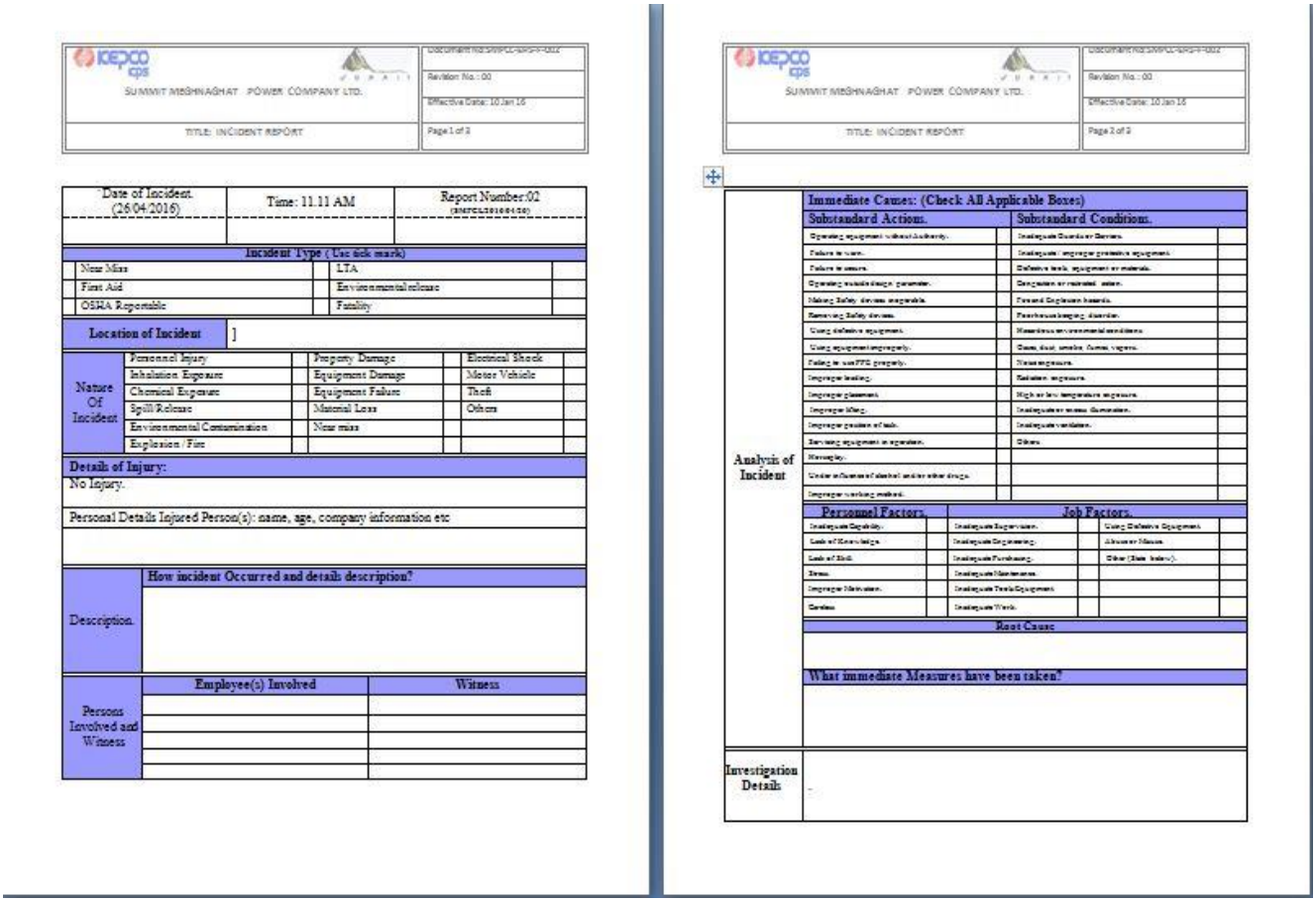
2.6 POST-EMERGENCY PROCEDURES

2.6.1 INCIDENT INVESTIGATION

Within 3 days of resolution of an emergency incident, the HSE Manger will conduct a thorough Incident Investigation and document his/her findings as per SMPCL Incident Investigation Procedure. The HSE Manger will conduct interviews with witnesses, including the employee who discovered and reported the incident, the control room employee who took the call, the SMPCL Incident Commander, and any other persons whose observations appear relevant to the investigation.

The incident investigation is a fact-finding exercise and must be performed without malice or implied threat to gather honest and valuable input. The HSE Manger must minimize or eliminate any bias in data collection, or the effort will likely generate a skewed evaluation of the incident and could likely lead to erroneous conclusions and inappropriate corrective action.

At the conclusion of the incident investigation, the HSE Manger will present his/her findings to the Plant Manager for review. The Plant Manager will be responsible for determining whether corrective actions must be implemented.



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TITLE: INCIDENT REPORT

Page 1 of 2

Date of Incident (26/04/2016)	Time: 11.11 AM	Report Number:02

Incident Type (Use tick mark)

Near Miss		LTA	
First Aid		Environmental release	
OSHA Reportable		Fatality	

Location of Incident]

Nature Of Incident					
	Personnel Injury		Property Damage		Electrical Shock
	Inhalation Exposure		Equipment Damage		Motor Vehicle
	Chemical Exposure		Equipment Failure		Theft
	Spill/Release		Material Loss		Others
	Environmental Contamination		Near miss		
	Explosion / Fire				

Details of Injury:

No Injury.

Personal Details Injured Person(s): name, age, company information etc

Description	How incident Occurred and details description?

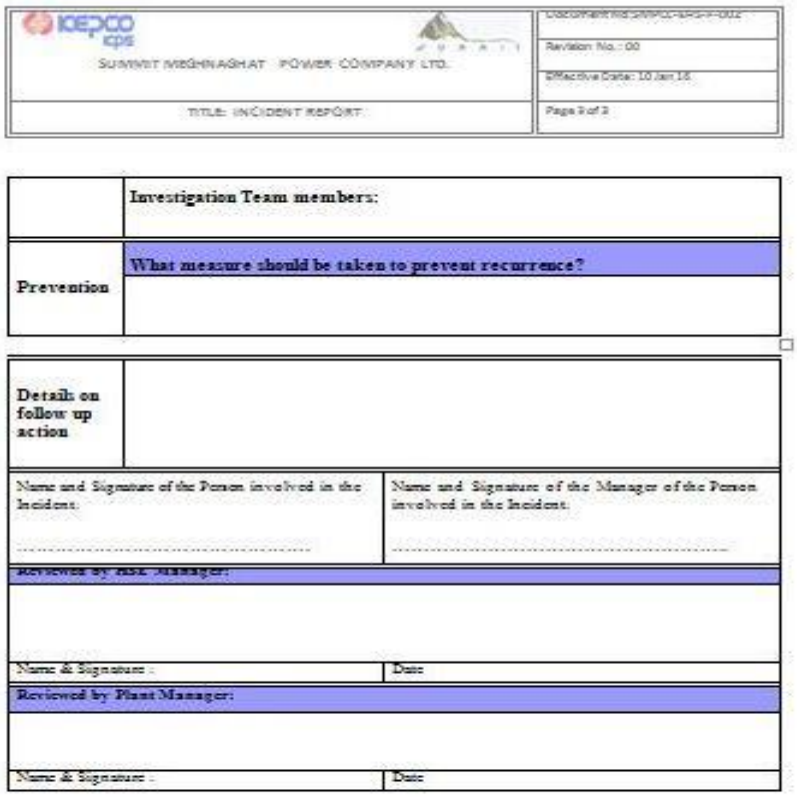
Persons Involved and Witness	Employee(s) Involved	Witness

SUMMIT MEGHNAGHAT POWER COMPANY LTD.

TITLE: INCIDENT REPORT

Page 2 of 2

Analysis of Incident	Immediate Causes: (Check All Applicable Boxes)			
	Substandard Actions.		Substandard Conditions.	
	Operating equipment without Authority.		Inadequate Guardover Barriers.	
	Failure to warn.		Inadequate / improper protective equipment.	
	Failure to secure.		Defective tools, equipment or materials.	
	Operating unsafe/at unsafe speed.		Congestion or restricted action.	
	Making Safety devices inoperable.		Personal Exposure hazards.	
	Removing Safety devices.		Poor housekeeping, disorder.	
	Using defective equipment.		Hazardous environmental conditions.	
	Using equipment improperly.		Gases, dust, smoke, fumes, vapors.	
	Failing to use PPE properly.		Noise exposure.	
	Improper loading.		Radiation exposure.	
	Improper placement.		High or low temperature exposure.	
	Improper lifting.		Inadequate or excess illumination.	
	Improper position of task.		Inadequate ventilation.	
	Servicing equipment in operation.		Others	
	Horseplay.			
	Under influence of alcohol and/or other drugs.			
	Improper working method.			
	Personnel Factors.		Job Factors.	
	Inadequate Capability.	Inadequate Supervision.	Using Defective Equipment.	
	Lack of Knowledge.	Inadequate Engineering.	Abnormal Stress.	
	Lack of Skill.	Inadequate Purchasing.	Other (State below).	
	Stress.	Inadequate Maintenance.		
	Improper Motivation.	Inadequate Tools/Equipment.		
	Careless.	Inadequate Work.		
	Root Cause			
	What immediate Measures have been taken?			
Investigation Details				



	Investigation Team members:
Prevention	**What measure should be taken to prevent recurrence?**
Details on follow up action	

Name and Signature of the Person involved in the Incident:	Name and Signature of the Manager of the Person involved in the Incident:
Reviewed by HSE Manager:	
Name & Signature :	Date
Reviewed by Plant Manager:	
Name & Signature :	Date

2.6.2 Follow-Up Agency Reports

Follow-up written reports will be made by HSE Manager.

Following an emergency incident, an incident investigation will be conducted in accordance with SMPCL's incident investigation procedures as documented in SMPCL's procedures manual. The goal of the investigation will be to determine the root cause of the incident and develop a plan for preventing a recurrence. Areas to focus on include human error, material

defects, mechanical defects, operating procedures, and maintenance procedures. SMPCL HSE Manager and/or their designated personnel will assist with the investigation. In addition, a contamination assessment study may be required to determine the extent of contamination.

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PART3.0

FIRE AND EXPLOSION

TABLE OF CONTENTS

Part	Description	Page
3.0	FIREANDEXPLOSION	32
3.1	FIREANDEXPLOSION RESPONSE	32
3.2	SITEACCESS	32
3.3	GASFIRE	32
3.4	LIQUID FUEL FIRE	33

3.0 FIREANDEXPLOSION

3.1 FIREANDEXPLOSION RESPONSE

The proper initial response to fire or any other emergency is to notify the Control Room as quickly as possible and provide the initial assessment information and the first discovery personnel will act as per Incident Commander Instruction.

Incident commander will decide to declare emergency and activate emergency response as required. To do fire fight, plant existing fire-fighting system will be used as per SMPCL-OP-003 Fire-fighting procedure. IC may seek help from Local Fire Brigade.

3.2 SITE ACCESS

In the event of a structural fire or an incipient fire that spreads, the local fire department will be contacted by the Control Room and will assume command of the response upon arrival. Based on the incident specifics, the Incident Commander will designate an employee to meet and direct the responding fire fighters to the appropriate location. The coordinating employee will receive the fire department at the main gate.

3.3 GAS FIRE

The proper initial response to gas fire emergency is to notify the Control Room as quickly as possible and provide the initial assessment information and the first discovery personnel will act as per Incident Commander Instruction.

The following steps should be followed when responding to incipient stage gas fire

- Inform Control room.
- Activate the emergency siren.
- Address about the emergency using the PA system and evacuate the area.
- Gas turbine and Fuel gas compressor may require emergency shutdown.
- Isolate the leaking pipe section.

- Remove all combustible sources from the area.
- Put Barrier and safety sign.

Fire-fighting will be carried out as per SMPCL fire-fighting procedure. IC shall seek help from the Fire brigade also from the Gas Supply & Transmission Company (Titas) if required.

3.4 LIQUID FUEL FIRE

The proper initial response to Liquid fuel fire emergency is to notify the Control Room as quickly as possible and provide the initial assessment information and the first discovery personnel will act as per Incident Commander Instruction.

The following steps should be followed when responding to incipient stage liquid fuel fire

•Inform Control room.
•Activate the emergency siren.
•Address about the emergency using the PA system and evacuate the area.
•Fuel transfer system should be isolate or stopped as necessary.
•Isolate the leaking pipe section.
•Remove all combustible sources from the area.
•Put Barrier and safety sign.

Fire-fighting will be carried out as per SMPCL fire-fighting procedure. IC shall seek help from the Fire brigade if required.

PART 4.0

MEDICAL EMERGENCY RESPONSE AND EVACUATION

TABLE OF CONTENTS

Part	Description	Page
4.0	MEDICALEMERGENCYRESPONSEAND EVACUATION	36
4.1	MEDICALEMERGENCIES	36
4.2	FACILITY EVACUATIONS	36

4.0 MEDICAL EMERGENCY RESPONSE AND EVACUATION OF INCIDENT AREA

4.1 MEDICAL EMERGENCIES

Take the following actions upon discovery of an incident:

- Immediately notify the Control Room that a medical emergency has occurred. Give specific information concerning the incident, (location, number injured & types of injuries)
- Do not move the injured person, except to the extent necessary to rescue & stabilize the victim.
- If safely possible, remain with the victim until help arrives.

Once the control room has been notified, it is the CRE/Shift Charge Engineer responsibility to perform the following:

- Notify the Incident Commander regarding the incident.
- Assess incident & activate the appropriate emergency response system by IC.
- Attend to the welfare of any injured party. Begin first aid treatment.
- Evacuate all personnel from the accident scene, except for trained & properly equipped first aid/CPR responders.
- Notify all other key personnel regarding the incident.
- Have personnel meet the responding agency at the main gate & escort them to the scene.

Incident commander will take the necessary action to handle the emergency, if required send the ambulance to the emergency point to rescue victim and send to nearest hospital after first aid given.

4.2 INCIDENT AREA EVACUATIONS

Except for trained and properly equipped first aid/CPR responders, employees in the immediate area of the medical emergency will be evacuated to a place of safe refuge. The presence of bystanders only hinders medical response.

PART 5.0

HAZARDOUS MATERIAL RELEASE

TABLE OF CONTENTS

Part	Description	Page
5.0	HAZARDOUS MATERIAL RELEASE	39
5.1	IMMEDIATE RESPONSE PROCEDURE	39

5.0 HAZARDOUS MATERIAL RELEASE

5.1 IMMEDIATE RESPONSE PROCEDURES

In the event of a chemical release, whether apparently contained or uncontained, the observing employee is to immediately contact the Control Room and provide the information requested. The only allowable immediate response is to observe and gather facts from a safe distance. Specific equipment and training requirements apply to close approach, whether responding defensively or aggressively.

The Control Room will initiate either an area or facility wide evacuation based on the potential hazards and spread capability of the material released and notify incident commander about the situation and inform other employee by public address system and radio.

Incident commander will assess the emergency and take necessary action to meet the emergency.

The SMPCL spill release procedure will be followed in this case.

PART 6.0

EARTHQUAKE RESPONSE

TABLE OF CONTENTS

Part	Description	Page
6.0	EARTHQUAKERESPONSE	42
6.1	IFINSIDEIN STRUCTURE DURINGAN	42
6.2	IFOUTSIDEDURINGANEARTHQUAKE	42
6.3	IFINSIDEANAUTOMOBILE	42
6.4	AFTERANEARTHQUAKE	43
6.5	PLANTBLACKOUTRESPONSE	43

6.0 EARTHQUAKE RESPONSE

If plant is running during earthquake, plant status may need to change and it will solely depend on the Operation person and the induced situation. If plant need to shutdown then duty shift charge engineer will decide as per SMPCL operation procedure.

6.1 IF INSIDE IN A STRUCTURE DURING AN EARTHQUAKE

If you are inside during an earthquake:

1. Try to protect your head with available material.
2. Immediately take cover under a table or desk, or stand in a doorway. In areas where cover is not available, kneel at the base of an interior wall, facing the wall and with the head down.
3. Turn your body away from windows and mirrors.
4. Be alert for falling objects and stay away from overhead fixtures, filing cabinets, bookcases, and electrical equipment.

6.2 IF OUTSIDE DURING AN EARTHQUAKE

If you are outside during an earthquake:

1. Move to an open area away from buildings, trees, and power lines.
2. If unable to move to an open area, watch for falling objects.

6.3 IF INSIDE AN AUTOMOBILE

If you are in an automobile during an earthquake:

1. Stop your vehicle in the nearest open area.

2. Stay in the vehicle until the shaking stops.

6.4 AFTER AN EARTHQUAKE

After an earthquake

1. Be aware of the possibility of aftershocks.
2. If possible and it is safe to do so, evacuate the building as soon as the shaking has ceased.
3. Do not move injured persons unless they are in obvious immediate danger (from fire, building collapse, etc.)
4. Open doors carefully. Watch for falling objects.
5. Do not use matches or lighters.
6. Limit use of telephone to call for emergency services.

6.5 PLANT BLACK OUT RESPONSE

There is operation procedure of Blackout activity. Other than this if Black out happened due to any extreme emergency arise then follow the operation procedure of blackout as well as those below point

- Emergency diesel generator should run with power outage, if not, send someone to run it manually.
- Plant wide DC lighting system should work, if not use emergency portable light kept in Central control room or cable spreading room.
- Address about the emergency using PA system and request everybody to stay calm.

PART 7.0

CHLORINE EMERGENCY RESPONSE

Table of Contents

Part	Description	Page
7.0	CHLORINEEMERGENCYRESPONSE	46
7.1	GENERALREQUIREMENTS	46
7.2	EMERGENCYRESPONSE	49

7.0 CHLORINEEMERGENCYRESPONSE

7.1 GENERALREQUIREMENTS

7.1.1 Staff Training

All BOP operations engineer & Plant operator shall be trained and knowledgeable of any and all Standard Operating Procedures related to "CHLORINE USE".

Entry Team

Each Entry Team member shall be thoroughly trained and be capable in the knowledge and/or use of the following:

- Personal Protective Equipment (PPE)
- Tools & Equipment
- Emergency Repair Kit
- Policies and Procedures for Action and Response Plans for Level I, II, orIII Hazardous Chlorine Conditions.

Personal Protective Equipment (PPE)

The HSE Manager and Incident Commander with the help of emergency response team shall have and be required to properly store and maintain any Personal Protective Equipment necessary for responding to a Level I, II, or III Hazardous Chlorine Condition. PPE shall be strategically located to accommodate the staging requirements. PPE requirements include but not limited to the following:

- Positive pressure SCBAs with spare air cylinders.
- Level A and/or B Chlorine Protection Suits.
- Chlorine resistant rubber gloves
- Explosion proof lantern type flashlights with spare batteries.

Tools and Equipment

Operations department shall maintain response designated:

- Ammonia vapor bottle(s) for leak detection.
- Two (2) spare chlorine cylinder valve wrenches.
- At minimum, one (1) Emergency Repair Kit. The Emergency Kit shall be kept and properly maintained at water treatment control room, and shall be well marked for easy identification and location.

7.1.1.2 Monthly Training & Emergency Mock Drill

In yearly EHS training Calendar, Chlorine handling training is a mandatory training for every year. Employee will get training through this training. In yearly emergency Mock drill calendar, Chlorine emergency drill also included every year for practice. Peoples are get trained through this process.

7.1.2 Wind Direction Indicators

HSE Manager shall arrange to install easily visible wind direction indicators strategically located throughout their plant. The wind direction indicator shall be a wind sock and shall be fluorescent in color.

7.1.3 Chlorine Gas Alarm

Chlorine alarm system shall be:

- Properly maintained, calibrated, and operational 24 hours a day
- Chlorine sensors are located in chlorine cylinder room and dosing room.

7.1.4 Emergency Condition

A Cl2 Alarm/Leak condition can be activated by the following means:

Chlorine Gas monitor located within the Chlorine Facility. The monitor will send a signal to activate the alarm to alert Plant personnel and the Chlorine neutralization system will be started at the same time.

Plant personnel, while performing any kind of work in the Chlorine Facility (loading or unloading cylinders, or moving cylinders).

In either case, all Chlorine Alarms will be taken seriously and responses shall be in a safe and proper manner.

7.1.5 Level I, II, III Alarm / Leak Condition

Chlorine Alarm/leak condition response shall be based on the degree or hazard level rating of the situation, Level I, II, III Hazardous condition.

Level I Potential Emergency Condition

A Level I condition is an incident or threat of the release of Chlorine gas which:

- Will be investigated and responded to by Operation personnel.
- Does not require the evacuation of other than the involved structure or the immediate downwind areas within the Plant boundaries
- Does not pose an immediate threat to life and property.

Level II: Limited Emergency Condition

A Level II condition is an incident involving a greater hazard (confirmed chlorine gas leak) which:

- Poses a potential threat to life and property.
- May require a limited evacuation
- May require road blocks in downwind areas.

Level III: Full Emergency Condition

A Level III incident that involves severe hazard (large release of chlorine liquid or gas, and/or highly likely release) which:

- Poses an extreme threat to life and property.
- Will probably require a large scale evacuation of the plant.

7.2 EMERGENCY RESPONSE

7.2.1 Response Plan Requirements

Staff Required:

Responsible person:

Incident Commander shall be in charge of the incident.

Entry Team: Two (2) members of emergency response team

1) One entry

2) One standby/rescue

Personal Protective Equipment:

Personal Protective Equipment (PPE) shall consist of the following:

- Elbow length rubber gloves (chlorine resistant)
- SCBA (positive pressure)
- Hard Hats, steel toe rubber boots
- Chlorine Chemical protective suits (Level A or B)
- Chlorine gas meter, duct tape

Tools:

- Cylinder valve wrench
- Portable Chlorine detector / Ammonia vapor bottle
- Chlorine cylinder Emergency Repair Kit

LEVEL I RESPONSE PROCEDURE

Staff Staging

Plant personnel shall remain at the Safety Zone (upwind area of the chlorine facility) or at the assembly points until the alarm condition has cleared and the responsible person has instructed otherwise.

Entry Team:

- Entry Team shall consist of an entry emergency response team member and a standby/Rescue emergency response team member.
- Entry Team, after donning their PPE, shall respond to the chlorine facility. The Standby/rescue emergency team member shall standby at the entrance door to the chlorine facility with the Entry response team member always in sight.
- The Standby/rescue emergency team member shall provide assistance or rescue the entry emergency team member.
- Entry emergency team member to observe the condition inside the chlorine cylinder storage area. Look for noticeable leak conditions.
- Close chlorine cylinder valve(s).
- Check for leaks on cylinder(s) (front, back, and sides) of all on-line connected and of full standby cylinders.

If a leak is found, notify the Incident commander of findings, indicating:

-

- A minor or major leak condition, and
- If the leak is minor, is it securable with or without the Emergency Repair Kit? Check air supply before attempting to secure the leak

If a major leak is identified:

1. Evacuate the area and return to the safety zone.
2. Discuss the situation with the Incident Commander
3. Follow sustained action (emergency evacuation plan) and notify the Fire Department for help.
4. Follow Level II or III Response Procedures.

If no cylinder leak is found, evacuate the area and return to the safety zone for decontamination and debriefing.

Plant personnel will decontaminate Entry Team, safety equipment and establish normal operation of system (if possible) or secure system until it can be restarted. Inform to the responsible person/Incident Commander of situation and status. Wait for further instructions.

Decontamination

Any Entry Team personnel or persons who have been exposed to chlorine gas shall be decontaminated in the safety zone. They shall be given medical attention if needed. Decontamination shall consist of washing all personal protective equipment and body parts with mild soap and water.

LEVEL II and III RESPONSE PROCEDURES

Staff Staging

Plant Personnel

Plant personnel shall remain at the safety zone (upwind area of the chlorine facility, or at the assembly points, until the alarm condition has cleared and/or Responsible person has instructed otherwise.

Entry Team

The Entry Team shall consist of an entry emergency response member and a Standby response member from emergency response team and if available Fire Department (rescue/backup) person.

The Entry Team shall meet with IC and discuss response plan

After donning PPE, Entry Team shall respond to the chlorine facility:

- The entry emergency response member shall close the cylinder valve(s) and check for leaks.

- The standby emergency response member shall standby at the chlorine facility door with the entry emergency response member in sight and shall provide assistance or rescue to the entry emergency response member.
- The Entry Team will not be allowed to spend more than 25 minutes in the chlorine leak area.
- The second (Standby) Entry Team may be called in to relieve the first Entry Team if deemed necessary by the IC.

After meeting with IC, donning of the required PPE, and provided with rescue backup person in the safety zone, the Entry Team will do the following upon reaching the chlorine facility:

- Observe the condition inside the chlorine cylinder room. Look for noticeable leaks
- Close the chlorine cylinder valve(s).
- Check for leaks on the front, back, and sides of all cylinders (on-line, connected and full standby cylinders).

If a leak is found:

1. Report findings to the command centre for further instructions.
2. Identify the leak as either a minor or major, and either a gas or liquid leak.

If no cylinder leaks are found after closing the valves, evacuate the area and return to command Centre for decontamination and debriefing.

If a leak is found on the cylinder:

1. Check SCBA air supply before attempting to make the repair. If air supply is low, return to the command centre and inform. The Standby Entry Team will be sent in.
2. If the leak is on the liquid portion of the cylinder, rotate the cylinder until the leak is on the gas portion of the cylinder
3. Use the Emergency Repair Kit and apply the appropriate attachment to the leak.
4. Once the leak is secured, evacuate the area and return to the command centre for decontamination and debriefing

After securing the leak and allowing the chlorine neutralization system to clear the chlorine gas from the area (testing with ammonia vapors or gas meters), operations will evaluate the damages and take appropriate plan of actions to establish for start up of the chlorination facility.

If a chlorine cylinder was found to be damaged and/or defective, discuss the situation with the chlorine manufacturer as to the safe and proper disposal of remaining chlorine.

Decontamination

Any Entry Team personnel or persons who have been exposed to chlorine gas shall be decontaminated in the safety zone. They shall be given medical attention if necessary.

7.2.2 ISOLATION AND EVACUATION ACTION PLAN

In case of chlorine leakage, wind direction determination is very much important for emergency response and evacuation plan. Chlorine gas will move with the downwind direction.

SMPCL Wind direction determination process:

A weather monitoring station has been installed at plant site and many wind socks have been installed at site for easy understanding of the wind flow direction.

Distribution of direction during the study period is represented by Wind rose diagram as shown in **Figure 1.0**

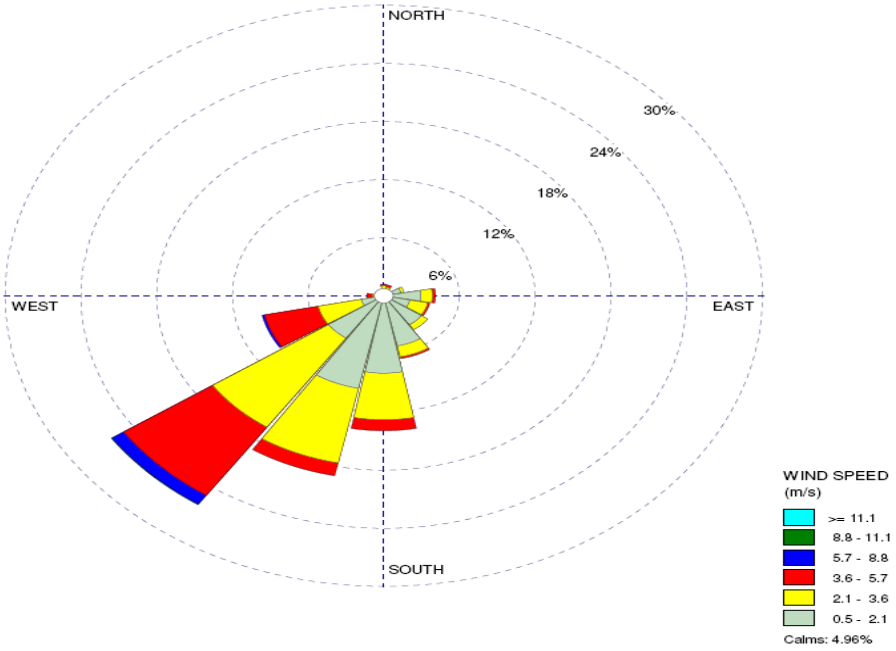


Figure: 1.0

It shows that predominant wind direction during this period was from South West towards North East.

Most of the season in the project area wind direction will be from South West towards North East according to the survey. Vulnerable zone or village has been identified according to the downwind direction of the project mentioned in figure: 2.

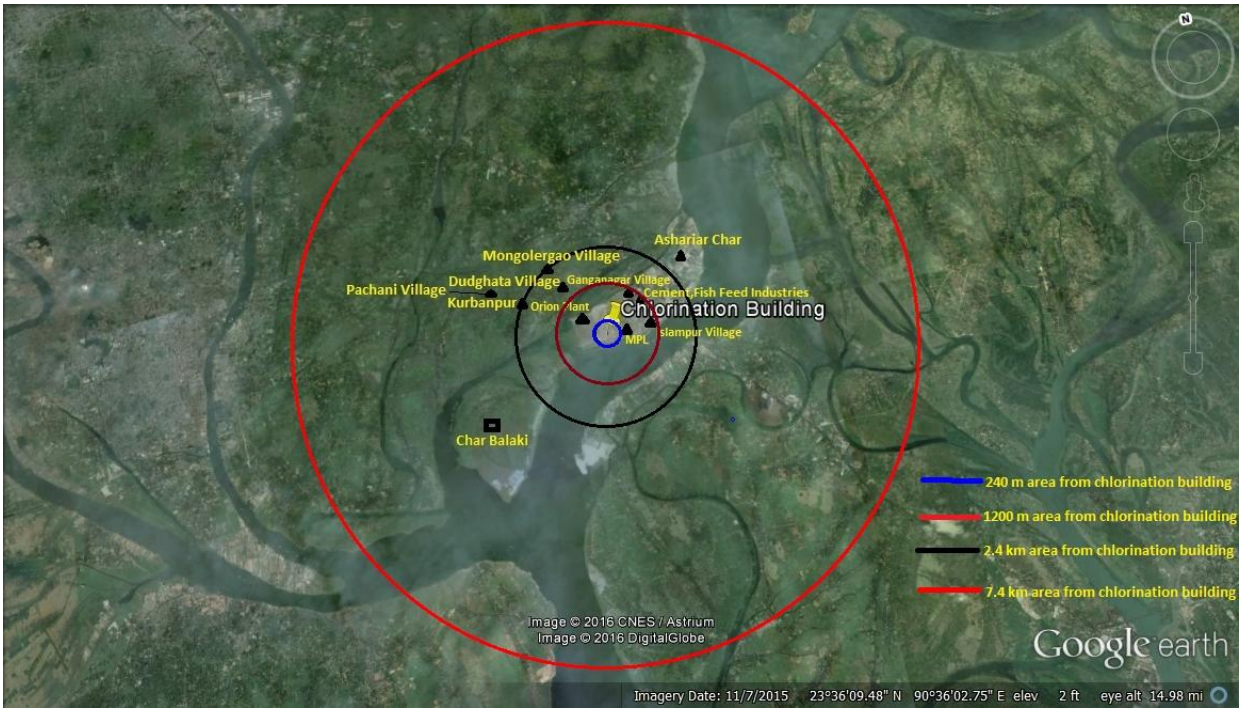


Figure: 2

List of vulnerable zones:

Table: 1

S/N	Vulnerable Zone Name	Location
	Within 240 m area from chlorination building	
1	MPL Power Plant	Project East side
	Within 1200 m area from chlorination building	
1	MPL power plant	Project East side
2	ORION power plant	Project west side
3	Ganganagor Village	Project North East side

4	Islampur Village	Project South East side
5	Cement, Fish feed industries	Project East side
	Within 2.4 km area from chlorination building	
1	Dudghata Village	Project North side
2	Kurbanpur Village	Project North west side
3	Mongoler Gao Village	Project North side
4	ORION power plant	Project west side
5	Ganganagor Village	Project North East side
6	Islampur Village	Project South East side
7	Cement, Fish feed industries	Project East side
8	MPL power plant	Project East side
	Within 7.4 km area from chlorination building	
1	Kurbanpur Village	Project North west side
2	Mongoler Gao Village	Project North side
3	ORION power plant	Project west side
4	Ganganagor Village	Project North East side
5	Islampur Village	Project South East side
6	Cement, Fish feed industries	
7	MPL power plant	
8	Dudghata Village	Project North side
9	Ashariar Char Village	Project North East side
10	Balakir Char	Project West side
11	Pachani Village	North West side

Occupational Exposure Limits

- **NIOSH REL**:

  Ceiling (15-minute): 0.5 ppm (1.45 mg/m^3)

- **OSHA PEL**:

  Ceiling: 1 ppm (3 mg/m^3)

Acute Exposure Guidelines

	5 min	10 min	30 min	1 hr	4 hr	8 hr
AEGL 1 (discomfort, non-disabling) - mg/m^3	Not established/ determined	0.50 ppm	0.50 ppm	0.50 ppm	0.50 ppm	0.50 ppm
AEGL 2 (irreversible or other serious, long-lasting effects or impaired ability to escape) - mg/m^3	Not established/ determined	2.8 ppm	2.8 ppm	2.0 ppm	1.0 ppm	0.71 ppm
AEGL 3 (life-threatening effects or death) - mg/m^3	Not established/ determined	50 ppm	28 ppm	20 ppm	10 ppm	7.1 ppm

According to the above table AEGL 3 (life-threatening effects or death) – 50 ppm has been considered the most Sevier situating during emergency. The most risky situation for leakage has been considered during chlorine cylinder handling from vehicle to storage room.

Small spills 200 liters or less

- First isolate in all directions: 30 meter i.e plant inside only.
- Then protect persons downwind during the day: 200 meter i.e. Plant site as well as Meghnaghat Power Limited (MPL) plant site. New RMS premises.
- Then protect persons downwind during the night: 1200m.
  Included area are SMPCL,MPL, Islampur village, Ganganagar village, Orion Power limited, Fresh Industries limited area.

Large spills greater than 200 liters

- First isolate in all directions 240 m. Plant site as well as Meghnaghat Power Limited (MPL) plant site, New RMS premises.

Then protect persons downwind during the day: 2.4 km. Included area are SMPCL,MPL, Islampur village, Ganganagar village, Orion Power limited, Fresh Industries limited area, Mongoler Gao village.

- Then protect persons downwind during the night 7.4 km then all area mentioned in the Table no. 01.

If a tank, rail car, or tank truck is involved in a fire, isolate it for 800 m in all directions; also consider initial evacuation for 800 m in all directions. IC shall instruct to communicate with nearby Plants for evacuation. IC shall send Community Liaison officer to near village Ganganagor & Islampur village for evacuation. As per requirement IC will sought for local government agency help. For this purpose, contact numbers of nearby Plants will be recoded and also disclose our procedure to them.

FIRE FIGHTING INFORMATION:

- Chlorine is not combustible, but it enhances the combustion of other substances.
- Chlorine reacts violently with many organic compounds, ammonia, hydrogen, and finely divided metals, causing fire and explosion hazards.
- The agent may ignite combustibles (wood, paper, oil, clothing, etc.).
- Fire will produce irritating, corrosive, and/or toxic gases.
- For small fires, use water FOG only; do not use dry chemical, carbon dioxide, or Halon™**.** Contain the fire and let it burn.
- For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from the area and let the fire burn.
- Run-off from fire control may cause pollution.
- If the situation allows, control and properly dispose of run-off (effluent).

PART 8.0

BOMB THREAT

TABLE OF CONTENTS

Part	Description	Page
8.0	BOMBTHREAT	61
8.1	PHONETHREATS	61
8.2	LETTER-PACKAGEBOMBS	62
8.3	DIRECT THREATS	62
8.4	OTHER THREATS	63
8.5	BOMBEVACUATION	63
8.6	POSTBOMBTHREAT	64

8.0 BOMBTHREAT

This procedure is designed to alert personnel of potential dangers and to assist in the apprehension and conviction of persons making threats against Summit Meghnaghat Power Company Limited and its personnel. Threats may be received by telephone, mail or by a direct confrontation with an individual.

8.1 PHONETHREATS

When a threat is received by phone:

- Treat it as though it were a real threat. Never disregard a threat.
- Remain calm and do not challenge the caller;
- Gather as much detail as possible, listening for background noises, and talking; and should also ask why the person has placed this threat, what are the motives behind the threat.
- The two people who listened to the call will use the Bomb Threat Form (Appendix
- 11.4) to provide information. Only the person who answered the call will talk with the caller.

The person and the listener, who received the call, are to:

- Inform the Plant Manger as soon as practicably possible.
- Do not disclose information until the police have arrived.

The Plant Manager or his designee will inform:

- The Police; and
- Concerned personnel of GOB (Government of Bangladesh), BPDB (Bangladesh Power Development Board)

If time allows personnel will be organize a search of the area identified by the caller for any evidence of a bomb. Look for

- packages not normally found in the area;
- door or drawers that are normally locked, but are now open or unlocked; and

- Any unusual activity, equipment, clothing, devices or anything which appears out of place.

If a particular area has not been identified, the entire power plant will have to be searched.

If any suspicious package is found:

- It is not to be touched or distributed in any manner.
- Evacuate the power plant following Plant Evacuation Procedure
- Inform the police or military of the location or locations of any suspicious devices.

8.2 LETTERS-PACKAGE BOMBS

When receiving mail, personnel should be alerted to any mail with:

- No postage or postage due indicated
- Addressed to a specific person rather than the company name and title of the person.
- Strange penmanship or markings on the envelops; and
- Suspicious activities of the mailed deliverer.

Actions to take if a suspicious letter or package is received:

- Do not open it
- Lay it on the desk and warn other people in the area.
- Vacate the area, closing all doors; and
- Contact the Plant Manager/Managers immediately.
- Call the police for assistance.

8.3 DIRECT THREATS

In the event a person is in the power plant and threatens o detonate a bomb:

- Evacuate the power plant.
- Call the police for assistance

- Work with the police to resolve the situation

8.4 OTHER THREATS

Threats may be received against the lives of individual power plant personnel or members of their immediate families unless money is paid or a specification is taken by SMPCL.

The receiver of this type of threat will use the Extortion/Threat Form (reference is made to resource list) together information:

- At all times remain calm. Ask question outlined in the form. If possible; flag another person to listen in on the call.
- The second person will listen only and offer no comment or remarks.
- After the call, contact the police. Do not talk with outsiders.
- Assist the police as necessary to secure the release of the person involved.

8.5 BOMB EVACUATION

The following must be followed in the event that there is a bomb threat to the plant:

- Evacuation must commence immediately or as soon as practically possible once the bomb threat as been declared. The IC and/or his/her designee will make the announcement for all personnel to evacuate the power plant.

- Evacuation procedures will be followed considering Main gate as the only available assembly point.

- Keep all personnel and contractors out of the power plant format least 75 minutes after the announced bomb detention time. A second or third device may have been planted in the area.

- If a bomb does detonate, do not allow any personnel or contractors to return to work for another 75 minutes in case a second or third device has been placed within the power plant.

8.6 POST BOMBTHREAT

Follow the directions of the police and/or military officials.

Plant Managers and plant personnel will assist as need in the collection or evidence and related information

PART 9.0

SEVERE WEATHER PLAN

TABLE OF CONTENTS

Part	Description	Page
9.0	SEVEREWEATHER PLAN	67
9.1	GENERALGUIDELINES	67

9.0 SEVEREWEATHER PLAN

9.1 GENERALGUIDELINES

The Severe weather plan provides a general guideline for actions to be taken in preparation for and during severe weather conditions.

The objective of this plan is to provide early notification of impending weather and provide for the safety and welfare of employees.

9.1.1 RESPONSIBILITIES

Acts of nature such as flood, storms, cyclones, earthquakes are natural disasters that are beyond human control. Incident Commander (IC) will analyze the situation and take appropriate measures. In the event of earthquake, employees will come out of their work places, wear hard hats, and assemble at safe open field, & wait there for head count or for guidance act according to section 6.0 of this procedure. Search & Rescue Team will start search and rescue as mentioned below.

With the close consultation, the rescue team will be directed by the Incident Commander. This team will work in close cooperation of the other team. The primary function of this team is to handle the smooth evacuation of personnel, supplies and personal belongings during the emergency. It is also the duty of this team to help extricate personnel who got trapped or injured in any of the rooms of the plant & buildings.

In this type of events Incident Commander will keep communication with the media & LDC with the help of other about the latest weather update and national grid condition and will take necessary action based on impending weather conditions.

Before any heavy flood, strong storm or cyclone noticed by weather forecasting, keep all the building door close, all loose objects like waste bins, which kept out side, tide with fixed object so that it does not fly here and there, keep outside crane mechanically locked. Employee will stay inside the building during such events. Incident Commander will give the clear directive to before and during such events. Ensure sufficient fuel for emergency generator, food, drinking water, and ambulance driver are

available. Incident Commander will keep communication with LDC about the safe Shutdown the plant.

Control room Engineer keeps supervision responsibilities during severe weather conditions will be consistent with normal national grid. Decisions as to the plan to be followed, timing, curtailment, shutdown, etc. will be made by the Incident Commander (IC).

PART 10.0

SPILL RESPONSE DURING TRANSPORTATION & TRANSFER

TABLE OF CONTENTS

Part	Description	Page
10.0	SPILL RESPONSE DURING TRANSPORTATION & TRANSFER	71
10.1	TRANSPORTATION	71
10.2	TRANSFER	71

10.0 SPILL RESPONSE DURING TRANSPORTATION & TRANSFER

10.1 TRANSPORTATION

BPC is the liquid fuel supplier of SMPCL. As per FSA agreement, all environment rules & regulation will be followed by the Fuel suppliers for transporting through river and delivered to SMPCL receiving point at floating jetty.

10.2 TRANSFER

Transfer can be categorized in two types as below

1. Liquid fuel transfer from the River Oil tanker to the SMPCL storage tank
2. Liquid fuel transfer from the storage tank to the various system such as Gas turbine, Black start Generator, EDG, Auxiliary Boiler and return from the various system to the storage tank again.

SMPCL will follow it's liquid fuel transfer procedure for fuel loading from the fuel tanker to SMPCL fuel storage tank. SMPCL has oil spill boom for oil spill containment over the water in river during fuel transfer from the oil tanker to Storage tank. If any spillage occurred during fuel transfer from the oil tanker, from the flange or any other means then it will be considered as most critical situation and informed the IC. He will immediately stop the fuel transfer and give instruction to take measure to stop the spillage. The IC can declare this situation as emergency on the severity of spillage. If emergency is declared then next steps will be as per section 2 of this procedure. By using oil dispersant chemical, floating oil on the water need to dispersed and other cleanup as necessary. The IC can communicate external cleanup expert if it is necessary.

During oil transfer from the storage tank to the various systems, oil spillage can take palace then information needs to share with the IC commander. He may stop the transfer, do any alternative operation to stop the leakage or may declare emergency. If emergency is declared, then section 2 of this procedure will be followed. To expedite the clean up SMPCL-EHS-008 will be used as guideline.

PART 11.0

TRAINING AND EXERCISE DRILLS

TABLE OF CONTENTS

Part	Description	Page
11.0	TRAININGANDEXERCISE DRILLS	74
11.1	EVACUATIONPLAN	74
11.2	EMERGENCYRESPONSEPLAN	74
11.3	EMERGENCYRESPONDER TRAINING REQUIREMENTS	74
11.4	RESPONSECRITIQUEANDPLANREVIEW	75
11.5	EMERGENCYCONTACTS	75

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11.0 TRAININGANDEXERCISE DRILLS

11.1 EVACUATION PLAN

Evacuation plan training is included in new employee orientation and presented by either Human Resources or the Supervisor to whom the new employee is assigned. Training includes are view of the plan; evacuation routes, designated safe refuge and headcount areas, and procedures for emergency reporting.

An evacuation drill is conducted at least annually, one for each work shift. The facility HSE Manager is responsible for reviewing the effectiveness of the drill and reporting any pertinent observations to the Plant Manager.

11.2 EMERGENCYRESPONSE PLAN

Emergency response training is provided commensurate with the role each person has in the response plan.

Refresher training is provided once in three years, either in the form of a single class or over a number of classes provided throughout the year.

Refresher training includes at least one hands-on drill wherein an emergency is simulated and responders work as abeam to resolve the issue as quickly as possible. The acting IC then conducts a debriefing which includes a chronological review of the incident, communication and deployment issues faced, command decisions made, and any difficulties encountered during the drill.

11.3 EMERGENCYRESPONDER TRAININGREQUIREMENTS

11.3.1 First Responder Awareness Level

The following criterion is required at the awareness level:

- Applicable to All Employees
- Included in New Employee Orientation
- Understanding of what hazardous substances are and the risks associated with them in an incident
- Understanding of how to recognize the presence of hazardous substances and the potential consequences of their presence
- Remote hazardous substance identification procedures
- Understanding of incident commands
- Notification procedures

11.3.2First Responder Operations Level

The following criteria are required at the Operations Level:

- Applicable to response team members
- Selection and use of PPE
- Understanding of basic hazardous materials terms
- Basic control, containment and/or confinement operations per the emergency response plan
- Decontamination techniques

11.3.3 Incident Commander

The following criteria are required at the Incident Commander Level:

- Applicable to designated Incident Commander and alternates
- First Responder Awareness and Operations Level requirements.
- Implementation of ICS and Emergency Response Plan.
- Understanding of risks and hazards associated with work in PPE
- Understanding of local and State Emergency Response Plans and coordination with responding and regulating agencies
- Understanding of decontamination procedures

11.4 RESPONSECRITIQUEANDPLANREVIEW

11.4.1 Annual Review

This plan will be revised, as need, to account for changes in operations, plant layout, personnel, etc., that could affect the successful implementation of the plan in an emergency. The plan will be reviewed at least annually to ensure that it is current and appropriate for existing operations.

11.4.2 Debriefing

During the course of an emergency response debrief, the acting IC will address any issues raised during the emergency where plan specifications were inadequate or inappropriate. The plan will then be modified to account for actual experience.

11.5 EMERGENCYCONTACTS

Updated emergency contact numbers are hanged on different location and near assembly points.

Tocall	Phone#	Phone# External*
Plant Manager		
HSE Manager		
Summit Meghnaghat Control Room		
Fire Station(Dhakacentral)		
Fire Station(Demra)		
Fire Station(Hajiganj)		
Fire Station(Bandar)		
Police Station(SonargaonThana)		
OCSonargaon		
ShuvechaHospital(nearestto plant)		

SECTION 12.0

HIGH VOLTAGE EMERGENCY RESPONSE PROCEDURE

TABLE OF CONTENTS

Part	Description	Page
12.0	HIGH VOLTAGE EMERGENCY RESPONSE	79
12.1	POWER TRANSFORMER EMERGENCY	79
12.2	SWITCH YARD EMERGENCY RESPONSE	79

12.0 HIGH VOLTAGE EMERGENCY RESPONSE

In SMPCL there are two high voltage area mentioned. One is switchyard and the other is all power transformer areas. Fire, explosion, lightning various hazard can cause the emergency.Fire in the CT, junction box, explosion of the surge arrester should be considered an emergency. Fire in the switchyard control Room also an emergency situation.

12.1 POWER TRANSFORMER EMERGENCY

Power transformer step up side is designed for 230kv. There is oil in the transformer. Surge arresters are in the transformer bay. Fire&explosion hazards are existing. If this happened, system protection will operate and the faulty zone will be electrically isolated or upon getting information electrical isolation will be carried out as per SMPCL operation procedure and earthling should be done for neutralizing the electrical charge before any manual fire fight like fire hydrant use or portable CO2 or foam used. IC may declare emergency after evaluating the situation. If emergency is declared then SMPCL will follow the **section 2** of this procedure. If explosion sound heard from any equipment specially surge arrestor, safe distance from the faulty equipment need to maintain to avoid high speed hitting from the bursting pieces. SMPCL Fire fighting procedure will be followed to do fire fight. There is auto deluge system in the Transformer area.The operation of this system is described in the SMPCL_Firefighting procedure-----.If any maintenance is required then SMPCL maintenance procedure should be followed to minimize risk.

12.2 SWITCH YARD EMERGENCY RESPONSE

In switchyard there is Oil filled CT, SF6 Breaker, DS, and ES junction box. Fire & explosion hazards are existing. If this happened, system protection will operate and the faulty zone will be electrically isolated or upon getting information electrical isolation will be carried out as per SMPCL operation procedure. IC may declare emergency after evaluating the situation. If emergency is declared then SMPCL will follow the section 2 of this procedure. If explosion sound heard from any equipment specially surge arrestor, safe distance from the faulty

equipment need to maintain. SMPCL Firefighting procedure will be followed to do fire fight. If any maintenance is required then SMPCL maintenance procedure should be followed to minimize risk. Normally there should be fire Hydrant in the switchyard field level. Water/Foam can be applied according to fire type. Water supplied will be get from the fire Hydrant. Before water applying, electrical isolation of that part should be done with electrical charge neutralize through grounding. Foam can be applied in a same manner to the oil filled CT, PT from the movable trolley. In case of fire in the switchyard control room, electrical isolation should be carried out according to SMPCL_Operation procedure. After that upon IC instruction fire fight should be done as fire fighting procedure. Normally Portable CO2 and dry powder should be used in Panel Fire.

PART 13.0

APPENDICES

TABLE OF CONTENTS

Part	Description	Page
13.0	APPENDICES	80
13.1	STANDARD PROCEDURE VALIDATION FORM	80

13.0 APPENDICES

13.1 EHS PROCEDURE VALIDATIO FORM

Name of General Manager(A&P): Kim Dohyung
Equipment or Systems Name: Emergency Response Procedure
Date:
Please check the alignment settings of this procedure and verify the accuracy and/or correctness.
I have reviewed this procedure and can validate the alignment settings for its accuracy. This procedure can therefore be released for operation for this equipment and/or system. Signed:_____ **A&P GM**



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